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Management A Bibliography for NASA Managers NASA SP-7500(21) April 1987

National Aeronautics and Space Administration

(NASA-SP-7500 (21)) N87-20833 MANAGEMENT: A FIBLICGRAPHY FOR NASA MANAGEES (National 70 p Aeronautics and Space Idministration) CSCL 05A Unclas 00/81 45217 8 lana Mana **e** nt Mā ent n a **e** a 9 na ľ E la nt na

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MANAGEMENT

A BIBLIOGRAPHY FOR NASA MANAGERS

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system during 1986.



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FOREWARD

Management gathers together references to pertinent documents — reports, journal articles, books — that will assist the NASA manager to be more productive. Items are selected and grouped according to their usefulness to the manager as *manager*. A methodology or approach applied to one technical area may be worthwhile for a manager in a different technical field.

Individual sections can be quickly browsed. Indexes will lead quickly to specific subjects or items.

TABLE OF CONTENTS

	Page
Category 01 Human Factors and Personnel Issues Includes organizational behavior, employee relations, employee attitudes and morale, personnel management, personnel development, personnel selection, performance appraisal, training and education, computer literacy, human factors engineering, ergonomics, human-machine interactions.	1
Category 02 Management Theory and Techniques Includes management overviews and methods, decision theory and decision making, leadership, oraganizational structure and analysis, systems approaches, operations research, mathematical/statistical techniques, modeling, problem solv- ing, management planning.	10
Category 03 Industrial Management and Manufacturing Includes industrial management, engineering management, design engineering, production management, construction, aerospace/aircraft industries, manu- facturing.	15
Category 04 Robotics and Expert Systems Includes artificial intelligence, robots and robotics, automatic control and cybernetics, expert systems, automation applications, computer-aided design (CAD), computer-aided manufacturing.	27
Category 05 Computers and Information Management Includes information systems and theory, information dissemination and retrieval, management information systems, database management systems and databases, data processing, data management, communications and communi- cation theory, documentation and information presentation, software, software acquisition, software engineering and management, computer systems design and performance, configuration management (computers), networking, office au- tomation, information security.	36
Category 06 Research and Development	49

Includes contracts and contract management, project management, program management, research projects and research facilities, scientific research, innovations and inventions, technology transfer and utilization, R&D resources, agency, national and international R&D.

Category 07 Economics, Costs and Markets

Includes costs and cost analysis, cost control and cost effectiveness, productivity and efficiency, economics and trade, financial management and finance, investments, value and risk (monetary), budgets and budgeting, marketing and market research, consumerism, purchasing, sales, commercialization, competition, accounting.

66

Category 08 Logistics and Operations Management

Includes inventory management and spare parts, materials management and handling, resources management, resource allocation, procurement management, leasing, contracting and subcontracting, maintenance and repair, transportation, air traffic control, fuel conservation, operations, operational programs.

Category 09 Reliability and Quality Control Includes fault tolerance, failure and error analysis, reliability engineering, quality assurance, wear, safety management and safety, standards and measurement, tests and testing inspections, specifications, performance tests, certification.

Category 10 Legality, Legislation, and Policy

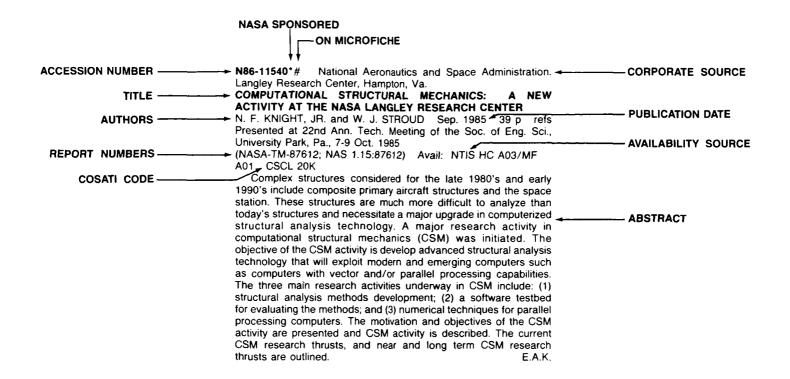
Includes laws and legality, insurance and liability, patents and licensing, legislation and government, regulation, appropriations and federal budgets, local, national, and international policy.

Subject Index	A-1
Personal Author Index	3-1
Corporate Source Index	C-1
Foreign Technology Index	D-1
Contract Number Index	E-1
Report Number Index I	F-1
Accession Number Index C	

77

82

TYPICAL REPORT CITATION AND ABSTRACT



TYPICAL JOURNAL ARTICLE AND ABSTRACT



MANAGEMENT

A Bibliography for NASA Managers

APRIL 1987

01

HUMAN FACTORS AND PERSONNEL ISSUES

Includes Organizational Behavior, Employee Relations, Employee Attitudes and Morale, Personnel Management, Personnel Development, Personnel Selection, Performance Appraisal, Training and Education, Computer Literacy, Human Factors Engineering, Ergonomics, Human-Machine Interactions.

A86-17320

HUMAN ROLES IN FUTURE SPACE SYSTEMS

H. L. WOLBERS (McDonnell Douglas Astronautics Co., Huntington Beach, CA) IN: Permanent presence - Making it work; Proceedings of the Twenty-second Goddard Memorial Symposium, Greenbelt, MD, March 15, 16, 1984 . San Diego, CA, Univelt, Inc., 1985, p. 57-69. refs

(AAS PAPER 84-117)

U.S. and Soviet space programs to date have graphically demonstrated the value of humans working in space. The point at issue is to determine where, along the continuum from direct manual intervention to completely automated operations, the mission requirements of future space programs can best be met. The criteria of performance, cost, and risk (mission success probability) are suggested as the principal factors by which program or project managers and systems engineers should select the most effective approach to meeting specific mission objectives. Examples of the application of these criteria are presented.

Author

A86-17771[•] Search Technology, Inc., Norcross, Ga. THE EFFECTS OF TYPE OF KNOWLEDGE UPON HUMAN PROBLEM SOLVING IN A PROCESS CONTROL TASK

N. M. MORRIS (Search Technology, Inc., Norcross, GA) and W. B. ROUSE (Georgia Institute of Technology, Atlanta) IEEE Transactions on Systems, Man, and Cybernetics (ISSN 0018-9472), vol. SMC-15, Nov.-Dec. 1985, p. 698-707. refs (Contract NAG2-123)

The question of what the operator of a dynamic system needs to know was investigated in an experiment using PLANT, a simulation of a generic dynamic production process. Knowledge of PLANT was manipulated via different types of instruction, so that four different groups were created: (1) minimal instructions only; (2) minimal instructions and guidelines for operation (procedures); (3) minimal instructions and dynamic relationships (principles); and (4) minimal instructions, and procedures, and principles. Subjects controlled PLANT in a variety of situations which required maintaining production while also diagnosing familiar and unfamiliar failures. Despite the fact that these manipulations resulted in differences in subjects' Knowledge, as assessed via a written test at the end of the experiment, instructions had no effect upon achievement of the primary goal of production, or upon subjects' ability to diagnose unfamiliar failures. However, those groups receiving procedures controlled the system in a more stable manner. Possible reasons for the failure to find an effect of principles are presented, and the implications of these results for operator training and aiding are discussed. Author **A86-18541**[•] National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PILOTS OF THE FUTURE - HUMAN OR COMPUTER?

A. B. CHAMBERS and D. C. NAGEL (NASA, Ames Research Center, Moffett Field, CA) Computer (ISSN 0018-9162), vol. 18, Nov. 1985, p. 74-87. refs

In connection with the occurrence of aircraft accidents and the evolution of the air-travel system, questions arise regarding the computer's potential for making fundamental contributions to improving the safety and reliability of air travel. An important result of an analysis of the causes of aircraft accidents is the conclusion that humans - 'pilots and other personnel' - are implicated in well over half of the accidents which occur. Over 70 percent of the incident reports contain evidence of human error. In addition, almost 75 percent show evidence of an 'information-transfer' problem. Thus, the question arises whether improvements in air safety could be achieved by removing humans from control situations. In an attempt to answer this question, it is important to take into account also certain advantages which humans have in comparison to computers. Attention is given to human error and the effects of technology, the motivation to automate, aircraft automation at the crossroads, the evolution of cockpit automation, and pilot factors. G.R.

A86-23521

THE ROLES OF ASTRONAUTS AND MACHINES FOR FUTURE SPACE OPERATIONS

R. H. SCHAEFER, R. E. OLSEN, and F. J. ABELES (Grumman Aerospace Corp., Bethpage, NY) AIAA, SAE, ASME, AIChE, and ASMA, Intersociety Conference on Environmental Systems, 15th, San Francisco, CA, July 15-17, 1985. 13 p.

(SAE PAPER 851332)

A comparative assessment is made of remote operation space environment systems and human EVAs, with a view to future space missions, both individually and in combination. The tasks in question encompass servicing and construction operations on manned space station and unmanned platforms. Laboratory tests and simulations of representative remote system and EVA task performance are discussed and recommendations for additional development activities are presented. O.C.

A86-25036

APPLICATION OF A MATHEMATICAL MODEL OF HUMAN DECISIONMAKING FOR HUMAN-COMPUTER COMMUNICA-TION

M. E. REVESMAN (BDM Corp., Albuquerque, NM) and J. S. GREENSTEIN (Clemson University, SC) IEEE Transactions on Systems, Man, and Cybernetics (ISSN 0018-9472), vol. SMC-16, Jan.-Feb. 1986, p. 142-147. refs

(Contract N00014-81-K-0143)

When a human and computer perform similar tasks in parallel, it is important that there be effective communication between the two entities. Because explicit communication may add to the human's workload, an implicit method of communication is suggested in which the computer references a model of human performance to predict the human's actions. The computer then determines its own actions so as to complement rather then conflict with the predicted human actions. A two-stage mathematical model of human performance is employed in an experimental situation in which both a human and computer act as decisionmakers. Implementation of the model significantly improves the human's performance, without degrading the computer's performance. Research into additional experimental and real-world situations is Author suggested.

A86-25037

DEVELOPMENT AND VALIDATION OF A MATHEMATICAL MODEL OF HUMAN DECISIONMAKING FOR HUMAN-COMPUT-ER COMMUNICATION

J. S. GREENSTEIN (Clemson University, SC) and M. E. REVESMAN (BDM Corp., Albuquerque, NM) IEEE Transactions on Systems, Man, and Cybernetics (ISSN 0018-9472), vol. SMC-16, Jan.-Feb. 1986, p. 148-154. refs

(Contract N00014-81-K-0143)

Since effective communication between computers and their human operators is essential to preventing redundant or interfering actions, attention is presently given to a method for accurately predicting human actions so that the computer may be able to complement an operator's activities rather than interfere with them. The two-stage mathematical model developed and empirically validated treats human performance in a real time situation with multiple tasks and process control. The model is able to consistently and accurately predict over 80 percent of the subject's actions over a range of situations. O.C.

A86-25038* Georgia Inst. of Tech., Atlanta.

SIGNIFICANCE TESTING OF RULES IN RULE-BASED MODELS OF HUMAN PROBLEM SOLVING

C. M. LEWIS and J. M. HAMMER (Georgia Institute of Technology, Atlanta) IEEE Transactions on Systems, Man, and Cybernetics (ISSN 0018-9472), vol. SMC-16, Jan.-Feb. 1986, p. 154-158. refs

(Contract NAG2-123)

Rule-based models of human problem solving have typically not been tested for statistical significance. Three methods of testing rules - analysis of variance, randomization, and contingency tables - are presented. Advantages and disadvantages of the methods are also described. Author

A86-26011[•] Arizona State Univ., Tempe. SUBJECTIVE WORKLOAD AND INDIVIDUAL DIFFERENCES IN INFORMATION PROCESSING ABILITIES

D. L. DAMOS (Arizona State University, Tempe) IN: Aerospace Behavioral Engineering Technology Conference, 3rd, Long Beach, CA, October 15-18, 1984, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 71-74. refs (Contract NCC2-202)

(SAE PAPER 841491)

This paper describes several experiments examining the source of individual differences in the experience of mental workload. Three sources of such differences were examined: information processing abilities, timesharing abilities, and personality traits/behavior patterns. On the whole, there was little evidence that individual differences in information processing abilities or timesharing abilities are related to perceived differences in mental workload. However, individuals with strong Type A coronary prone behavior patterns differed in both single- and multiple-task performance from individuals who showed little evidence of such a pattern. Additionally, individuals with a strong Type A pattern showed some dissociation between objective performance and the experience of mental workload. Author

A86-29090

A REVIEW OF THE PSYCHOLOGICAL ASPECTS OF SPACE FLIGHT

J. M. CHRISTENSEN (Federation of American Societies for Experimental Biology, Bethesda, MD; Universal Energy Systems, Inc., Dayton, OH) and J. M. TALBOT (Federation of American Societies for Experimental Biology, Bethesda, MD) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 57, March 1986, p. 203-212. refs

The major observations and conclusions of the FASEB's ad hoc Working Group's report to NASA on the aspects of human behavior and performance related to the Shuttle Program and to the planned U.S. Space Station are presented. The report focuses on the performance requirements for the long-term manned missions; human perceptual, cognitive, and motor capabilities and limitations in space; crew composition, individual competences, selection criteria, and special training; and environmental factors influencing behavior. Consideration is also given to the psychosocial aspects of multi-person spacecrews on long-term missions; career determinants in NASA; investigational methodology and equipment; and psychological support. Suggestions for near-term planning cover uses of the Shuttle onboard video and audio resources for the behavioral observations, and include the perceptual, cognitive, and psychomotor parameters and group dynamics into space station mock-up studies. For the long-term research, the need of methodology and instrumentation for objective measurements of psychophysiological processes, status, and performance is emphasized. LS.

A86-29851

SYMPOSIUM ON AVIATION PSYCHOLOGY, 3RD, COLUMBUS, OH, APRIL 22-25, 1985, PROCEEDINGS

R. S. JENSEN, ED. and J. ADRION, ED. (Ohio State University, Columbus) Symposium sponsored by the Ohio State University and Association of Aviation Psychologists. Columbus, OH, Ohio State University, 1985, 777 p. For individual items see A86-29852 to A86-29861, A86-29863 to A86-29936.

The present conference on the complex interactions between pilots and their cockpit environments discusses topics in such fields as cockpit design, voice data entry for avionics, cockpit displays, air traffic control automation, pilot workload monitoring and management, pilot judgment and reliability, cockpit communications and resource management, pilot selection and training, pilot visual perception, pilot physiology, and accident investigation. Specific attention is given to cockpit design and evaluation data bases, ergonomic principles for auditory signals in military aircraft, subjective assessments of workloads in an advanced fighter cockpit, time-sharing ability in zero-input tracking analyzer scores, cockpit speech interference considerations, psychosocial aspects of male and female pilot errors, test anxiety in cockpit simulators, fatigue, stress and preoccupation effects, and aircraft accident investigation psychological methods. C.D.

A86-29879*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

VERSUS EXPERIENCED WORKLOAD AND PREDICTED PERFORMANCE ON A SUPERVISORY CONTROL TASK

V. BATTISTE and S. G. HART (NASA, Ames Research Center, Moffett Field, CA) IN: Symposium on Aviation Psychology, 3rd, Columbus, OH, April 22-25, 1985, Proceedings . Columbus, OH, Ohio State University, 1985, p. 255-262.

The multitask simulation of a supervisory control system was examined in order to evaluate the ability of operators to predict the workload and performance impact of unfamiliar task features, using their basic knowledge and specific information provided before each scenario. Task difficulty and experienced workload were varied by manipulating the number of elements per task, the number of tasks, task schedule, and availability of task elements for performance. The results have indicated that an operator might correctly predict the workload of a realistically complex task if (1) he is familiar with the basic system, and (2) the design, functional requirements, and operational procedures of the proposed modifications are described clearly. He is less able to predict unfamiliar rate or schedule complexity manipulations for which timing is an important element. LS.

A86-31823

THE FUNCTIONAL AGE PROFILE - AN OBJECTIVE DECISION CRITERION FOR THE ASSESSMENT OF PILOT PERFORMANCE CAPACITIES AND CAPABILITIES

R. BRAUNE and C. D. WICKENS (Illinois, University, Urbana) Human Factors (ISSN 0018-7208), vol. 27, Dec. 1985, p. 681-693. refs

(Contract N00204-82-C-0113)

The initial development of a computer-based informationprocessing performance battery with aviation-relevant task structures is reported. It is shown that the currently existing prototype is sensitive to individual differences within chronological age groups as well as to age-related changes across different age groups. The utilization of such a test battery for the longitudinal assessment of aviator performance capabilities is discussed. Author

A86-33787

WORKLOAD MEASUREMENT IN SYSTEM DESIGN AND EVALUATION

F. T. EGGEMEIER (Wright State University, Dayton, OH), C. A. SHINGLEDECKER, and M. S. CRABTREE (Ergometrics Technology, Inc., Dayton, OH) IN: Human Factors Society, Annual Meeting, 29th, Baltimore, MD, September 29-October 3, 1985, Proceedings. Volume 1 . Santa Monica, CA, Human Factors Society, 1985, p. 215-219. refs

(Contract F33615-82-K-0522)

Because of its central role in system development, workload measurement has been extensively researched. These efforts have produced a variety of workload assessment techniques, many of which can be classified as either subjective, physiological, or behavioral measures. These categories of measures can vary along several dimensions that can be used as criteria in selection of a technique for a particular application. The proposed selection criteria include the sensitivity, diagnosticity, and intrusiveness associated with a technique. Different stages of system design can require techniques that differ on the noted dimensions. Since no technique is capable of meeting all of the applicable criteria, a comprehensive approach to workload assessment will require a battery of subjective, physiological, and behavioral measures. Further research dealing with comparative evaluation of the various assessment techniques along the noted dimensions will be required in order to refine workload metric selection criteria. Author

A86-33804* Technion - Israel Inst. of Tech., Haifa.

THE PSYCHOPHYSICS OF WORKLOAD - A SECOND LOOK AT THE RELATIONSHIP BETWEEN SUBJECTIVE MEASURES AND PERFORMANCE

D. GOPHER, N. CHILLAG, and N. ARZI (Technion - Israel Institute of Technology, Haifa) IN: Human Factors Society, Annual Meeting, 29th, Baltimore, MD, September 29-October 3, 1985, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1985, p. 640-644.

(Contract NAGW-494)

Load estimates based upon subjective and performance indices were compared for subjects performing size matching and letter typing tasks under 6 levels of priorities, in single and dual task conditions. Each half of the group used a different task as reference in their subjective judgement. The results are interpreted to indicate that subjective measures are especially sensitive to voluntary allocation of attention and to the load on working memory. Association with performance is expected whenever these two factors are main determinants of performance efficiency, otherwise the two are likely to dissociate. Author

A86-34983

THE ROLE OF THE TECHNOLOGIST IN SPACE PRODUCTIVITY

K. E. MCKEE (IIT Research Institute, Chicago, IL) IN: Space and society - Progress and promise; Proceedings of the Twenty-second Space Congress, Cocoa Beach, FL, April 23-26, 1985 . Cape Canaveral, FL, Canaveral Council of Technical Societies, 1985, p. 9-26 to 9-36.

In this paper the role of technologists throughout the space program is reviewed, i.e., from R&D through system maintenance. The interactions of the technologists with management, labor, capital, technology, and government are considered. Recommendataions to enhance the contribution of the technical staff are made.

A86-35440

WORKLOAD ASSESSMENT - PROGRESS DURING THE LAST DECADE

T. M. MCCLOY and W. L. DERRICK (U.S. Air Force Academy, Colorado Springs, CO) IN: Aerospace Behavioral Engineering Technology Conference, 4th, Long Beach, CA, October 14-17, 1985, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1985, p. 125-130. USAF-supported research. refs

(SAE PAPER 851877)

Over the last decade, considerable research has been conducted on the construct of operator workload and its measurement. From this research, both theory and methods have evolved to provide valid assessment of this construct. Two classes of assessment methods, secondary tasks and subjective scales, dominate the literature at this time. This paper traces the development of both methods, ties their use to current theories of human processing resources, and evaluates both with respect to five criteria. Author

A86-37037* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE HUMAN ROLE IN SPACE: TECHNOLOGY, ECONOMICS AND OPTIMIZATION

S. B. HALL, ED. (NASA, Marshall Space Flight Center, Huntsville, AL) Park Ridge, NJ, Noyes Publications, 1985, 398 p. No individual items are abstracted in this volume.

Man-machine interactions in space are explored in detail. The role and the degree of direct involvement of humans that will be required in future space missions are investigated. An attempt is made to establish valid criteria for allocating functional activities between humans and machines and to provide insight into the technological requirements, economics, and benefits of the human presence in space. Six basic categories of man-machine interactions are considered: manual, supported, augmented, teleoperated, supervised, and independent. Appendices are included which provide human capability data, project analyses, activity timeline profiles and data sheets for 37 generic activities, support equipment and human capabilities required in these activities, and cumulative costs as a function of activity for seven man-machine modes.

N86-11073# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Industrial Engineering.

ON THE STRUCTURE OF MANPOWER PLANNING, A CONTRIBUTION OF SIMULATION EXPERIMENTS WITH DECOMPOSITION METHODS

J. D. VANDERBIJ, J. WESSELS, and J. WIJNGAARD Aug. 1983 19 p refs

(MANPOWER-PLANNING-28) Avail: NTIS HC A02/MF A01

Manpower planning in a personnel system consisting of one personnel group, located in different organizational units is considered. The ease with which personnel availability can be matched to personnel requirement, when the flexibility within the personnel group is used is analyzed. This is done by comparing the performance of integrated planning, coordinated planning, and decomposed planning. Results are derived by simulation experiments. Author (ESA)

N86-11075# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Industrial Engineering.

ON THE STRUCTURE OF MANPOWER PLANNING, A CONTRIBUTION OF SIMULATION EXPERIMENTS WITH AGGREGATION METHODS

J. D. VANDERBIJ, J. WESSELS, and J. WIJNGAARD Aug. 1983 24 p refs

(MANPOWER-PLANNING-30) Avail: NTIS HC A02/MF A01

Two ways to estimate the possibilities of matching manpower availability to manpower requirement in the organization activity plan of a task oriented unit of an organization are considered. One estimation procedure is based on detailed information about the personnel groups which are located in the task oriented unit. The other procedure is based on aggregate information about total availability and total personnel requirement in the whole unit. A situation for the case that steps are taken on the basis of detailed information and for the case that steps are taken on the basis of aggregate information was analyzed. Results show that use of aggregate information in drawing up personnel plans causes no extra problems if the maximum potential mobility is high or if future manpower requirements in personnel groups is highly correlated.

N86-12212*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

AN ANALYSIS OF THE APPLICATION OF AI TO THE DEVELOPMENT OF INTELLIGENT AIDS FOR FLIGHT CREW TASKS

S. BARON and C. FEEHRER Washington NASA Oct. 1985 114 p refs

(Contract NAS1-17335)

(NASA-CR-3944; NAS 1.26:3944) Avail: NTIS HC A06/MF A01 CSCL 05H

This report presents the results of a study aimed at developing a basis for applying artificial intelligence to the flight deck environment of commercial transport aircraft. In particular, the study was comprised of four tasks: (1) analysis of flight crew tasks, (2) survey of the state-of-the-art of relevant artificial intelligence areas, (3) identification of human factors issues relevant to intelligent cockpit aids, and (4) identification of artificial intelligence areas requiring further research. Author

N86-13906# Purdue Univ., West Lafayette, Ind. ALERTED MONITORS: HUMAN OPERATORS AIDED BY AUTOMATED DETECTORS Final Report

R. D. SORKIN and D. E. ROBINSON Dec. 1984 55 p (Contract DTRS56-83-C-00047)

(PB85-222750; DOT/OST/P34-85/021) Avail: NTIS HC A04/MF A01 CSCL 05H

In an alerted monitor system, an automated detector assists a human operator in the detection and diagnosis of problems occurring in some monitored process. Air traffic control centers and the flight decks of commercial aircraft include many examples of such systems. This project developed a general model of the altered-monitor system and evaluated the effects on system performance of interactions between the human operator and automated detector. One of the types of interaction evaluated (contingent criterion strategy) yields optimal performance from the combined person-machine system. Two laboratory experiments were performed to evaluate the assumptions of the model and the interactions between the operator and automated components.

N86-15163*# Columbia Univ., New York. Teachers Coll. MANAGEMENT BEHAVIOR, GROUP CLIMATE AND PERFORMANCE APPRAISAL AT NASA

G. MANDERLINK, L. P. CLARK, W. M. BERNSTEIN, and W. W. BURKE *In* NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 51-62 1985 refs

Avail: NTIS HC A25/MF A01 CSCL 05A

The relationships among manager behavior, group climate and managerial effectiveness are examined. Survey data were collected from 435 GM14-15 managers and their subordinates at NASA concerning management practices and perceptions of the group environment. Performance ratings of managers were obtained from their superiors. The results strongly supported a causal model in which subordinates' climate perceptions mediate the effects of manager behavior on performance. That is, the development of group climate provides the process through which the effects of manager practices may be understood. Analyses also revealed that the function performed by a manager and his group (e.g., research) influenced the specific nature of the causal dynamics. Some implications of the results for management training and development are discussed.

N86-15164*# Federal Express Corp., Memphis, Tenn. MENTORING AS A COMMUNICATION CHANNEL: IMPLICATIONS FOR INNOVATION AND PRODUCTIVITY L. AVANT and R. W. BOOZER (Memphis State Univ.) /n NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 63-72 1985 refs Avail: NTIS HC A25/MF A01 CSCL 05A

The impact of a formalized mentoring program as a communication channel for enhancing information distribution, innovation, and productivity is investigated. Formal and informal approaches to mentoring are discussed. Interviews with 11 members of formal mentor-protege teams indicate communications in the mentoring relationship can affect individual and organizational innovation and productivity. Author

N86-15167*# Universities Space Research Association, Huntsville, Ala.

PRODUCTIVITY ISSUES AT ORGANIZATIONAL INTERFACES

A. W. HOLLAND *In* NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 109-119 1985 refs

Avail: NTIS HC A25/MF A01 CSCL 05A

The need for close interdependence between large numbers of diverse and specialized work groups makes the Space Program extremely vulnerable to loss of productivity at organizational interfaces. Trends within the program also suggest that the number and diversity of interfaces will grow in the near term. Continued maintenance of R&D excellence will require that interface performance issues be included in any future productivity improvement effort. The types and characteristics of organizational interfaces are briefly presented, followed by a review of factors which impact their productivity. Approaches to assessing and improving interface effectiveness are also discussed. Author

N86-15170*# Texas Univ., Arlington.

A CASE STUDY IN R AND D PRODUCTIVITY: HELPING THE PROGRAM MANAGER COPE WITH JOB STRESS AND IMPROVE COMMUNICATION EFFECTIVENESS

W. D. BODENSTEINER and E. A. GERLOFF *In* NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 142-148 1985 refs Avail: NTIS HC A25/MF A01 CSCL 05A

Certain structural changes in the Naval Material Command which resulted from a comparison of its operations to those of selected large-scale private sector companies are described. Central to the change was a reduction in the number of formal reports from systems commands to headquarters, and the provision of Program Management Assistance Teams (at the request of the program manager) to help resolve project problems. It is believed that these changes improved communication and information-processing, reduced program manager stress, and resulted in improved productivity. Author

N86-15178*# Rockwell International Corp., Canoga Park, Calif. PRODUCTIVITY IMPROVEMENT IN ENGINEERING AT ROCKETDYNE

R. M. NORDLUND, S. T. VOGT, and A. K. WOO In NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 231-238 1985 Avail: NTIS HC A25/MF A01 CSCL 05A The Rocketdyne Division of Rockwell International has

embarked on a productivity improvement program in engineering. This effort included participation in the White Collar Productivity Improvement (WCPI) project sponsored by the American Productivity Center. A number of things have been learned through this project. It seems that any productivity improvement project should be employee driven. The Rocketdyne project was essentially started as a result of a grassroots effort to remove some particular hindrances, and employee enthusiasm was a prime factor in the continuing progress of the effort. A significant result was that awareness of problems at all levels increased. Many issues surfaced in the diagnostic phase, and were then noted and discussed. This process added legitimacy to issues that had previously been merely unspoken concerns. The initial feelings of many members of the pilot group was that significant changes would occur relatively quickly. It is now recognized that this will have to be an ongoing, long-term effort. Author

N86-15182*# Westinghouse Mfg. Systems and Technology Center, Columbia, Md. Socio-Technical Engineering. SOCIO-TECHNICAL INTEGRATION OF THE WORKPLACE

G. L. CARTER *In* NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program 1985 refs p 275-288

Avail: NTIS HC A25/MF A01 CSCL 05K

The objective of socio-technical theory and design is to provide the best match between the social system and the technical system. The achievement of a best match makes optimal use of the resources of both systems. Implementation of this theory is best served when there is involvement by the user organization. The involvement relative to the introduction of new technology in the organization is extremely significant. Employee involvement is critical to effective participative management. The trends toward participative management and employee involvement have taken various forms. These have included quality circles, semi-autonomous teams and adhoc action teams. It is noteworthy to point out, as these processes have evolved, the role of a facilitator has become more prevalent. The facilitation of the socio-technical design system in industrial engineering is described. B.W.

N86-15184*# Hughes Aircraft Co., Los Angeles, Calif. TRAINING MANAGERS FOR HIGH PRODUCTIVITY: **GUIDELINES AND A CASE HISTORY**

R. M. RANFTL *In* NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 310-323 1985

Avail: NTIS HC A25/MF A01 CSCL 05A

Hughes Aircrafts 13-year productivity study clearly identifies management as the key link in the entire productivity chain. This fact led to the establishment of a long-term series of seminars on personal, managerial, organizational, and operational productivity for all levels and sectors of line and staff management. To inspire the work force to higher levels of productivity and creativity management, itself, must first be inspired. In turn they have to clearly understand the productive and creative processes, fashion an effective productivity improvement plan with sound strategy and implementation, create an optimal environmental chemistry, and provide the outstanding leadership necessary to propel their organizations to achieve full potential. The primary goals of the seminars are to (1) ignite that spark of inspiration, enabling productive action to follow, (2) provide participants a credible roadmap and effective tools for implementation, and (3) develop a dedicated commitment to leadership and productivity throughout the management team. Author

N86-15186*# Loyola Univ., Chicago, III. GROUP STRUCTURE AND GROUP PROCESS FOR EFFECTIVE SPACE STATION ASTRONAUT TEAMS

J. M. NICHOLAS and R. S. KAGAN In NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 330-339 1985 refs

Avail: NTIS HČ A25/MF A01 CSCL 05A

Space Station crews will encounter new problems, many derived from the social interaction of groups working in space for extended durations. Solutions to these problems must focus on the structure of groups and the interaction of individuals. A model of intervention is proposed to address problems of interpersonal relationships and emotional stress, and improve the morale, cohesiveness, and productivity of astronaut teams. Author

N86-15187*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif. Man-Machine Systems.

SPACE CREW PRODUCTIVITY: A DRIVING FACTOR IN SPACE STATION DESIGN

H. L. WOLBERS In NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 340-350 1985 refs

Avail: NTIS HC A25/MF A01 CSCL 05A

The criteria of performance, cost, and mission success probability (program confidence) are the principal factors that program or project managers and system engineers use in selecting the optimum design approach for meeting mission objectives. A frame of reference is discussed in which the interrelationships of these pertinent parameters can be made visible, and from which rational or informed decisions can be derived regarding the potential impact of adjustments in crew productivity on total Space Station System effectiveness. Author

N86-15194*# McDonnell-Douglas Technical Services Co., Inc., Houston, Tex.

STREAMLINING: REDUCING COSTS AND INCREASING STS **OPERATIONS EFFECTIVENESS**

R. K. PETERSBURG In NASA, Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 415-424 1985

Avail: NTIS HC A25/MF A01 CSCL 05A

The development of streamlining as a concept, its inclusion in the space transportation system engineering and operations support (STSEOS) contract, and how it serves as an incentive to management and technical support personnel is discussed. The mechanics of encouraging and processing streamlining suggestions, reviews, feedback to submitters, recognition, and how individual employee performance evaluations are used to motivation are discussed. Several items that were implemented are mentioned. Information reported and the methodology of determining estimated dollar savings are outlined. The overall effect of this activity on the ability of the McDonnell Douglas flight preparation and mission operations team to support a rapidly increasing flight rate without a proportional increase in cost is illustrated. E.A.K.

N86-15201*# Martin Marietta Aerospace, New Orleans, La. QUALITY CIRCLES: ORGANIZATIONAL ADAPTATIONS, IMPROVEMENTS AND RESULTS

R. TORTORICH In NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 490-494 1985 refs

Avail: NTIS HC A25/MF A01 CSCL 14D

The effective application in industry and government of quality circles work was demonstrated. The results achieved in quality and productivity improvements and cost savings are impressive. The circle process should be institutionalized within industry and government. The stages of circle program growth, innovations that help achieve circle process institutionalization, and the result achieved at Martin Marietta's Michoud Division and within the National Aeronautics and Space Administration (NASA) are addressed. E.A.K.

N86-15202*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

PRODUCTIVITY ENHANCEMENT PLANNING USING PARTICIPATIVE MANAGEMENT CONCEPTS

M. E. WHITE and J. C. KUKLA *In* NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 495-505 1985

Avail: NTIŠ HC A25/MF A01 CSCL 05A

A productivity enhancement project which used participative management for both planning and implementation is described. The process and results associated with using participative management to plan and implement a computer terminal upgrade project where the computer terminals are used by research and development (R&D) personnel are reported. The upgrade improved the productivity of R&D personnel substantially, and their commitment of the implementation is high. Successful utilization of participative management for this project has laid a foundation for continued style shift toward participation within the organization. E.A.K.

N86-15203*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

RESULTS OF INNOVATIVE COMMUNICATION PROCESSES ON PRODUCTIVITY GAINS IN A HIGH TECHNOLOGY ENVIRONMENT

B. J. KELLY *In* NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program $p \ 506-515 \ 1985$

Avail: NTIS HC A25/MF A01 CSCL 05A

The technology which resulted in performance breakthroughs at engineering and management services is discussed. As a result of the innovative approaches of communicating productivity concepts to the employees, specific outcomes can now be pinpointed at all levels of the organization such as: (1) employee-headed program; (2) performance feedback processes; and (3) an investigative approach to creating leadership. The Lockheed Corporation began the innovative trend in 1974 when they became the first company to introduce quality circles in America. Although some of Lockheed-EMSCO's processes may sound different from traditional improvement processes, the context out of which those to be presented evolved has sustained more than 10 years of positive results through employee involvement activities. E.A.K.

N86-15957# Washington Univ., Seattle. Dept. of Psychology. PROBLEM SOLVING UNDER TIME-CONSTRAINTS M. RICHARDSON and E. HUNT 15 Aug. 1985 29 p (Contract N00014-84-K-5553) (AD-A158921; TR-10) Avail: NTIS HC A03/MF A01 CSCL 05J

The computer science concept of production execution has been the basis of a large number of simulations of human problem solving. Typically these simulations have operated in a timeless environment, in the sense that they did not consider any constraints to solve problems quickly. In a previous technical report in this series Hunt and Lansman proposed an architecture for production-executing machines that could be applied to real-time problem solving. Hunt and Lansman supported their ideas by simulating data from laboratory studies drawn from the attention and performance field. In this paper Hunt and Lansman's approach is extended to the simulation of people doing a simple arithmetic task under considerable time pressure and when subject to interruptions. Data from the simulation is compared to data from college students doing the same task. GRA

AUTOMATION AND THE ALLOCATION OF FUNCTIONS BETWEEN HUMAN AND AUTOMATIC CONTROL: GENERAL METHOD

R. PULLIAM and H. E. PRICE Jan. 1985 106 p Prepared in cooperation with Essex Corp., Alexandria, Va. (Contract F33615-82-C-0513)

(AD-A161072; AFAMRL-TR-85-017) Avail: NTIS HC A06/MF

A01 CSCL 05H

This report was prepared as a Human Engineering Data Base Supplement to the Integrated Perceptual Information for Designers (IPID) Engineering Data Compendium. It describes a general method for allocation of functions during systems development, with particular focus on what functions should be automatic. The method was originally developed for use in the nuclear power industry, and has here been redeveloped for use in aerospace systems. The report is intended for use of project managers, systems engineers and system designers, as an applied guide during the development of aerospace systems. It provides a detailed procedure for allocation of functions (AOF), a procedure to be applied during the research, development, test and evaluation (RDT&E) process. The report uses a hierarchical structure in which each of five sections treats the AOF process at an increasing level of detail, as follows: section 1 concerns how to use the report; section 2 describes the RDT&E process in terms of the cyclic decision and test steps by which design proceeds, and identifies those steps which are critical to a successful AOF; section 3 focuses on one critical step in RDT&E, the formation of design hypotheses, and describes that step in greater detail; section 4 focuses even more narrowly on a step within design hypothesis, and identifies four sets of criteria which should be applied in sequence to assist AOF decisions; finally, section 5 identifies human-machine models by which aerospace systems can be analyzed during systems design. GRA

N86-21419*# American Productivity Center, Houston, Tex. WHITE COLLAR PRODUCTIVITY IMPROVEMENT: SPONSORED ACTION RESEARCH 1983 - 1985

1985 41 p Presented at the National Conference on White Collar Productivity Improvement, Dallas, 30-31 Oct. 1985; sponsored by Dun and Bradstreet Corp., General Dynamics Corp., McDonnell Douglas Corp., Northern Telecom Ltd., Westinghouse Furniture Systems, and the US Dept. of Labor Sponsored in part by Armco., Inc., Atlantic Richfield Co., Johnson and JohnsonMotorola, Inc., Ortho Pharmaceutical Corp., Rockwell International Corp., TRW, Inc., and Warner-Lambert Co. (Contract NASW-3834)

(NASA-CR-176366; NAS 1.26:176366) Avail: NTIS HC A03/MF A01 CSCL 05A

A program developed by the American Productivity Center to boost white collar worker effectiveness is described. This program is the culmination of a two-year sponsored action research project, White Collar Productivity Improvement. Traditional attempts aimed at cutting costs or staffing levels, often alienating workers at the outset. They typically focused on increased efficiencies in individual activities or specific procedures, such as paperwork processing. In contrast, the Center's approach to white collar productivity focuses on the effectiveness of actual outputs, typically professional services. These typically consist of both tangible products, such as a financial report or research study, and intangibles, such as the expertise, advice or guidance that accompanies the product. Eight general observations about white collar productivity improvement are summarized. B.W. N86-21499# Committee on Science and Technology (U. S. House).

ASTRONAUTS AND COSMONAUTS BIOGRAPHICAL AND STATISTICAL DATA, REVISED JUNE 28, 1985

Washington GPO Dec. 1985 407 p Presented to the Subcommittee on Space Science and Applications of the Committee on Science and Technology, 99th Congress, 1st Session, 26 Aug. 1985 Prepared by the Library of Congress, Congressional Research Service

(GPO-52-498) Avail: Subcommittee on Space Science and Applications

Astronauts' and cosmonauts' biographical and statistical data are reported. The following issues are described. Astronaut selection criteria, education and experience, medical and psychological condition; US payload specialists and passengers; the X-15, X-20 Dynasolar, and manned orbiting laboratory program, Soviet cosmonauts; non-US, non-Soviet spacenauts, and comparative data on American and Soviet spaceflights. E.A.K.

N86-23260# Joint Publications Research Service, Arlington, Va. INFLUENCE OF COMPLEXITY OF CONTROL TASK ON LEVEL OF ACTIVATION OF OPERATORS PHYSIOLOGICAL FUNCTIONS WHEN WORKING WITH WAITING Abstract Only M. A. GRITSEVSKIY and Z. I. ZAYTSEVA *In its* USSR Report: Life Sciences. Biomedical and Behavioral Sciences (JPRS-UBB-86-004) p 102 12 Mar. 1986 Transl. into ENGLISH from Fiziologiya Cheloveka (Moscow, USSR), v. 11, no. 3, May -Jun. 1985 p 504-510

Avail: NTIS HC A07/MF A01

Experiments were conducted to answer two questions: (1) do model experiments reveal differences in the functional status in comparing operator's work with various degrees of complexity; and (2) are these changes similar in nature to those manifestations of differing intensity discovered under production conditions. Programs with various specific shares of single and multiple movement control tasks were used to model operators work of varying degrees of complexity. During the experiments, reaction time, EEG, skin-galanic reaction and pulse rate were continually recorded. Differences in bioenergetic activity of the cerebral cortex and differences in autonomic activity and regulations were observed. It is indicated that waiting for signals requiring complex processing is accompanied by higher mobilization of preparedness of the operator. Decreased attention level was observed at the beginning of the day and toward the end of long days. E.A.K.

N86-24257# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

COMMUNICATION AND MISCOMMUNICATION

B. A. GOODMAN Oct. 1985 234 p

(Contract N00014-77-C-0378; N00014-85-C-0079)

(AD-A162843; BBN-5681) Avail: NTIS HC A11/MF A01 CSCL 09B

This report discusses one aspect of enabling people to communicate in natural language with computers. The central focus of this work is a study on how one could build robust natural language processing systems that can detect and recover from miscommunication. The study of miscommunication is a necessary task within such a context since any computer capable of communicating with humans in natural language must be tolerant of the complex, imprecise, or ill-devised utterances that people often use. This goal first required an inquiry into how people communicate and how they recover from problems in communication. This led to the development of techniques for avoiding failures of reference that were employed in the reference identification component of a natural language understanding program. The traditional approaches to reference identification in previous natural language systems were found to be less elaborate than people's real behavior. To model a listener's behavior, a new component was added to the traditional reference identification mechanism to resolve difficulties in a speaker's description.

GRA

N86-24554# Horizon Inst. for Advanced Design, Inc., Rockville, Md.

COMPARISON OF SCIENTIFIC AND TECHNICAL PERSONNEL TRENDS IN THE UNITED STATES, FRANCE, WEST GERMANY AND THE UNITED KINGDOM SINCE 1970

J. MINTZES and W. TASH Mar. 1985 253 p

(Contract NSF SRS-82-15756)

(PB86-133030; NSF-84-335) Avail: NTIS HC A12/MF A01 CSCL 05A

Comparative data on the number of natural scientists and engineers showed that in the early 1980's, the United States had 2.6 million natural scientists and engineers in the labor force compared with 621 thousand for West Germany, 633 thousand for fFrance, and 592 thousand for the United Kingdom. Although the United States has more natural scientists and engineers in the labor force than these three countries combined, the U.S. proportion of natural scientists and engineers in the labor force in the early 1980's was about the same as that of other countries. It is agreed that scientists and engineers in the United States demonstrate a higher degree of mobility (geographic and occupational) than do their counterparts in the European countries. Engineers in France and West Germany more frequently move into top management positions than do those in the United States and the United Kingdom. Less attention is given in the United States to the systematic training of technicians and establishment of standards than in the European countries. Updating of skills of scientists and engineers is also more systematic in the European countries than in the United States with special tax-supported programs, notably in France. In the United States, larger firms often carry out such training for their staff and, more often than in Europe, it is up to the individuals. GRA

N86-25123# Naval Postgraduate School, Monterey, Calif. MAN-MACHINE SYSTEMS OF THE 1990 DECADE: COGNITIVE FACTORS AND HUMAN INTERFACE ISSUES

P. J. HOFFMAN Aug. 1985 53 p refs

(AD-A163865; NPS74-85-002) Avail: NTIS HC A04/MF A01 CSCL 05H

This paper presents the primary psychological concepts which are fundamental to the design of man-machine interfaces for intelligent systems of the 1990's. These concepts embrace perception, learning motivation, and cognitive capacities of human operators, in systems which require a high degree of operator-machine interaction. The central role of feedback is emphasized through simple schematic examples, designed to provide an understanding of the reciprocity requirements in man-machine communication. Cognitive theory and recent experimental data form the basis for discussion of visual image storage, short-term memory, long-term memory, transfer rates and buffering of information being processed by the human operator. under control of a central processor with a cycle time of roughly 70 milliseconds. Systems of the 1990 era will provide increased capability for high-speed processing of data and will utilize increasing numbers of decision-aides, spreadsheets and AI tools. Users of these systems will be components of networks, linked via efficient communication systems to other users and other subsystems. These developments will lead to fundamental changes in the work place. GRA

N86-26078# California Univ., Berkeley. Operations Research Center.

THE GROUP CONSENSUS PROBLEM

K. CHANG Dec. 1985 49 p refs

(Contract N00014-85-K-0384; AF-AFOSR-0122-81)

(AD-A164064; ORC-85-13) Avail: NTIS HC A03/MF A01 CSCL 12A

In a group consensus problem, there is a group with K greater than or equal to 2 members who are jointly responsible for the aggregation of their opinions. The group may not have a predefined real decision problem. French called the group consensus problem with a predefined real decision problem a group decision problem and the group consensus problem without a real decision problem a text-book problem. Suppose a group with K members are

interested in forecasting demands for a commodity for a given time period. Production planning for this commodity depends on demands. Each group member may have his own opinion for demands in the form of probability distribution. In this case the group has a real decision problem in which they should determine the amount of the commodity to be produced. Here the group consensus opinion is a probability distribution for demands obtained from the group members' prior opinions for demands. For example a group of meteorologists are required to give a single forecast for weather without having any real decision problem. This is an example of the text-book problem. Savage suggested that the whole of statistical theory is directly or indirectly aimed at the solution of a version of the text-book problem. The objective of this paper is to give a unified approach for these two problems. In this paper all the group members are assumed to be GRA Bavesians.

N86-26840# Pattern Analysis and Recognition Corp., McLean, Va.

HUMAN FACTORS IN RULE-BASED SYSTEMS Final Report

P. E. LEHNER, D. ZIRK, R. B. HALL, and L. ADELMAN 14 Oct. 1985 30 p refs

(Contract N00014-83-C-0537)

AD-A165309; AD-E301922; PAR-85-109) Avail: NTIS HC A03/MF A01 CSCL 05H

This report summarizes several experiments investigating the impact of mental models and cognitive consistency on user/expert system interaction. Results indicate that user/expert system combined problem solving performance significantly improves if the user has a good mental model of expert system processes. Furthermore, cognitive consistency between the user and system problem solving procedures only degrades performance in situations where users do not have a good mental model. Some practical implications of this research is discussed.

Author (GRA)

N86-26843# Pattern Analysis and Recognition Corp., McLean, Va.

MENTAL MODELS AND PROBLEM SOLVING WITH A KNOWLEDGE-BASED EXPERT SYSTEM

R. B. HALL Oct. 1985 28 p

(Contract N00014-83-C-0537)

(AD-A165398; PAR-85-108) Avail: NTIS HC A03/MF A01 CSCL 09B

Previous research in the area of user/expert system interaction has shown that the quality of problem solving with a general expert system (ES) is associated with mental model, a user's conceptual understanding of the basic principle of an ES's problem solving process. The current paper describes an experiment with MYCIN, a medical knowledge-based expert system, that lends additional support to the link between problem solving quality and mental model. GRA

N86-27941# Softech, Inc., Waltham, Mass. ADA (TRADEMARK) TRAINING CURRICULUM: SOFTWARE ENGINEERING FOR MANAGERS M101 TEACHER'S GUIDE 1986 359 p

(Contract DAAB07-83-C-K506)

(AD-A165123) Avail: NTIS HC A16/MF A01 CSCL 051

The Ada training curriculum: Software engineering for managers M101 teacher's guide contains the following: (1) Background and Motivation - Definition of Software Engineering, and Motivation for Software Engineering (Software Crisis); (2) Software Engineering and its Goals - Software Engineering Goals, and Software Engineering Principles; (3) Achieving Software Engineering Goals - Software Life-Cycle, Methods and Tools for each phase of Life-Cycle, Testing, and Software Management: (4) Software Engineering and Ada - Relationship of Software Engineering to Ada. GRA

N86-29805# Air Command and Staff Coll., Maxwell AFB, Ala. WILL THE USAF NEED GROUND-BASED AIR TRAFFIC CONTROL RADAR IN THE YEAR 2000?

G. L. VARN Apr. 1986 49 p (AD-A166504; AD-E750871; ACSC-86-2585) Avail: NTIS HC A03/MF A01 CSCL 17G

Advanced technology in military aviation is developing rapidly. The Global Positioning System (GPS) and Microwave Landing System (MLS) will give the pilot precision navigation capability when fully deployed in the 1990s. The Joint Tactical Information Distribution System (JTIDS) will give the pilot the capability to display enemy and friendly aircraft in his area in his cockpit. At the same time, our mobile air traffic control (ATC) radars are aging and need to be replaced. But, with the new technology in the cockpit, it may be more feasible to eliminate ground-based ATC radar and let the pilot do his own ATC from the cockpit. This study examines the feasibility of a cockpit-based ATC system by looking at the requirement for military ATC, specific capabilities that new technologies give the pilot, and human considerations in a cockpit-based ATC system. The study concludes that a cockpit-based ATC system is not feasible and that there will be a need for ground-based ATC radar, at least through the year 2000 Author (GRA)

N86-31223# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho. System Safety Development Center.

BASIC HUMAN FACTORS CONSIDERATIONS

R. J. NERTNEY and D. L. FILLMORE Dec. 1985 37 p (Contract DE-AC07-76ID-01570)

(DE86-008181; SSDC-34) Avail: NTIS HC A03/MF A01

Models and concepts for analyzing the human element in working programs and systems are introduced. The method of attack is a functional one based on analysis of the work to be done (job-task analysis). Based on the results of the job-task analysis, psychological and physiological requirements and criteria can be defined for the system. DOE

N86-31226# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho. System Safety Development Center.

HUMAN FACTORS MANAGEMENT

R. J. NERTNEY and D. L. FILLMORE Jul. 1985 44 p (Contract DE-AC07-76ID-01570)

(DE86-008184; SSDC-30) Avail: NTIS HC A03/MF A01

Evaluating a system to determine if it has the right people working using the right procedures and management controls with the right hardware at all times is the facet of human factors discussed in this manual. The following areas of concern are specifically addressed: (1) the selection process must be proper to select qualified workers who are given proper training for the work and whose skills are maintained; (2) a proper behavioral climate must be established at the work station; (3) all task assignments must contain elements of instruction and training; and (4) all supporting systems must interact with the human to ensure that the work can be completed. All of these areas of concern can be successfully completed using the existing company organization by following the considerations presented in this document and maintaining proper interfaces between the different DOE branches of the company.

N86-31251# Oak Ridge Gaseous Diffusion Plant, Tenn. Computer-Aided Engineering.

IN-HOUSE CAD TRAINING: A REALISTIC APPROACH

T. WHITUS 10 Apr. 1986 11 p Presented at the American Institute for Design and Drafting Convention, Hollywood, Fla., 7 Apr. 1986

(Contract DE-AC05-84OT-21400)

(DE86-008926; K/D-5697; CONÉ-8604150-1) Avail: NTIS HC A02/MF A01

The need for industry to retrain its engineering personnel to use a CAD system can be demanding, as well as frustrating. In fact, the larger and more diverse the organization, the more demanding these requirements may be. It should be noted that in preparing for CAD implementation, the training needs and requirements are often underestimated. Additionally, most engineering organizations implementing CAD do not have personnel experienced in developing training programs or in teaching manipulative skills. This text describes the evolution of the in-house CADAM basic training program at Martin Marietta Energy Systems, Inc. Rather than emphasize the theoretical aspects of designing such a program, the paper will concentrate on the practical, more realistic aspects of program development. The paper should serve as a guide to others desiring to develop a similar program. This paper first presents a brief look at factors concerning retraining the experienced engineering employee. Then, the actual planning, organization, structuring, implementation, and evaluation of the training program, as well as possible future directions are presented. Finally, the paper offers advice to those planning similar in-house CAD training programs. DOE

N86-32102*# National Aeronautics and Space Administration, Washington, D.C.

NASA FACTS: SPACE SHUTTLE FOOD SYSTEMS

1986 15 p

(NF-150/1-86) Avail: Issuing Activity CSCL 06H

On the Space Shuttle, the food is prepared at a galley installed on the Orbiter's mid-deck. The galley is a modular unit that can be removed for special weight-critical missions or missions that require extra interior space. It contains a personal hygiene station, a water dispenser, an oven, condiment and meal tray stowage, and a food preparation area. Foods are individually packaged and stowed for easy handling in the zero gravity of space. All food is precooked or processed so it requires no refrigeration and is either ready to eat or can be prepared simply by adding water or heating. The only exception is the fresh fruit and vegetables stowed in the fresh food locker. The supplies consist of rehydratable food and beverages, thermostabilized food, intermediate moisture foods, natural form foods, irradiated meats, and condiments. A sample menu is also included. B.G.

N86-32969# Hershey (Milton S.) Medical Center, Hershey, Pa. DATA COLLECTION VIA A QUASI-EXPERIMENTAL SIMULATION TECHNOLOGY. PART 1: MULTIPLE MEASUREMENT OF PERFORMANCE EXCELLENCE IN COMPLEX AND UNCERTAIN MANAGERIAL TASKS Interim Report

S. STREUFERT, R. M. POGASH, and M. T. PIASECKI Apr. 1986 74 p

(Contract MDA903-83-C-0106; DA PROJ. 2Q1-61102-B-74-F) (AD-A167949; ARI-RN-86-41) Avail: NTIS HC A04/MF A01 CSCL 05A

A simulation technique is used to determine whether complexity (multidimensionality) of task performance in complex managerial tasks is trainable. The present report is specifically concerned with measurement. Previous simulation based measurement, which had included sixteen measures was extended to thirty-seven primary measures and twelve derived measures. Information is provided on the characteristics and purpose of each of those measures. In addition formulas or related statements that allow calculation of performance scores by other researchers and/or in other settings is provided. Further, this report considers the Time-Event Matrix on which measurement is based. GRA

N86-32985*# California Univ., Los Angeles. Dept. of Safety Science and Human Factors.

KNOWLEDGE-BASED LOAD LEVELING AND TASK ALLOCATION IN HUMAN-MACHINE SYSTEMS

M. H. CHIGNELL and P. A. HANCOCK In NASA. Ames Research Center, 21st Annual Conference on Manual Control 11 p May 1986

Avail: NTIS HC A22/MF A01 CSCL 05H

Conventional human-machine systems use task allocation policies which are based on the premise of a flexible human operator. This individual is most often required to compensate for and augment the capabilities of the machine. The development of artificial intelligence and improved technologies have allowed for a wider range of task allocation strategies. In response to these

01 HUMAN FACTORS AND PERSONNEL ISSUES

issues a Knowledge Based Adaptive Mechanism (KBAM) is proposed for assigning tasks to human and machine in real time, using a load leveling policy. This mechanism employs an online workload assessment and compensation system which is responsive to variations in load through an intelligent interface. This interface consists of a loading strategy reasoner which has access to information about the current status of the human-machine loading strategies. Difficulties standing in the way of successful implementation of the load leveling strategy are examined. Author

N86-33023# Lawrence Livermore National Lab., Calif. HUMAN FACTORS REVIEW PLAN

B. PARAMORE, ed. and L. R. PETERSON, ed. Dec. 1985 261 p Prepared in cooperation with Essex Corp., Alexandria, Va. (Contract W-7405-ENG-48)

(DE86-010561; UCRL-15688) Avail: NTIS HC A12/MF A01

Human Factors is concerned with the incorporation of human user considerations into a system in order to maximize human reliability and reduce errors. This review plan is intended to assist in the assessment of human factors conditions in existing DOE facilities. In addition to specifying assessment methodologies, the plan describes techniques for improving conditions which are found to not adequately support reliable human performance. The following topics are addressed: (1) selection of areas for review describes techniques for needs assessment to assist in selecting and prioritizing areas for review; (2) human factors engineering review is concerned with optimizing the interfaces between people and equipment and people and their work environment; (3) procedures review evaluates completeness and accuracy of procedures, as well as their usability and management; (4) organizational interface review is concerned with communication and coordination between all levels of an organization; and (5) training review evaluates training program criteria such as those involving: trainee selection, qualification of training staff, content and conduct of training, regualification training, and program management.

N86-33210*# Washington Univ., Seattle. Coll. of Architecture and Urban Planning.

THE QUANTITATIVE MODELLING OF HUMAN SPATIAL HABITABILITY Final Report, Feb. - Dec. 1985

J. A. WISE 1985 154 p

(Contract NAG2-346)

(NASA-CR-179716; NAS 1.26:179716) Avail: NTIS HC A08/MF A01 CSCL 05K

A model for the quantitative assessment of human spatial habitability is presented in the space station context. The visual aspect assesses how interior spaces appear to the inhabitants. This aspect concerns criteria such as sensed spaciousness and the affective (emotional) connotations of settings' appearances. The kinesthetic aspect evaluates the available space in terms of its suitability to accommodate human movement patterns, as well as the postural and anthrometric changes due to microgravity. Finally, social logic concerns how the volume and geometry of available space either affirms or contravenes established social and organizational expectations for spatial arrangements. Here, the criteria include privacy, status, social power, and proxemics (the uses of space as a medium of social communication). B.G.

02

MANAGEMENT THEORY AND TECHNIQUES

Includes Management Overviews and Methods, Decision Theory and Decision Making, Leadership, Organizational Structure and Analysis, Systems Approaches, Operations Research, Mathematical/Statistical Techniques, Modelling, Problem Solving, Management Planning.

A86-15619*# National Aeronautics and Space Administration, Washington, D.C.

AN OVERVIEW OF THE SPACE STATION TECHNOLOGY/AD-VANCED DEVELOPMENT PROGRAM

R. F. CARLISLE, J. H. AMBRUS, and D. L. HALL (NASA, Office of Space Station, Washington, DC) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 12 p. (IAF PAPER 85-28)

The Advanced Technology Plan of the Fiscal Year (FY) 1986 is designed to focus on the most promising technology options applicable to the Space Station (SS), selected from the list of tasks identified by the FY 1984 Technology Program as the most critical technologies to be developed for the initial SS Initial Operating Capability. Most of the current activities are in the stages of manufacture and life tests of specific SS subsystems. Special attention is given to major technologies, which include power systems (PSs) (with emphasis on a Solar Dynamic PS concept); the thermal control system (with the focus on the 'thermal bus' concept); the environmental control and life support system; and the data management system; all are illustrated schematically. Other tasks, including dynamics, communications, extravehicular activities, mechanics, propulsion, and fluid, as well as the tasks of cost, maintainability, automation and robotics, and productivity are discussed. 1.S.

A86-15635*# National Aeronautics and Space Administration, Washington, D.C.

PLANNING FOR SPACE STATION UTILIZATION

W. RANEY (NASA, Office of Space Station, Washington, DC) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 5 p.

(IAF PAPER 85-48)

User requirements for the planned Space Station, and utilization planning to meet those needs, are discussed. The continual involvement of the customer in all aspects of the Space Station Program is to be achieved by identifying customers and by defining, refining, and integrating their requirements so as to stimulate the best possible design, development, and operations. Planning guidelines to be used in the Space Station definition process are shown and discussed, as is the Space Station Planning Schedule.

A86-15849#

PLANNING FOR TELESAT CANADA'S NEXT GENERATION SATELLITES

E. BERTENYI and R. TINLEY (Telesat Canada, Ottawa) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 11 p.

(IAF PAPER 85-354)

Telesat Canada's present satellites and the current planning of Telesat's next generation satellites are examined. In particular, single versus dual band payload space segment replenishment scenarios are reviewed, as are various spacecraft communication system related features which are expected to improve system performance. As a result of the planning process, it has been determined that the optimum configuration in terms of total system cost, performance, and risk is the large dual band satellite with C-band and Ku-band capacity similar to ANIK C and ANIK D designs. V.L.

A86-19487

REMOTE SENSING RESEARCH - THE PAST AS PROLOG

D. A. LANDGREBE (Purdue University, West Lafayette, IN) IN: Remote sensing; Proceedings of the Meeting, Arlington, VA, May 1, 2, 1984 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 130-135.

It is pointed out that the remote sensing community has a major opportunity at the present time which it must seize and use effectively. This opportunity is related to the undeveloped potential of the technology, the base of new fundamental knowledge now available, and the recognition that some good planning must now be done. The basic elements of a remote sensing research program are introduced, and the assembly of these elements into a unified program is considered. The elements of the development dimension include basic research, technology research, earth surface research, application research, projects, and operations. Elements of the system dimension include sensor, preprocessing, data analysis, and user application. G.R.

A86-23561* Honeywell, Inc., Minneapolis, Minn. AUTOMATED SUBSYSTEMS CONTROL DEVELOPMENT

R. F. BLOCK (Honeywell, Inc., Space and Strategic Systems Div., Minneapolis, MN), D. B. HEPPNER (Life Systems Inc., Cleveland, OH), F. H. SAMONSKI, JR., and N. LANCE, JR. (NASA, Johnson Space Center, Houston, TX) AIAA, SAE, ASME, AICHE, and ASMA, Intersociety Conference on Environmental Systems, 15th, San Francisco, CA, July 15-17, 1985. 14 p. NASA-sponsored research.

(SAE PAPER 851379)

NASA has the objective to launch a Space Station in the 1990s. It has been found that the success of the Space Station engineering development, the achievement of initial operational capability (IOC), and the operation of a productive Space Station will depend heavily on the implementation of an effective automation and control approach. For the development of technology needed to implement the required automation and control function, a contract entitled 'Automated Subsystems Control for Life Support Systems' (ASCLSS) was awarded to two American companies. The present paper provides a description of the ASCLSS program. Attention is given to an automation and control architecture study, a generic automation and control approach for hardware demonstration, a standard software approach, application of Air Revitalization Group (ARG) process simulators, and a generic man-machine interface.

A86-24116

ENTREPRENEURIAL SPIRIT COMBINES WITH HARD-HEADED BUSINESS SENSE

R. G. OLONE Commercial Space (ISSN 8756-4831), vol. 1, Fall 1985, p. 37-39.

The difficulties encountered by small companies in their development and completion of space projects are examined. The lack of adequate capital to complete the intended projects is analyzed. The inexperience of the personnel, the selection of improper projects, and improper calculation of the time required to complete the projects are all factors which contributed to the failure of many companies. The assembly of experienced and competent management teams is discussed. The possible need for private entrepreneurs to join with large aerospace firms in order to complete space projects is investigated. Examples of companies which have tried and failed to complete space projects are presented.

A86-27887#

LEARNING FROM THE PAST - BRINGING ADAM SMITH INTO ORBIT

F. L. SMITH, JR. (Competitive Enterprise Institute, Washington, DC) IN: Space, our next frontier; Proceedings of the Conference, Dallas, TX, June 7, 8, 1984. Dallas, TX, National Center for Policy Analysis, 1985, p. 246-254.

An historical evaluation of the development of U.S. transportation is used as the basis for projections of useful governmental activities in the case of future space

commercialization policy. Restrictive regulation, predatory pricing, a possibility of the socialization of space insurance, a lack of enforceable property rights in space, and export/import imbalances, are among the problems anticipated. The inherent difficulties that will be encountered by attempts to improve the productivity of government agencies, and the political obstacles that will arise to attempts at privatization, are noted to be among the more difficult O.C. aspects of this issue.

A86-29652#

SATELLITE SYSTEM OPERATIONS - A VIEW FROM THE TRENCHES

J. W. MCBEATH (AT&T Communications, Hawley, PA) IN: Communication Satellite Systems Conference, 11th, San Diego, CA, March 17-20, 1986, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1986, p. 614-620. refs (AIAA PAPER 86-0705)

AT&T's approach to managing the operation of its satellite system is discussed. A brief overview of AT&T's satellite history and services is given, followed by a discussion of TT&C, orbital dynamics, earth station operation and maintenance, customer service, and computer software. Organization, staffing, and training are reviewed, and the major operational issues are discussed. Particular emphasis is placed on the role of human beings in the successful operation of the satellite system. CD

A86-40526

AUTOMATION REQUIREMENTS DERIVED FROM SPACE MANUFACTURING

H. R. HALLETT and D. A. KUGATH (General Electric Co., Philadelphia, PA) IN: Space tech; Proceedings of the Conference and Exposition, Anaheim, CA, September 23-25, 1985 . Dearborn. MI, Society of Manufacturing Engineers, 1985, p. 9-1 to 9-18.

Automation, robotics, and expert systems are necessary to support two conceptual space manufacturing facilities envisioned for the year 2010. The two concepts were chosen because they require a high degree of automation, and therefore involve extensive use of teleoperators, robotics, process mechanization, and artificial intelligence. The major challenges of space manufacturing are maintenance, repairs, and waste management. Without the automation capabilities to accomplish these functions, manufacturing in space of items in large production lots will be unattainable. Author

A86-40602*# Air Force Space Div., Los Angeles, Calif. NATIONAL SPACE TRANSPORTATION AND SUPPORT STUDY/MISSION REQUIREMENTS AND ARCHITECTURE STUDIES

C. L. DUROCHER (USAF, Space Div., Los Angeles, CA) and C. R. DARWIN (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Space Systems Technology Conference, San Diego, CA, June 9-12, 1986, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1986, p. 201-203.

(AIAA PAPER 86-1211)

The government approach to fulfilling the requirements of the National Space Transportation and Support Study is described. DOD and NASA were required to determine the architecture and technology that would be needed for civil and defense space transportation during the 1995-2010 time range. NASA collected data from the National Commission on Space and the DOD research focused on SDI requirements. The objectives and recommendations of the space transportation architecture, transportation and support systems, and technology assessment and planning tasks are discussed. I.F.

A86-41385

GENERALIZATION IN DECISION RESEARCH - THE ROLE OF FORMAL MODELS

R. M. HOGARTH (Chicago, University, IL) IEEE Transactions on Systems, Man, and Cybernetics (ISSN 0018-9472), vol. SMC-16, May-June 1986, p. 439-449. Navy-supported research. refs

A given generalization, which is a working hypothesis typically expressed in terms of cause-effect relations, 'decays' due to the

02 MANAGEMENT THEORY AND TECHNIQUES

difficulty of identifying appropriate cause-effect relations and the sensitivity of such relations to the influence of environmental conditions. Attention is given to two basic types of model for generalizable knowledge: the replica model and the symbolic model. In addition to suggesting what experimental evidence should be collected, symbolic models can help determine when data collection may be of little value. The nature of the evidence generated by replica models (experiments) is considered from three viewpoints: (1) asymmetries in the way data and theory interact in affecting conclusions; (2) apparent but illusory conflicts between the goals of internal and external validity; and (3) the importance of conducting experiments despite poor prospects for the creation of generalizable knowledge. OC.

A86-46425* National Aeronautics and Space Administration, Washington, D.C.

SPACE SHUTTLE DEVELOPMENT

J. C. FLETCHER (NASA, Washington, DC) and J. LOGSDON (George Washington University, Washington, DC) Science (ISSN 0036-8075), vol. 233, July 18, 1986, p. 263. The technical-planning and decision-making processes involved

in the initiation of the NASA Space Shuttle program in 1970-1972 are briefly discussed, responding to the critical evaluation of Logsdon (1986). The complex nature of the interactions among White House, OMB, DOD, and NASA; the difficulty of making long-term commitments under the U.S. system; the positive technological achievements of the program; and the need for unemotional evaluation of the policy options available after the loss of the Challenger are stressed. In a reply by Logsdon, it is argued that the structuring of the policy process itself and the presentation of the Shuttle to Congress as a relatively inexpensive routine launch system for virtually all government needs were directly related to its failure to gain continuing full funding from Administrations and Congress. It is suggested that a strong proposal of bold scientific and exploratory objectives for the space program could be more successful in gaining such long-term support. ТΚ

A86-49558*# National Aeronautics and Space Administration, Washington, D.C.

SPACE STATION OVERALL MANAGEMENT APPROACH FOR **OPERATIONS**

G. PAULES (NASA, Office of Space Station, Washington, DC) AIAA, Space Station in the Twenty-first Century, Meeting, Reno, NV, Sept. 3-5, 1986. 6 p.

(AIAA PAPER 86-2322)

An Operations Management Concept developed by NASA for its Space Station Program is discussed. The operational goals, themes, and design principles established during program development are summarized. The major operations functions are described, including: space systems operations, user support operations, prelaunch/postlanding operations, logistics support operations, market research, and cost/financial management. Strategic. tactical. and execution levels of operational decision-making are defined. C.D.

A86-50265*# National Aeronautics and Space Administration, Washington, D.C.

SPACE STATION IN THE 21ST CENTURY - A SOCIAL PERSPECTIVE

B. J. BLUTH (NASA, Space Station Program Office, Washington, DC) AIAA, Space Station in the Twenty-first Century, Meeting, Reno, NV, Sept. 3-5, 1986. 9 p. refs

(AIAA PAPER 86-2349)

A human factors and sociological consideration of Space Station crew facilities and interactions is presented which attempts to place the experiences of astronaut communities in the larger context of late 20th century industrial, economic, and cultural trends. Attention is given to the relationship of Space Station communities to 'Information Society' - related historical developments. O.C.

N86-10899# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.

DERIVATIONAL ANALOGY: A THEORY OF RECONSTRUCTIVE PROBLEM SOLVING AND EXPERTISE ACQUISITION

J. G. CARBONELL 5 Mar. 1985 26 p (Contract N00014-79-C-0661; N00014-82-C-5076)

(AD-A156817; CMU-CS-85-115) Avail: NTIS HC A03/MF A01 ČSCL 05J

Derivational analogy, a method of solving problems based on the transfer of past experience to new problem situations, is discussed in the context of other general approaches to problem solving. The experience transfer process consists of recreating lines of reasoning, including decision sequences and accompanying justifications, that proved effective in solving particular problems requiring similar initial analysis. The role of derivational analogy in case-based reasoning and in automated expertise acquisition is Author (GRA) discussed.

Research Inst. of National Defence, Stockholm N86-11072# (Sweden).

MANAGEMENT OF ORGANIZATIONAL OPERATIONS IN DYNAMIC ENVIRONMENTS. TOWARDS A FRAME OF REFERENCE.

R. HAGAFORS and R. ALLARD Feb. 1985 25 p refs (FOA-C5-85-0003-H2: ISSN-0347-7665) Avail: NTIS HC A02/MF A01

The premises, the structure and the process of managing organizations are discussed. The organization is regarded as an open system and a dynamic environment model is assumed. The implications of the assumptions are described, and a frame of reference for analyzing the management situation is put forward. The hierarchical structure of organizations, the dimension of time in the management process, and the role of the management task, are discussed. Author (ESA)

N86-11076# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Industrial Engineering.

FAILURES AND SUCCESSES OF QUANTITATIVE METHODS IN MANAGEMENT

C. B. TILANUS May 1984 18 p refs Presented at ORSA/TIMS Joint Natl. Meeting, San Diego, CA., 25-27 Oct. 1982, 15th Operational Res. Soc. of India Ann. Conv., Kharagpur, India, 9-11 Dec. 1982, and Netherlands Soc. of Statistics and Operations Res. Ann. Conf., Eindhoven, Netherlands, 31 Mar. 1983 Revised (ARW-03-THE-BDK/ORS/83-06) Avail: NTIS HC A02/MF A01

About 60 cases of failures and successes of quantitative methods in management, collected in industry, business and government are analyzed for features determining failure or success. Author (ESA)

Institute for Perception RVO-TNO, Soesterberg N86-11077# (Netherlands). Experimental Psychology Group.

RISK PROPENSITY, ACTION READINESS AND THE ROLES OF SOCIETAL AND INDIVIDUAL DECISION MAKERS

S. LICHTENSTEIN, W. A. WAGENFAR, G. B. KEREN, and T. W. Aug. 1984 VANDERSCHAAF 21 p refs Sponsored by Central Organization TNO

(IZF-1984-27; TDCK-79524) Avail: NTIS HC A02/MF A01 Decision making by public officials and citizens was compared by eliminating different socio-economic backgrounds and different available information; to investigate the effects of adopting one role or the other (societal vs individual). Dependent measures were the willingness to choose a risky option vs a sure outcome, and the readiness to take explicit action or not. A total of 478 student subjects read the same cover story which deals with the decision problem of how to limit the number of victims of an epidemic. The results (choices and reasons) show that societal decision makers are less likely than individuals to take explicit action. Taking action is more often preferred when associated with the risky option than with the sure outcome. The large majority of subjects justify their choice on the basis of the number of victims. Results are discussed in terms of framing. Author (ESA)

N86-15161*# Rockwell International Corp., Pittsburgh, Pa. THE KEY TO SUCCESSFUL MANAGEMENT OF STS OPERATIONS: AN INTEGRATED PRODUCTION PLANNING SYSTEM

W. A. JOHNSON and C. T. THOMASEN In NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 33-40 1985

Avail: NTIS HC A25/MF A01 CSCL 05A

Space Transportation System operations managers are being confronted with a unique set of challenges as a result of increasing flight rates, the demand for flight manifest/production schedule flexibility and an emphasis on continued cost reduction. These challenges have created the need for an integrated production planning system that provides managers with the capability to plan, schedule, status and account for an orderly flow of products and services across a large, multi-discipline organization. With increased visibility into the end-to-end production flow for individual and parallel missions in process, managers can assess the integrated impact of changes, identify and measure the interrelationships of resource, schedule, and technical performance requirements and prioritize productivity enhancements. Author

N86-15181*# Bendix Corp., Southfield, Mich. IMPROVED PRODUCTIVITY THROUGH INTERACTIVE COMMUNICATION

P. P. MARINO In NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 265-274 1985

Avail: NTIS HC A25/MF A01 CSCL 05A

New methods and approaches are being tried and evaluated with the goal of increasing productivity and quality. The underlying concept in all of these approaches, methods or processes is that people require interactive communication to maximize the organization's strengths and minimize impediments to productivity improvement. This paper examines Bendix Field Engineering Corporation's organizational structure and experiences with employee involvement programs. The paper focuses on methods Bendix developed and implemented to open lines of communication throughout the organization. The Bendix approach to productivity and quality enhancement shows that interactive communication is critical to the successful implementation of any productivity improvement program. The paper concludes with an examination of the Bendix methodologies which can be adopted by any corporation in any industry. Author

N86-19249# Science Applications International Corp., McLean, Va. Behavioral Sciences Research Center.

ANNOTATED BIBLIOGRAPHY OF LITERATURE ΔN INTEGRATING ORGANIZATIONAL AND SYSTEMS THEORY

E. G. DAVIS, G. D. FOSTER, E. KIRCHNER-DEAN, and R. W. SWEZEY Sep. 1985 341 p (Contract MDA903-79-C-0699; DA PROJ. 2Q1-62722-A-791)

(AD-A160912; SAI-82-03-178; ARI-RN-85-95) Avail: NTIS HC A15/MF A01 CSCL 05A

This annotated bibliography presents a summary of articles on organizational and systems theory up to and including 1980. The articles are divided into three categories: (1) systems theory, (2) organizational behavior, effectiveness and development and (3) simulation and training. The primary purpose of this report is to examine the literature in this area to identify the dimensions of organizational structure and processes that are related to various organizational outcomes. It is suggested that the identification of these dimensions can lead to increased effectiveness of simulation and training programs. Author (GRA)

02 MANAGEMENT THEORY AND TECHNIQUES

N86-22437# Science Applications International Corp., McLean, Va. Behavioral Sciences Research Center.

ASPECTS OF COGNITIVE COMPLEXITY THEORY AND RESEARCH AS APPLIED TO A MANAGERIAL DECISION MAKING SIMULATION

S. STREUFERT and R. W. SWEZEY Sep. 1985 133 p (Contract MDA903-79-C-0699; DA PROJ. 2Q1-62722-A-791) (AD-A161376; SAI-82-03-178; ARI-RN-85-96) Avail: NTIS HC A07/MF A01 CSCL 05A

This research note is a post-1977 review of the literature in the areas of theory, research, and measurement of cognitive complexity. It updates the previous major review effort of Streufert and Streufert (1978). Additional discussion is devoted to the approaches selected for measuring cognitive complexity with a mini-computer based Management Assessment and Training Simulation System. Author (GRA)

N86-25289# Coopers and Lybrand, Washington, D.C. EVALUATING R AND D AND NEW PRODUCT DEVELOPMENT VENTURES: AN OVERVIEW OF ASSESSMENT METHODS

Jan. 1986 56 p Prepared in cooperation with Commerce Dept., Washington, D.C.

(PB86-110806) Avail: NTIS HC \$12.00/MF A01 CSCL 05A Techniques to assess the business potential of technology projects are introduced. The intent is to familiarize decisionmakers with the range of available techniques. The principles involved are applicable to all those involved in the process of technological innovation: investors, financial intermediaries, individual entrepreneurs and other personnel who screen projects for possible commercial application. The assessment techniques include: checklist analyses, constraint analysis, environmental scoring model, profitability measures, sensitivity analysis, risk analysis, decision analysis and decision trees, and assessment of probabilities. GRA

N86-25299# Office of Management and Budget, Washington, D.C.

MANAGING FEDERAL INFORMATION RESOURCES: REPORT UNDER THE PAPERWORK REDUCTION ACT OF 1980 Sep. 1985 54 p refs

(PB86-247682; AR-4) Avail: NTIS HC A04/MF A01 CSCL 05B

Topics covered include: controlling paperwork (information collection reviews, the information collection budget, other paperwork reduction act activities, legislative activites and issues, delegation of clearance authority); information policy (information technology planning process, federal information policy circular, federal telecommunications systems, security of information technology systems, protecting personal privacy, coordination of U.S. Government information flows in support of international affairs, Office of Management and Budget's leadership role); and statistical policy (long range planning, evaluation, coordination standards, major statistical policy issues addressed in 1984 to 1985). GRA

N86-25687# RAND Corp., Santa Monica, Calif. TELECOMMUNICATIONS ALTERNATIVES FOR FEDERAL USERS: MARKET TRENDS AND DECISIONMAKING CRITERIA L. L. JOHNSON, M. A. SIRBU, and B. M. MITCHELL Dec. 1985 237 p refs Sponsored by NSF

(Contract NSF PRA-84-00689)

(PB86-153764; R-3355-NSF; ISBN-0-8330-0692-4;

NSF/PRA-85023) Avail: NTIS HC A11/MF A01 CSCL 17B

The telecommunications market has been marked by growing competition in local and long-distance transmission and in terminal equipment. In response to this, the goal of the study is to show what kinds of information government agencies should collect, and how they should use it, to improve decision making. The study considers four objectives: (1) to identify and assess options for meeting voice and data needs, taking into account technical, economic, and regulatory constraints; (2) to show how Federal agencies can evaluate their needs in light of the options for supplying them; (3) to establish criteria for evaluating the relative merits of options in light of these needs; and (4) to construct a decision making framework for choosing among options, taking into account uncertainties about costs, performance, and benefits. Author (GRA)

N86-25992# Engineering Research Associates, Inc., Vienna, Va.

SCHEMA-BASED THEORY OF INFORMATION PRESENTATION FOR DISTRIBUTED DECISION MAKING Interim Report

D. F. NOBLE and J. A. TRUELOVE Aug. 1985 120 p refs (Contract N00014-84-C-0484) (AD A162150: B 028 85) Avail: NTIS HC 406 (ME A01 CSC

(AD-A163150; R-028-85) Avail: NTIS HC A06/MF A01 CSCL 05J

The Schema-Based Theory of Information Presentation for Distributed Decision Making describes a schema structure appropriate for understanding connections between the way that information is presented and its impact on distributed decision making. The theory suggests a process for determining how information should be presented so that consensus and coordination will be improved and decision conflicts will be reduced. The theory proposes that experienced decision makers select alternatives by mental processes that match the features of the current situation to features of reference situations for which possible alternatives are known to be appropriate. These reference situations may specify particular threat activities and dispositions, own Battle Group objectives, prescribed contingency plan action, and decision behavior of other decision makers to the group. Information presented according to the principles derived from the theory will encourage each decision maker to more fully consider the impact of each action on the objectives of other decision makers. Applying the principles requires that the general schema used by decision makers be determined prior to the time when particular situation-specific information is presented. Given this prior determination, the principles sugg est what emphasis needs to be given to specific features and feature relationships in the presentation of the current situation. GRA

N86-27113# Colorado Univ., Boulder. Center for Research on Judgement and Policy.

A THEORETICALLY BASED REVIEW OF THEORY AND RESEARCH IN JUDGMENT AND DECISION MAKING

K. R. HAMMOND Feb. 1986 96 p refs

(Contract N00014-81-C-0591)

(AD-A164914; CRJP-260) Ávail: NTIS HC A05/MF A01 CSCL 05J

Barriers to unification lie in the false dichotomy and rivalry between intuition and analysis, the arbitrary choice of task conditions, and the absence of a theory of successful intuition, as well as in current research practices. A theoretical framework is presented that is intended to overcome these barriers. The theory is anchored in task conditions, specifies the variety of cognitive properties they induce, and indicates subsequent behavior. GRA

N86-27950# Dynamic Systems, Inc., Urbana, III. LEADER-FOLLOWER STRATEGIES UNDER MODELING AND INFORMATION UNCERTAINTIES Final Technical Report 26 Apr. 1986 260 p

(Contract DE-AC01-81RA-50658)

(DE86-000203; DOE/RA-50658/T1) Avail: NTIS HC A12/MF A01

Focus of the research is the characterization and formulation of control strategies for large-scale systems which have two or more decision making authorities. The actions of each decision maker contribute to the total behavior of the system. Furthermore, the information on which each decision maker is based is affected by the action of the other decision makers. Thus the role of multiple decision making in the theory and methodology pertaining to the analysis, planning, and control of large-scale systems is very significant. This research addressed the central influence of hierarchical organizational forms in developing control strategies in large-scale systems when the decision makers do not have identical capabilities, priorities, and information structures. This

02 MANAGEMENT THEORY AND TECHNIQUES

report is divided into five parts corresponding to the five tasks for the project: global feedback, adaptive control concepts, multiparameter singularly perturbed systems with multiple decision makers, multitime scales induced by the information pattern, and problems of control organizations where the organizational center is the leader and the agents are followers. DOE

N86-28007# National Oceanic and Atmospheric Administration, Washington, D. C.

OPTIMUM MANAGEMENT STRATEGIES FOR THE NOAA (NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION) POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITES, 1985-2000. VOLUME 1 Final Report W. H. ESKITE and W. P. BISHOP Apr. 1985 70 p

W. H. ESKITE and W. P. BISHOP Apr. 1985 70 p (AD-A165143) Avail: NTIS HC A04/MF A01 CSCL 05A

The experience of the past 15 years was used as a basis to establish the best management principles to apply to the POES for the next 15 years. This was done for both a two-satellite configuration and a one-satellite configuration. The principles include always having a spare available, a 4-month call-up capability, taking advantage of satellites that live longer than their design life, and taking advantage of early indications of imminent failure. These principles must be applied in different ways to the two configurations. Applying these principles to several scenarios for the future leads to the conclusion that we should plan for 12 satellites for the next 15 years for either the one-satellite or the two-satellite system. Author (GRA)

N86-29874# Lawrence Livermore National Lab., Calif. TOWARD A PERMANENT LUNAR SETTLEMENT IN THE COMING DECADE: THE COLUMBUS PROJECT

R. A. HYDE, M. Y. ISHIKAWA, and L. L. WOOD 19 Nov. 1985 28 p Presented at the US Space Foundation Symposium, Colorado Springs, Colo., 20 Nov.1985

(Contract W-7405-ENG-48)

(DE86-006709; UCRL-93621; CONF-8511155-1) Avail: NTIS HC A03/MF A01

The motivation for creating a permanent lunar settlement is sketched, and reasons for doing so in the coming decade are put forward. A basic plan to accomplish this is outlined, along technical and programmatic axes. It is concluded that founding a lunar settlement on the five hundredth anniversary of the Columbus landing - a Columbus Project - could be executed as a volunteer-intensive American enterprise requiring roughly six thousand man-years of skilled endeavor and a total Governmental contribution of the order of a half-billion dollars. DOE

N86-31412*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

EVALUATING SPACE STATION APPLICATIONS OF AUTOMATION AND ROBOTICS TECHNOLOGIES FROM A HUMAN PRODUCTIVITY POINT OF VIEW

J. F. BARD *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 46 p Jul. 1986

Avail: NTIS HC A99/MF E03 CSCL 05H

The role that automation, robotics, and artificial intelligence will play in Space Station operations is now beginning to take shape. Although there is only limited data on the precise nature of the payoffs that these technologies are likely to afford there is a general consensus that, at a minimum, the following benefits will be realized: increased responsiveness to innovation, lower operating costs, and reduction of exposure to hazards. Nevertheless, the question arises as to how much automation can be justified with the technical and economic constraints of the program? The purpose of this paper is to present a methodology which can be used to evaluate and rank different approaches to automating the functions and tasks planned for the Space Station. Special attention is given to the impact of advanced automation on human productivity. The methodology employed is based on the Analytic Hierarchy Process. This permits the introduction of individual judgements to resolve the confict that normally arises when incomparable criteria underly the selection process. Because

of the large number of factors involved in the model, the overall problem is decomposed into four subproblems individually focusing on human productivity, economics, design, and operations, respectively. The results from each are then combined to yield the final rankings. To demonstrate the methodology, an example is developed based on the selection of an on-orbit assembly system. Five alternatives for performing this task are identified, ranging from an astronaut working in space, to a dexterous manipulator with sensory feedback. Computational results are presented along with their implications. A final parametric analysis shows that the outcome is locally insensitive to all but complete reversals in preference.

N86-32111*# State Univ. of New York, Binghamton. Dept. of Biological Sciences.

EVALUATION OF THE NEED FOR A LARGE PRIMATE RESEARCH FACILITY IN SPACE

F. M. SULZMAN 1986 50 p

(Contract NAG2-232)

(NASA-CR-179661; NAS 1.26:179661) Avail: NTIS HC A03/MF A01 CSCL 06B

In the summer of 1983, an advisory committe was organized that would be able to evaluate NASA's current and future capabilities for nonhuman primate research in space. Individuals were chosen who had experience in four key research areas: cardiovascular physiology, vestibular neurophysiology, musculo-skeletal physiology, and fluid and electrolyte balance. Recommendations of the committee to NASA are discussed.

B.G.

N86-32750# Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.

A COMPARISON OF A MANUAL AND COMPUTER-INTEGRATED PRODUCTION PROCESS IN TERMS OF PROCESS CONTROL DECISION-MAKING Interim Report

S. M. MILLER and S. R. BEREITER Mar. 1986 50 p (AD-A168037; CMU-RI-TR-86-6) Avail: NTIS HC A03/MF A01 CSCL 13H

This report is an investigation into the changes in process control that took place in the body shop of a vehicle assembly plant that was modernized from a principally manual process to one that extensively uses programmable automation. In this study, process control is defined as the information flow and decision-making required to perform basic process operations. We investigate affects of the implementation of a computer-integrated production system on the amount of process control decision-making, the types of process control decisions being made, and the distribution process control decision-making between humans and machines. We found that as a result of the modernization, the amount of process control decision-making nearly tripled, the emphasis on decisions to meet product quality specifications increased, and the emphasis on decisions related to flexibility in handling a variety of product options decreased. Decisions relating to meeting product quality specifications and to timing and synchronization of tasks were mostly taken on by the automated equipment, while decisions relating to the flexibility of the process remained to a large extent under manual control. Whereas humans made nearly 75 percent of the decisions required to assemble and weld a vehicle body in the principally manual system, humans made fewer than ten percent of the comparable decisions in the automated system. GRA

N86-32864*# California Univ., Santa Barbara.

SUPPORT FOR GLOBAL SCIENCE: REMOTE SENSING'S CHALLENGE

J. E. ESTES and J. L. STAR *In its* Remote Sensing Information Sciences Research Group, Santa Barbara Information Sciences Research Group, year 3 13 p 5 Jan. 1986 Avail: NTIS HC A05/MF A01 CSCL 05B

Remote sensing uses a wide variety of techniques and methods. Resulting data are analyzed by man and machine, using both analog and digital technology. The newest and most important initiatives in the U. S. civilian space program currently revolve around the space station complex, which includes the core station as well as co-orbiting and polar satellite platforms. This proposed suite of platforms and support systems offers a unique potential for facilitating long term, multidisciplinary scientific investigations on a truly global scale. Unlike previous generations of satellites, designed for relatively limited constituencies, the space station offers the potential to provide an integrated source of information which recognizes the scientific interest in investigating the dynamic coupling between the oceans, land surface, and atmosphere. Earth scientist already face problems that are truly global in extent. Problems such as the global carbon balance, regional deforestation, and desertification require new approaches, which combine multidisciplinary, multinational research teams, employing advanced technologies to produce a type, quantity, and quality of data not previously available. The challenge before the international scientific community is to continue to develop both the infrastructure and expertise to, on the one hand, develop the science and technology of remote sensing, while on the other hand, develop an integrated understanding of global life support systems, and work toward a quantiative science of the biosphere. Author

N86-33198# Department of Energy, Washington, D. C. Office of Project and Facilities Management.

COST AND SCHEDULE CONTROL SYSTEMS CRITERIA FOR CONTRACT PERFORMANCE MEASUREMENT. DATA ANALYSIS GUIDE Mar. 1986 128 p

(DE86-010796; DOE/MA-0221) Avail: NTIS HC A07/MF A01

The Data Analysis Guide has been prepared to aid both DOE and industry personnel in the effective use of contract performance measurement data. It suggests techniques for analyzing contractor cost and schedule data to give insight into current contract performance status and help validate contractor estimates of future contract performance. The techniques contained herein should be modified and tailored to fit particular project and special needs. DOE

N86-33201# Texas A&M Univ., College Station. Dept. of Management.

ORGANIZATIONS AS INFORMATION PROCESSING SYSTEMS: ENVIRONMENTAL CHARACTERISTICS. COMPANY PERFORMANCE AND CHIEF EXECUTIVE SCANNING, AN **EMPIRICAL STUDY**

R. DAFT, J. SORMUNEN, and D. PARKS Apr. 1986 59 p (Contract N00014-83-C-0025)

(AD-A168035; TR-DG-20-ONR) Avail: NTIS HC A04/MF A01 CSCL 05B

Chief executives in fifty manufacturing companies were interviewed about the perceived strategic uncertainty in six environmental sectors, and the frequency and mode of scanning used for each sector. The findings suggest customer, economic, and competitor sectors generated greater strategic uncertainty than technological, regulatory, and socio-cultural sectors. When sector uncertainty was high, executives reported greater frequency of scanning and greater use of personnal information sources. Chief executives in high performing companies scanned more frequently and more broadly in response to strategic uncertainty than their counterparts in low performing companies. GRA

03

INDUSTRIAL MANAGEMENT AND MANUFACTURING

Includes Industrial Management, Engineering Management, Design Engineering, Production Management, Construction, Aerospace/Aircraft Industries, Manufacturing,

A86-10926#

AIRPLANE DERIVATIVE DEVELOPMENT LARGE METHODOLOGY

D. L. ROBINSON and M. F. MELARY (Boeing Co., Seattle, WA) AIAA, AHS, and ASEE, Aircraft Design Systems and Operations Meeting, Colorado Springs, CO, Oct. 14-16, 1985. 14 p. (AIAA PAPER 85-3043)

The methodology and technologies applied to design derivatives of large commercial aircraft are described. Redesigns are achieved after a five-stage process consisting of requirements definition. preliminary design, detail design and analysis, testing and qualification and product development/design refinement. All factors involved in initiating and accomplishing a new design are performed with an eye to safety as a fundamental design criteria. Decisions can then proceed on the basis of the needs of the market up to 4 yr in advance. The designs must also minimize the airlines' acquisition and operating costs while incorporating state of the art technologies and configuration flexibility. CAD has emerged as a central tool to the development and assessment process. The 747-300 design process is outlined as a case study to illustrate the procedures described. M.S.K.

A86-10930*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SOME COMPARISONS OF US AND USSR AIRCRAFT DESIGN DEVELOPMENTS

M. L. SPEARMAN (NASA, Langley Research Center, Hampton, VA) AIAA, AHS, and ASEE, Aircraft Design Systems and Operations Meeting, Colorado Springs, CO, Oct. 14-16, 1985. 15 p. refs

(AIAA PAPER 85-3060)

A review is given of the design and development of some U.S. and U.S.S.R. aircraft. The emphasis is on the historical development of large aircraft - civil and military transports and bombers. Design trends are somewhat similar for the two countries and indications are that some fundamental characteristics are dictated more by ideological differences rather than technological differences. A brief description is given in a more or less chronological order of the major bomber aircraft, major civil and military transport aircraft, and the development of the air transport systems. Author

A86-10932#

A RAPID EVALUATION APPROACH FOR CONFIGURATION DEVELOPMENT OF NEW AIRCRAFT

Y. T. PHOA, F. CAMPISANO, P.-C. CHEN, and G. WAKAYAMA (Northrop Corp., Aircraft Div., Hawthorne, CA) AIAA, AHS, and ASEE, Aircraft Design Systems and Operations Meeting, Colorado Springs, CO, Oct. 14-16, 1985. 9 p. refs

(AIAA PAPER 85-3068)

Procedures followed in a computerized rapid evaluation (REV) approach to in-depth evaluations of new aircraft configurations at the early conceptual design stage are outlined. REV permits the incorporation of state of the art technology, design trade-off studies and structural design practices which lead to an optimal planform before metal cutting begins. Details of aerodynamic and structural optimization of a wing are reviewed, including the optimization codes employed in the REV CAD studies. Future extensions of the REV process to aeroelastic tailoring of entire aircraft are discussed from the point of view of the required algorithms, particularly in applications with forward swept wing aircraft.

M.S.K.

A86-10936#

REQUIREMENTS, DEVELOPMENT AND PARAMETRIC ANALYSIS FOR SPACE SYSTEMS DIVISION

B. G. MORAIS (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) AIAA, AHS, and ASEE, Aircraft Design Systems and Operations Meeting, Colorado Springs, CO, Oct. 14-16, 1985. 7 p. (AIAA PAPER 85-3078)

This paper presents a tutorial on requirements development and parametric analysis. It provides an overview of the System Engineering process and presents the approach and an example of parametric analysis as it relates to deriving requirements for large space systems. Author

A86-10960#

RAPID SIZING METHODS FOR AIRPLANES

J. ROSKAM (Kansas, University, Lawrence) AIAA, AHS, and ASEE, Aircraft Design Systems and Operations Meeting, Colorado Springs, CO, Oct. 14-16, 1985. 8 p.

(AIAA PAPER 85-4031)

A rapid method for preliminary weight sizing of aircraft which uses a series of logarithmic correlations between takeoff weight and empty weight is presented. The method allows rapid calculation of aircraft growth factors due to changes in mission specifications or changes in drag polar, engine specifics, payload, and empty weight. For a given mission specification, a rapid method for estimating takeoff gross weight, empty weight, and mission fuel weight is presented. The method applies to the following 12 types of aircraft: (1) homebuilts; (2) single engine props; (3) twin engine props; (4) agriculturals; (5) business jets; (6) regional turboprops; (7) transport jets; (8) military trainers; (9) fighters; (10) military patrol, bomb, and transport aircraft; (11) flying boats, amphibious, and float aircraft; (12) supersonic cruise aircraft. C.D.

A86-11961

OPTIMUM WING - FOR ALL FLIGHT CONDITIONS?

J. H. BRAHNEY Aerospace Engineering (ISSN 0736-2536), vol. 5, Oct. 1985, p. 36-40.

The present paper is concerned with a mission adaptive wing which will automatically adjust its camber to achieve optimum performance throughout the flight envelope. It is pointed out that such a wing is nearing reality. The mission adaptive wing (MAW) installed on the AFTI/F-111 (Advanced Fighter Technology Integration) test bed will soon be proving the concept. Eventually, the mission adaptive wing will operate in four automatic modes, each of which can be selected individually or combined. These modes include the 'cruise camber control', the 'maneuver camber control', and the 'maneuver enhancement and gust control mode'. G.R.

A86-14243#

A SELF-REPAIRING AIRCRAFT?

E. J. LERNER Aerospace America (ISSN 0740-722X), vol. 23, Nov. 1985, p. 22, 24.

Attention is given to a computer program which will allow future control-configured fighter aircraft to automatically compensate for the loss of a control surface due to combat damage, in order to maintain stability. Such a system, if successfully implemented, would also be able to compensate for electronic and hydraulic system failures, effectively obviating the presently critical requirement for four-fold redundancy in such systems. This would reduce cost and complexity, while increasing MTBF. The reliable detection of system failures is identified as a major problem in implementation. O.C.

A86-19489

FUTURE OF REMOTE SENSING - A VIEWPOINT FROM INDUSTRY

A. B. PARK (Natural Resources Consulting Services, Arnold, MD) IN: Remote sensing; Proceedings of the Meeting, Arlington, VA, May 1, 2, 1984 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 148-151.

It appears that the present paper is presented at a critical time in the life of land remote sensing. The technology involved

is just over 20 years old, and remote sensing has undergone a remarkable growth during this time. An intensive effort is currently being made to create a Commercial Land Remote Sensing (CRLS) system including both space and ground segments. The present time represents a major milestone in remote sensing. This milestone serves to divide the program into two segments, including a research program largely but not completely sponsored by the Federal Government, and commercial program driven almost entirely by the profit motive. Over the past five years, industry has intensely studied the viability of a commercial program. It was concluded that money could be made by industry in operating the ground segment. Such a result leaves in the hands of the government the space segment and the space/ground communications responsibility.

A86-19525* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SYSTEMS ENGINEERING - SPACE TELESCOPE PROJECT

F. S. WOJTALIK (NASA, Marshall Space Flight Center, Huntsville, AL) IN: The National Symposium and Workshop on Optical Platforms, Huntsville, AL, June 12-14, 1984, Proceedings . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 10-18.

At midpoint in the development of the Space Telescope (ST), a review process was conducted which determined that much benefit could be derived from an expanded systems engineering effort. The Systems Engineering Office thus established is responsible for the running of a management information system whose functions encompass design change control and the implementation of a maintenance and refurbishment program. By these means, interface hardware/software incompatibilities between critical ST modules and subsystems have been revealed and corrected. O.C.

A86-20039#

ASSESSING COST-EFFECTIVE WEIGHT SAVING IN AIRCRAFT OPERATIONS

D. G. PECK (Transport Canada, Ottawa) (CASI, Annual General Meeting, 31st, Ottawa, Canada, May 28, 1984) Canadian Aeronautics and Space Journal (ISSN 0008-2821), vol. 31, March 1985, p. 45-51.

Three methods of establishing cost/weight savings for aircraft are analyzed. The first method described involves measuring the value of the weight by useful load; dividing the points of useful load into the aircraft cost will establish the cost/pound value of the aircraft. A table of values of useful load for various aircraft types is provided. The second technique which calculates the value of weight by the amount of fuel saved is examined; it is observed that jets provide more savings than propeller aircraft and more flight time increases savings. The usefulness of the third method where a value is assigned to weight saving revenue purposes is revealed through an example.

A86-20591

HAVE FACTORY, WILL LAUNCH

M. REGISTER Space World (ISSN 0038-6332), vol. W-1, Jan. 1986, p. 11-13.

The design of the Industrial Space Facility (ISF) is described. The ISF, which will be powered by solar arrays, consists of a 35 ft long facility module for manufacturing and a 6 or 12 ft supply module. The ISF is to be fully operational when it is deployed in a 230-nautical-mile orbit inclined to 28.5 degrees. The equipping of the factory to meet the requirements of its users is discussed. The stabilization and stationkeeping systems for the ISF are analyzed. The agreement with NASA that does not require any payments prior to launching of the factory is examined.

A86-21896# 'SMART' ENGINE

'SMART' ENGINE COMPONENTS - A MICRO IN EVERY BLADE?

A. H. EPSTEIN (MIT, Cambridge, MA) Aerospace America (ISSN 0740-722X), vol. 24, Jan. 1986, p. 60-62, 64.

'Smart' gas turbine engine technology applies feedback control to the adaptive variation of component settings in changing local conditions; as in any closed loop control system, the smart engine employs sensors, processors, and actuators. Near-term applications of these principles encompass active control of blade tip clearances and active exhaust nozzle position improvement. Longer-term applications extend to active compressor inlet distortion control, active stall alleviation of compressor flow, and active noise control. Hot section smart features may be very long term design concerns, focusing on turbine blade stress or temperature distribution. O.C.

A86-22141#

AIRFRAME DESIGN TO ACHIEVE MINIMUM COST

B.R. NOTON (Battelle Memorial Institute, Columbus, OH) IN: Evolution of Aircraft/Aerospace Structures and Materials Symposium, Dayton, OH, April 24, 25, 1985, Proceedings . Dayton, OH, American Institute of Aeronautics and Astronautics, 1985, p. 18-1 to 18-11. refs

Cost drivers related to aircraft performance, design, material selection and manufacturing are discussed, and also those related to industry in general. The design objectives and manufacturing technology requirements for low-speed and high-speed aircraft are illustrated to indicate possible cost drivers. The importance of the early developmental phases to reduce cost of engineering systems, is emphasized. To minimize cost drivers, the Air Force has developed a 'Manufacturing Cost/Design Guide' which puts designers on the lowest cost track early in the design phase and also enables trade-off studies to be conducted while developing alternative structural configurations. The methodology used to address cost drivers and to quantify these ae reviewed. Due to problems of cyclic production and stretched-out delivery schedules. some guidance is provided to designers with respect to the importance of learning curves. A worksheet is provided for designers to summarize the cost of parts, subassemblies and the program aircraft. Author

A86-24106

STRUCTURES IN SPACE - CONTRACTORS ADAPT EARTH-BASED CONSTRUCTION METHODS TO MICROGRAVITY

S. W. KANDEBO Commercial Space (ISSN 8756-4831), vol. 1, Summer 1985, p. 52, 53.

The development of construction techniques for the Space Station is briefly considered. Emphasis is given to the application of earth-based construction techniques and structural frameworks to the microgravity environment. A design concept for the modular Power Tower of the Space Station, which uses a repeating geometry network of interlocking struts and hubs, is described in detail. Color photographs of a typical hub-strut construction system are provided. I.H.

A86-24667

ROBOTIC APPLICATIONS TO AUTOMATED COMPOSITE AIRCRAFT COMPONENT MANUFACTURING

B. SARH (Rohr Industries, Inc., Riverside, CA) Society of Manufacturing Engineers, Conference on Fabricating Composites, Hartford, CT, June 11-13, 1985. 18 p.

(SME PAPER MF85-506)

This paper considers robotic applications in aircraft prepreg composite structure fabrication. The process steps involved in automated prepreg production are described with a focus on process efficiency. For a typical composite structural shell, the number of different preprep pieces used is compared to the number of parts involved in a conventional metal structure, and the potential for automated production is shown. Specific process times and efficiencies for the process steps in fabricating a composite aircraft shell are calculated. Author

A86-24828

ELECTRIC POWER MANAGEMENT AND DISTRIBUTION FOR AIR AND SPACE APPLICATIONS

B. MEHL and E. HENDERSON (Sundstrand Corp., Rockford, IL) IN: Intersociety Energy Conversion Engineering Conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volume 1. Warrendale, PA, Society of Automotive Engineers, Inc., 1985, p. 1.374-1.381. refs

The historical growth of electric power systems for aircraft and space applications is briefly reviewed, and the technical issues involved in electric power management and distribution are discussed. The discussion covers bus architectures, power management components, power system controls, autonomous power management, transient reduction, and autonomous system reconfiguration. Particular attention is given to advanced electric power systems concepts and alternative implementations. V.L.

A86-24988

ONE MAN AND 3,000 MILLION OPERATIONS A SECOND - PREPARING FOR THE LHX COCKPIT

M. LAMBERT Interavia (ISSN 0020-5168), vol. 41, Jan. 1986, p. 27-30.

With the use of the Advanced Rotorcraft Technology Integrator (ARTI), an equipment system is being developed for the mid-1990's for the LHX helicopter to enable single pilot operation of all eight of its scout and attack missions. The system must be capable of executing 3,231 million operations/sec covering navigation, communication, electronic defensive measures, displays, interfaces, target recognition and weapon delivery. If it becomes available, Very High-Speed Integrated Circuitry will make possible a system design of relatively low weight (54 kg), volume, and cost. The system necessitates helicopter design changes to simplify handling, such removal of cross coupling between the axes of control, and creating an optimum combination of side-stick and rudder pedal control. A computer-based Cockpit Emergency Directed Action Program could be used to detect and take action on system faults. Information will have to be circulated over multiple electronic and optical data buses. R.R.

A86-26114

THE WORLD AIRCRAFT INDUSTRY

D. TODD (Manitoba, University, Winnipeg, Canada) and J. SIMPSON London/Dover, MA, Croom Helm/Auburn House Publishing Co., 1986, 282 p. refs

A comprehensive survey of the current state of the world aircraft industry is presented. The development of the industry and its current problems are considered. The role of governments is examined, showing how this differs from country to country. The prospects for the future shape of the industry, as newly industrialized countries become involved, are assessed. C.D.

A86-26299

TOMORROW CONCORDE'S SUCCESSOR?

G. CORMERY (Aerospatiale, Division Avions, Paris, France) and G. PATRI Revue Aerospatiale (ISSN 0065-3780), Feb. 1986, p. 10-15. In English and French.

The current state-of-the-art in supersonic transport is discussed along with studies for the development of the Future (second-generation) Supersonic Transport (FSST). Technological advances flight-proven in Concorde's 10 years of commercial experience include full-authority fly-by-wire controls on all three axes and on the engine, digital computers, and an automatic flight management system. Studies for the development of an FSST center on wind-tunnel model testing using the following parameters: Mach 2-2.2, 50 percent aerodynamic, propulsion and weight improvement over the Concorde, an 8000 km/200 passenger profile with 1000 km subsonic flight, the use of existing airport installations, and ICAO A.16.1971 subsonic aircraft noise limitations. The adoption of a variable-cycle engine providing a bypass flow at subsonic regimes and a single flow for supersonic flight will provide the best compromise between general performance and noise limitations. Other projected technologies include the extensive use

of the control-configured vehicle concept, permitting flight with zero static margins. R.R.

A86-28346

DIGITAL AVIONICS FOR MODERN AIRCRAFT - A CASE STUDY INTO THE PROBLEMS AND PROMISE OF AIRCRAFT **ELECTRONICS**

H. S. ARCHER, III (Lockheed-Georgia Co., Marietta) IN: NAECON 1985; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1985. Volume 1 . New York, Institute of Electrical and Electronics Engineers, 1985, p. 144-151.

With decreasing static stability margins and increasingly rigorous mission requirements, the role of aircraft electronics has become vital. A brief historical perspective of the evolution of avionics is given, and the harsh environmental constraints under which current avionics must operate are noted. The case for spatially redundant integrated racks composed of standardized modules is made. A state-of-the-art design approach is then presented, followed by a discussion of an advanced system that will be typical of aircraft in the 1990's. The topics discussed include: designing for thermal management, distributed processing, built-in-test requirements, and redundant systems for flight-critical applications. Author

A86-28455#

2010 - THE SYMBIONIC COCKPIT

J. M. REISING and R. W. MOSS (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN: NAECON 1985; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1985. Volume 2 . New York, Institute of Electrical and Electronics Engineers, 1985, p. 1050-1054. refs

The cockpit of the year 2010 is described in terms of both the capabilities and systems it contains and how the pilot interacts with it. A brief mission narrative is provided describing several hours in the life of the Manta air superiority fighter. This is followed by a discussion of the pilot interface components employed in the cockpit including hueristic voice, instrument panel display, canopy display, and holographic display systems. The concept of a 'symbionic' system is then introduced, describing in some detail the capabilities and features of a cockpit system that senses the physiological and mental state of the pilot and responds accordingly. Finally, conclusions and predictions are made that summarize and emphasize the points made in the paper. Author

A86-28596

ARIANE 5 - A NEW LAUNCHER FOR EUROPE

H. LAPORTE-WEYWADA and E. RAILLON (CNES, Etablissement d'Evry, France) IN: Europe/United States space activities . San Diego, CA, Univelt, Inc., 1985, p. 389-404.

(AAS 84-226)

The design characteristics of the Ariane 5 launcher system are described. The launcher consists of three separate stages, with the two stages of the lower section operating in parallel, and an upper section comprising the third stage, Vehicle Equipment Bay (VEB) payload, and nose fairing. The lower section is driven by an HM60 motor and two solid propellant boosters similar to those of the Shuttle. The two boosters are arranged on either side of the second stage and provide a thrust of 900 tons on liftoff. The upper stage incorporates a spherical tank design containing the same LOX fuel used in the lower section. The storable propellant third stage of the Ariane 5 is driven by an MMH/N2O4 motor delivering between 10 and 15 kN thrust. The MMH/N2O4 propellant is contained in two small spherical tanks. Commencement of actual production of the Ariane 5 launcher and the MH60 motor is scheduled for mid-1986 in order to achieve ground qualifications by the middle of 1993 with test flights starting in 1994. Detailed line drawings of the fuel tanks, motors, and fairings of the separate launcher stages are provided. LH.

A86-29586*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. SPACECRAFT 2000

K. A. FAYMON (NASA, Lewis Research Center, Cleveland, OH) IN: Communication Satellite Systems Conference, 11th, San Diego, CA, March 17-20, 1986, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1986, p. 88-91, refs (AIAA PAPER 86-0616)

The Spacecraft 2000 program has been conceived by NASA with the objective to maintain the U.S. in a strong technical position in the space arena. The program is to involve a cooperative NASA/industry effort with long-range technology development aims. The technology areas addressed are related to spacecraft power, spacecraft energy storage, power management and distribution, autonomous operation-control, onboard systems integration, secondary propulsion, communications technologies, and systems/subsystems technology verification. Aspects of Spacecraft 2000 interactions with industry are discussed, taking into account visitations of NASA personnel to selected industrial concerns, most critical concerns (general), major technical concern, technology drivers for future spacecraft power systems, technology considerations for secondary propulsion, and questions of commercialization. Plans related to a Spacecraft 2000 program formulation are also considered. G.R.

A86-29668#

ARIANE AND ARIANESPACE STATUS AND CAPABILITY

D. A. HEYDON (Arianespace, Inc., Washington, DC) AIAA. Communication Satellite Systems Conference and Exhibits, 11th, San Diego, CA, Mar. 16-20, 1986. 24 p. (AIAA PAPER 86-0671)

A European company has provided launch vehicles for over six years, taking into account the launching of satellites for communications and other applications. This paper presents a review of the status of the Ariane program, giving attention to its ability to respond to the increasing demands of today's dynamic conditions. In response to a third stage ignition problem, liquid hydrogen and liquid oxygen inlet valves were modified to improve seal performance. An increase in the launch rate is expected from six launches in 1986 to eight in 1987 and 1988. Payload mass/weight performance is discussed along with payload volume, injection accuracy, and the operating environment. G.R.

A86-29674#

A COMMERCIAL COMMUNICATIONS SATELLITE SYSTEM FOR JAPAN

M. A. BERTA (Hughes Communications, Inc., El Segundo, CA) and M. MARUMO (Japan Communications Satellite Co., Inc., Tokvo) AIAA, Communication Satellite Systems Conference and Exhibits, 11th, San Diego, CA, Mar. 16-20, 1986. 8 p. (AIAA PAPER 86-0680)

JC SAT will provide commercial Ku-band communications service to the Japanese islands commencing in early 1988. The satellite is a Hughes HS-393 with 32 transponders and a 27 MHz bandwidth. The communications payload has 40 for 32 redundancy with nominal 20 watt traveling wave tubes. Eighteen of the transponders contain linearizer-TWT combinations. This system will provide highly reliable service for the complete range of applications from TV broadcast to digital data dissemination using relatively small receiving antennas. Author

A86-29680#

SATELLITE COMMUNICATIONS BASICS - A COLLOQUIUM LECTURE

J. KAISER (Kaiser, Inc., Bethesda, MD) AIAA, Communication Satellite Systems Conference and Exhibits, 11th, San Diego, CA, Mar. 16-20, 1986, Paper. 24 p.

The basic concepts of satellite communications are reviewed. Digital and satellite methods of communications are examined; a schematic of a satellite communication link is provided. The calculations of uplink and downlink budgets which estimate the power necessary to transmit digital signals are discussed; the required formulas and parameters are listed. The components of

earth stations including antennas, transmitters, receivers, and converters are described. Consideration is given to wideband receivers, switching, amplifiers, antenna systems, spacecraft bus subsystems, launch vehicle interface, and satellite orbits. Diagrams of various communication satellites and system components are presented.

A86-30187

SATELLITE COMMUNICATIONS PLANNING AND EQUIPMENT MANUFACTURING IN LATIN AMERICA

A. SERRANO and J. C. POMALAZA (CICESE, Ensenada, Mexico) International Journal of Satellite Communications (ISSN 0737-2884), vol. 3, Oct.-Dec. 1985, p. 295-299. refs

This paper emphasizes the importance of and presents ideas for the participation of Latin American countries in the planning and manufacturing of their satellite communication systems. A strategy to stimulate manufacturing of local satellite communications equipment is presented considering the planning and manufacturing experience obtained in Mexico. Author

A86-31038

WHAT TECHNOLOGIES AWAIT THE FUTURE AIRLINER?

P. CONDOM and M. LAMBERT Interavia (ISSN 0020-5168), vol. 41, Feb. 1986, p. 145-149.

The present assessment of technology readiness in the fields of airliner aerodynamics, structures, avionics, control systems, and propulsion, attempts to forecast the likely character of the next generation in commercial aircraft design. Although both political and commercial pressures exist for renewed efforts toward a second-generation SST, current technology development efforts are centered on continued refinement of laminar aerodynamics, propfan and unducted fan propulsion, thermoplastic matrix composites and aluminum-lithium alloys for structures and digital avionics and control. Attention is given to the boundary layer wing-skin suction flow laminarization technique and the competition between engine manufacturer's innovative propfan technologies. O.C.

A86-31253

AEROSPACE AND ELECTRONIC SYSTEMS - ADVANCED CONCEPTS AND PIONEERING PERSPECTIVES; PROCEEDINGS OF THE SIXTH SYMPOSIUM, DAYTON, OH, NOVEMBER 14, 15, 1984

Symposium sponsored by IEEE. New York, Institute of Electrical and Electronics Engineers, 1984, 116 p. No individual items are abstracted in this volume.

Among the topics discussed are: the PRAM approach to technology transfer; all-electric aircraft development; and electronic enhancements for the combat aircraft cockpit. Consideration is also given to application of AI systems to military aircraft; ECM and ECCM technology; and the history of monolithic ICs. Developments in the USAF Avionics Integrity Program (AVIP) are reviewed, with emphasis given to: preventive measures for electrostatic discharges; corrosion prevention to increase avionics integrity; and criteria for stress screening temperature levels. I.H.

A86-31330#

X-AIRCRAFT FOR WORLD LEADERSHIP IN AERONAUTICS

R. S. COOPER Aerospace America (ISSN 0740-722X), vol. 24, Feb. 1986, p. 26-28.

Continuing vigorous and sufficiently funded aeronautical research involving experimental aircraft is a necessity if the U.S. is to retain world leadership in aerospace defense and industrial technologies. The most recent program, the X-29, illustrates the process of demonstrating a proof of concept as a key effort in introducing new ideas into operational aircraft. The alternative to flight testing experimental demonstrator aircraft can be several years of studies in wind tunnels and in computer time, substantially increasing program costs and usually producing only an incremental increase in performance instead of an integer multiplicative advance. The next likely demonstrator program will be the DARPA-NASA X-wing circulation control (CC) rotor aircraft. CC

distributed propulsion and controlling drag, concepts which may eventually be applied in long-endurance high altitude atmospheric aircraft that may replace geosynchronous satellites. A subsequent program to develop a hydrogen-fueled aerospaceplane powered by a supersonic-combustion ramjet propulsion system may encounter funding obstacles when the time comes to construct a demonstrator experimental aircraft near the end of the 1980s.

M.S.K.

A86-31777

AEROSPACE GUIDANCE AND CONTROL IN THE UNIVERSITY - ANTICIPATED TRENDS

R. D. CULP (Colorado, University, Boulder) IN: Guidance and control 1985; Proceedings of the Eighth Annual Rocky Mountain Conference, Keystone, CO, February 2-6, 1985 San Diego, CA, Univelt, Inc., 1985, p. 3-7.

(AAS PAPER 85-001A)

Advances in microelectronics and computational capabilities that have changed guidance, navigation, and control are examined. These hardware improvements have occurred primarily in industry; therefore, the universities are not able to produce the type or quantity of aerospace control engineers required by industry. The development of programs which will foster industry/university interaction is proposed.

A86-34124

IN-PROCESS INSPECTION OF THE PARAMETERS OF THE ELECTRON BEAM IN ELECTRON BEAM WELDING

V. V. BASHENKO, E. A. MITKEVICH, and N. N. DETSIK (Leningradskii Politekhnicheskii Institut, Leningrad, USSR) (Svarochnoe Proizvodstvo, no. 5, 1985, p. 18, 19) Welding Production (ISSN 0043-230X), vol. 32, May 1985, p. 13, 14. Translation. refs

A simple and reliable in-process method for the electron beam welding process is described, which makes it possible to control the beam current and specific power in the heating spot. The method is based on the use of a signal, formed at the instant of plasma formation above the surface heated by the beam. The applicability of the method is limited by the possibilities of measuring the duration of the short pulses and the curvature of the front of the leading edge of the welding current. A diagram of the controlling device is included.

A86-34989* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

COST CONTAINMENT AND KSC SHUTTLE FACILITIES OR COST CONTAINMENT AND AEROSPACE CONSTRUCTION

J. A. BROWN (NASA, Kennedy Space Center, Cocoa Beach, FL) IN: Space and society - Progress and promise; Proceedings of the Twenty-second Space Congress, Cocoa Beach, FL, April 23-26, 1985 . Cape Canaveral, FL, Canaveral Council of Technical Societies, 1985, p. 12-15 to 12-25. refs

This presentation has the objective to show examples of Cost Containment of Aerospace Construction at Kennedy Space Center (KSC), taking into account four major levels of Project Development of the Space Shuttle Facilities. The levels are related to conceptual criteria and site selection, the design of construction and ground support equipment, the construction of facilities and ground support equipment (GSE), and operation and maintenance. Examples of cost containment are discussed. The continued reduction of processing time from landing to launching represents a demonstration of the success of the cost containment methods. Attention is given to the factors which led to the selection of KSC, the use of Cost Engineering, the employment of the Construction Management Concept, and the use of Computer Aided Design/Drafting. G.R.

A86-35216

SPACE STATION DESIGN-TO-COST MASSIVE ENGINEERING CHALLENGE

M. C. SIMON (General Dynamics Corp., Space Systems Div., San Diego, CA) Society of Allied Weight Engineers, Annual Conference, 44th, Arlington, TX, May 20-22, 1985. 11 p. refs (SAWE PAPER 1673)

The Space Station, NASA's first major test of design-to-cost concepts, must include: (1) pressurized modules with habitat provisions for six crewpersons as well as space for laboratory and logistics functions; (2) a power system capable of generating 75 kilowatts of continuous power; and (3) unmanned platforms for conducting experiments that cannot be accommodated on the core facility. Beyond the implementation of these basic necessities, NASA and its contractors must adhere to a rigorous design-to-cost approach to SS design, development and production. Ultimately, size, shape and function of the SS will be determined by cost more than any single evaluation criterion. K.K.

A86-35223

STARSHIP I - A WEIGHT CONTROL CHALLENGE

H. L. FRISCH (Beech Aircraft Corp., Wichita, KS) Society of Allied Weight Engineers, Annual Conference, 44th, Arlington, TX, May 20-22, 1985, 17 p.

(SAWE PAPER 1682)

The Starship I utilizes many new state-of-the-art concepts in design, materials selection, and fabrication techniques for development of a next generation business aircraft. Composite materials comprise approximately 72 percent of the aircraft structural weight and are a major contribution to the success of the program. This presentation includes a description of the aircraft configuration, weight control philosophy, and computerized mass properties accounting system. Author

A86-35438* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ADVANCED CONCEPTS TRANSPORT AIRCRAFT OF 1995

S. L. CHAPPELL (NASA, Ames Research Center; Informatics General Corp., Moffett Field, CA) and G. A. SEXTON (Lockheed-Georgia Co., Marietta) IN: Aerospace Behavioral Engineering Technology Conference, 4th, Long Beach, CA, October 14-17, 1985, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1985, p. 103-108.

(SAE PAPER 851808)

The components of the Advanced Concepts Flight Simulation Facilities used to evaluate proposed human-machine interfaces are described. The facilities consist of: (1) an advanced concept flight station, which is a wide-body, composite airframe propelled by two turbo-fan engines; (2) an integrated air traffic control simulation; and (3) experimenter/observer stations. The flight controls and displays, and their operation are studied. The air traffic control provided in the simulation is examined. The control of the flight conditions and data collection by the experimenter are discussed. LF.

A86-35644

HELICOPTER CUSTOMER SUPPORT - ARE WE AWARE OF HOW GREAT IT CAN BE

J. J. ALEXANDER (Aerospatiale Helicopter Corp., Grand Prairie, TX) IN: American Helicopter Society, Annual Forum, 41st, Fort Worth, TX, May 15-17, 1985, Proceedings . Alexandria, VA, American Helicopter Society, 1985, p. 617-622. refs

Helicopter manufacturers' customer support services encompass the provision of spare parts, maintenance and repair equipment, and technical expertise, to customers on the basis of analyses of product histories. The manufacturer must address the service requirements of pilots, maintenance personnel, and spare parts inventory managers, in addition to members of administrative and financial departments. Attention is presently given to support service requirement information flowing from customers to manufacturers, typical product accident/incident cause analysis, and both obvious and hidden expenditures by customers that must be anticipated by support services. O.C.

A86-35645

THE FIELD REPRESENTATIVE 'FRONT LINE ACTIONEER'

W. G. TRIPP (United Technologies Corp., Sikorsky Aircraft Div., Stratford,, CT) IN: American Helicopter Society, Annual Forum, 41st, Fort Worth, TX, May 15-17, 1985, Proceedings . Alexandria. VA, American Helicopter Society, 1985, p. 623-627.

A helicopter manufacturer's field service representative must address the maintenance, operation and support requirements of customers operating one or several of the manufacturer's products. In addition to the technical expertise required to soundly advise operators on cost-minimizing procedures in operations, maintenance and repair, the representative must also possess and exercise evaluative judgment through which the manufacturer's staff can act on customers feedback. The degree to which a field service representative's work will enhance customer performance and satisfaction is presently assessed. O.C.

A86-35660

ROBOTICS IN AIRCRAFT MANUFACTURING

J. J. BARTO, JR. (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) IN: American Helicopter Society, Annual Forum, 41st, Fort Worth, TX, May 15-17, 1985, Proceedings . Alexandria, VA, American Helicopter Society, 1985, p. 793-800.

Attention is given to two robotic installations for the manufacture of helicopter airframe components: a small hole-drilling and deburring system, an assembly system for drill/wet-seal/rivet operations. The multistation drilling system employs a robot to drill pilot holes in a family of machined aluminum cabin frame structures, and also brush-deburrs the machined surfaces. The assembly system involves a track-mounted robot designed to drill, wet-seal, and rivet Kevlar and aluminum panels onto preassembled frames that are positioned in a work cell arrangement. O.C.

A86-36853#

DEVELOPMENT OF A KNOWLEDGE BASE FOR AN EXPERT SYSTEM FOR DESIGN OF STRUCTURAL PARTS

J. J. SHAH (Arizona State University, Tempe) IN: Computers in engineering 1985; Proceedings of the International Computers in Engineering Conference and Exhibition, Boston, MA, August 4-8, 1985. Volume 2 . New York, American Society of Mechanical Engineers, 1985, p. 131-136. refs

The paper describes some preliminary work done in developing an expert system for conceptual form design of load-bearing machine parts. Design of this nature can be done without calculating stress magnitude. The knowledge base is built from case studies of form design, starting with simple structures and gradually increasing the complexity. It was found that this method of case studies was a convenient way of gradually building universal rules for designing. Several types of constraints were also considered. It has been demonstrated that knowledge bases for such design problems are not just knowledge intensive but procedure and analysis dependent. Author

A86-36941

ENGINEERING FLIGHT SIMULATION - A REVOLUTION OF CHANGE

T. L. FRASER and C. E. PHILLIPS (Boeing Computer Services Flight Systems Laboratory, Seattle, WA) IN: Flight simulation/simulators; Proceedings of the Aerospace Technology Conference and Exposition, Long Beach, CA, October 14-17, 1985 . Warrendale, PA, Society of Automotive Engineers, Inc., 1985, p. 11-17.

(SAE PAPER 851901)

Issues which require consideration when developing an engineering simulation facility are presented, with emphasis placed on the incorporation of a dynamic computing technology into short and long-term planning. The effects of the operation environment, simulation growth, and simulation payoff are discussed in relation to external influences of computer architecture, re-education of the programmer, and simulation user help. It is concluded that new simulation technology may include the application of a modular computing architecture in the form of multi-processors and engineering workstations, as well as extensive input/output and file networking systems. Moreover, it would include the selection and education of new programming languages and the development of adequate help systems. K.K.

A86-37060*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. CONSTRUCTION AND CONTROL OF LARGE SPACE

STRUCTURES

M. F. CARD, W. L. HEARD, JR. (NASA, Langley Research Center, Hampton, VA), and D. L. AKIN (MIT, Cambridge, MA) Israel Annual Conference on Aviation and Astronautics, 28th, Tel Aviv and Haifa, Israel, Feb. 19, 20, 1986, Paper. 21 p. refs

Recent NASA research efforts on space construction are reviewed. Preliminary results of the EASE/ACCESS Shuttle experiments are discussed. A 45-foot beam was constructed on orbit in 30 minutes using a manual assembly technique at a work station. A large tetrahedron was constructed several times using a free floating technique. The capability of repair, utilities installation, and handling the structures using a mobile foot restraint on the RMS was also demonstrated. Implications of the experiments for Space Station are presented. Models of 5-meter Space Station structure together with neutral buoyancy simulations suggest manual assembly techniques are feasible. Selected research on control of flexible structures is discussed. To support planned flight experiments, studies of the design and optimal placement of distributed active dampers are underway. Author

A86-39567#

NEXT GENERATION AIRCRAFT STRUCTURES - THE NEED FOR CO-ORDINATED CANADIAN R & D PROGRAMS

J. THOMPSON (CASI, Structures and Materials Section, Ottawa, Canada) Canadian Aeronautics and Space Journal (ISSN 0008-2821), vol. 32, March 1986, p. 50-53.

The directions which Canadian R & D in aircraft structures are expected to take over the next 25 yr are discussed. Current programs are targeted at developing composite secondary structures which can be certified for regular use, particularly in the DHC-7 and DHC-8 aircraft. Near- and mid-term research will examine carbon-fiber, aramid, aramid/aluminum hybrids, aluminum lithium alloys, and powder metallurgy ingot aluminum alloys, mainly for commuter aircraft. The parts which will receive the most attention are wings and flaps, empennages, fuselages and flight control surfaces. The efforts will require the development of standardized analytical and numerical tools, NDE testing methods and test procedures, extensive material characterization studies. and funding and performance of components testing programs. It is notable that commuter aircraft primary structures will be required to be as resistant to impact damage from, e.g., birds, as typical modern larger passenger aircraft. M.S.K.

A86-39794

ON A MICROCOMPUTER INTEGRATED SYSTEM FOR STRUCTURAL ENGINEERING PRACTICES

W. KANOK-NUKULCHAI (Tokyo, University, Japan) Computers and Structures (ISSN 0045-7949), vol. 23, no. 1, 1986, p. 33-37. refs

This paper describes a comprehensive use of microcomputer for professional practices of structural engineers. Transition from the conventional method to a computer-based procedure calls for a complete rethinking of an accurate, unambiguous definition of all the elementary activities, their logical orders as well as inter-relationships. An integrated database software system is then proposed for analysis and design of structures, on microcomputer. With a common data bank, all previously processed data can serve directly as a basis for subsequent activities, such as computer-aided drafting, computer-aided construction planning, etc. Several program strategies to attain a maximum efficiency within existing microcomputer constraints are discussed. Author

A86-40514

TRADES AND ANALYSES MANAGEMENT SYSTEM (TRAMS)

H. WYLE (Abacus Programming Corp., Van Nuys, CA) and L. M. SUAREZ (Rockwell International Corp., Downey, CA) IN: Space tech; Proceedings of the Conference and Exposition, Anaheim, CA, September 23-25, 1985. Dearborn, MI, Society of Manufacturing Engineers, 1985, p. 6-1 to 6-13. Research supported by the Rockwell International Corp.

TRAMS is a database system for managing and providing user visibility into a large group of inter-related engineering studies. It permits on-line scanning of study definitions, schedules and results, detects study-to-study incompatibilities, and provides a simulation capability allowing users to determine potential impacts of proposed changes in a given study on other studies. TRAMS should be seen as a part of the movement towards greater use of automated tools in reducing the life-cycle costs of large aerospace systems. Author

A86-41155

KEYS TO ENGINEERING MANAGEMENT REDUCING THE RISKS OF R&D START-UPS PLANNING

R. N. WOLL (N. Woll and Co., Inc., San Jose, IL) IN: Winter National Design Engineering Show and Conference, Anaheim, CA, December 11-13, 1985, Conference Talks . Stamford, CT, Cahners Exposition Group, 1985, p. 241-252.

Planning is crucial to success in every venture and can minimize exposure to risk. The risks of research and development ventures are of special concern because of the nature of the work. All organizations involved in research and development share this concern. This paper discusses potential areas of risk and provides suggestions for dealing with risk as it pertains to both large and small organizations. Author

A86-42764*# Rockwell International Corp., Canoga Park, Calif. DEVELOPMENT HISTORY OF THE SPACE SHUTTLE MAIN ENGINE

T. J. PETERSON (Rockwell International Corp., Rocketdyne Div., Canoga Park, CA) AIAA, ASME, SAE, and ASEE, Joint Propulsion Conference, 22nd, Huntsville, AL, June 16-18, 1986. 8 p. (Contract NAS8-27980) (AIAA PAPER 86-1635)

The development of the Space Shuttle Main Engine has provided a high performance, reusable component for the Space Transportation System. A discussion of how ground testing identified problems and their resolution paved the way for certification of the engine for flight. A launch summary and a discussion of launch anomalies are included. Continuing improvements and established overhaul criteria are described which will extend the operating life and allow each engine to be used efficiently. Author

A86-44919

WORLD AEROSPACE PROFILE 1986

London, Sterling Publications, Ltd., 1986, 352 p. No individual items are abstracted in this volume.

A comprehensive evaluation is made of state-of-the-art achievement and development trends for numerous fields in aerospace technology throughout the industrial world, with attention to airframe, engine and avionics manufacturers in the U.S., U.K., France, West Germany, and Japan. Both civilian and military programs are discussed in articles covering composite airframes for materials, anticorrosion design practices, tilt-rotor aircraft design, next-generation SSTs, supersonic STOL and V/STOL development trends, Unducted Fan engine design evolution, propeller design trends, and novel aviation fueling methods. Also discussed are avionics for all glass cockpits, HUDs, future ATC developments, RPVs, flight simulators, advanced components, safety systems, commercial aircraft interior design, airport and airline planning, and financial management. O.C. **A86-45300*** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

TOUGH COMPOSITE MATERIALS: RECENT DEVELOPMENTS L. F. VOSTEEN, ED., N. J. JOHNSTON, ED., L. A. TEICHMAN, ED., and C. P. BLANKENSHIP, ED. (NASA, Langley Research Center, Hampton, VA) Park Ridge, NJ, Noyes Publications, 1985, 484 p. No individual items are abstracted in this volume.

The present volume broadly considers topics in composite fracture toughness and impact behavior characterization, composite system constituent properties and their interrelationships, and matrix systems' synthesis and characterization. Attention is given to the characterization of interlaminar crack growth in composites by means of the double cantilever beam specimen, the characterization of delamination resistance in toughened resin composites, the effect of impact damage and open holes on the compressive strength of tough resin/high strain fiber laminates, the effect of matrix and fiber properties on compression failure mechanisms and impact resistance, the relation of toughened neat resin properties to advanced composite mechanical properties, and constituent and composite properties' relationships in thermosetting matrices. Also treated are the effect of cross-link density on the toughening mechanism of elastomer-modified epoxies, the chemistry of fiber/resin interfaces, novel carbon fibers and their properties, the development of a heterogeneous laminating resin, solvent-resistant thermoplastics, NASA Lewis research in advanced composites, and opportunities for the application of composites in commercial aircraft transport structures. O.C.

A86-46964*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.

EOS PRODUCTION ON THE SPACE STATION

F. C. RUNGE (McDonnell Douglas Astronautics Co., Huntington Beach, CA) and M. GLEASON (McDonnell Douglas Astronautics Co., St. Louis, MO) AIAA, Space Station in the Twenty-first Century, Meeting, Reno, NV, Sept. 3-5, 1986. 6 p. (Contract NAS8-36607)

(AIAA PAPER 86-2358)

The paper discusses a conceptual integration of the equipment for EOS (Electrophoresis Operations/Space) on the Space Station in the early 1990s. Electrophoresis is a fluid-constituent separation technique which uses forces created by an electrical field. Aspects covered include EOS equipment and operations, and Space Station installations involving a pressurized module, a resupply module, utility provisions and umbilicals and crew involvement. Accommodation feasibility is generally established, and interfaces are defined. Space Station production of EOS-derived pharmaceuticals will constitute a significant increase in capability compared to precursor flights on the Shuttle in the 1980s.

Author

A86-47402#

THIRTY YEARS WITH THE JETS: COMMERCIAL TRANSPORT FLIGHT MANAGEMENT SYSTEMS - PAST, PRESENT, AND FUTURE

R. L. SCHOENMAN (Boeing Commercial Airplane Co., Seattle, WA) IN: Guidance, Navigation and Control Conference, Williamsburg, VA, August 18-20, 1986, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1986, p. 1-10.

(AIAA PAPER 86-2289)

It has been almost thirty years since the first commercial jet transport entered airline service, and there have been many significant changes in flight-management systems during this period. A short historical review of these systems is presented for various time periods, followed by a discussion of the evolution of automatic-flight-control approaches and design techniques. This includes such areas as analysis, simulation, and laboratory and flight tests. The design of flight management systems for future aircraft is discussed, including such subjects as fly-by-wire, new display technology, flight-deck design, system integration, digital implementation of critical systems, etc. Finally, a discussion related to design issues and a view into the commercial transport environment of the future is offered.

A86-47603* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

COMPOSITES IN TODAY'S AND TOMORROW'S U.S. AIRLINERS

H. L. BOHON (NASA, Langley Research Center, Hampton, VA) IN: AIRMEC '85 - Aviation equipment servicing: Aircraft and helicopter maintenance; International Exhibition and Conference, 4th, Duesseldorf, West Germany, February 26-March 3, 1985, Conference Reports . Duesseldorf, West Germany, Duesseldorfer Messegesellschaft mbH, 1985, 33 p. refs

The research conducted by NASA's Aircraft Energy Efficiency Composites program in developing essential technologies for the efficient utilization of composites in the airframe structures of transport aircraft is described. Current activities, present state-of-the-art, production trends in the U.S., and the outlook for major use of composites in primary structures are examined. Special attention is given to application of composites in transport wing and fuselage structures. The projections for the Advanced Tactical Fighter of the late eighties suggest application of composites in the airframe structures to the extent of 50 percent, an all-composite transport could become a reality in the mid-nineties.

A86-48995#

A REVIEW OF UNCONVENTIONAL AIRCRAFT DESIGN CONCEPTS

R. H. LANGE (Lockheed-Georgia Co., Marietta) IN: ICAS, Congress, 15th, London, England, September 7-12, 1986, Proceedings. Volume 1 . New York, American Institute of Aeronautics and Astronautics, Inc., 1986, p. 191-200. refs

The need for improved aircraft performance and efficiency has provided the motivation for consideration of unconventional design concepts for aircraft envisioned for operation in the 1990-2000 time period. Advances in technology permit continuing improvements in aircraft performance and economics but unconventional design concepts show the potential for larger incremental improvements in aircraft efficiency. The paper reviews preliminary design system studies of unconventional aircraft including span-distributed loading, multibody, wing-in-ground effect, flatbed and transonic biplane design concepts. The data include a comparison of the performance and economics of each concept to that for conventional designs. All of the design concepts reviewed incorporate appropriate advanced technologies. The aircraft design parameters include Mach numbers from 0.30 to 0.95, design payloads over 1 million pounds, and design ranges up to 5,500 nautical miles.

A86-49448

MANUFACTURERS SEEK REDUCED COSTS THROUGH NEW FABRICATION TECHNIQUES

S. W. KANDEBO Aviation Week and Space Technology (ISSN 0005-2175), vol. 125, July 21, 1986, p. 73, 76, 77.

Production and design cost reductions achieved by increasing reliance on automation, robotics and computer simulation and design are seen by aircraft manufacturers as the means to assure industrial growth in a future of anticipated spending level reductions and shrinking budgets. The technology of advanced composites is one area where cost reductions are being achieved. Grumman's automated integrated and integrated laminating center and McDonnell Aircraft manufacturing system Company's automated ply laminating system are considered. McDonnell is investigating mathematical modeling of composite curing, in order to eliminate slow, expensive, empirical data collection; modeling will permit production increases, improved autoclave utilization, and better quality. McDonnell-Douglas' automated drilling facilities for graphite/epoxy wings for the F/A-18 and the use of computational fluid dynamics codes to study pressures on the F/A-18 are described. Other technological innovations include: superplastic forming/diffusion bonding of titanium, computer simulations for logistic support, and computer-aided engineering/computer-integrated manufacturing (CAE/CIM) to tie all the production advances together. CAE/CIM, according to industry surveys, can permit 70-90 percent reduction in part rejection, 10-30 percent reduction in direct labor costs, 30-60 percent reduction in indirect labor costs, 30-50 percent reduction in floor space, and up to 90 percent reduction in inventory and lead times. DH

A86-49571#

THE COMPETITIVE AND COOPERATIVE OUTLOOK FOR AIRCRAFT PROPULSION SYSTEMS

J. M. SCHOFIELD (United Technologies Corp., Commercial Products Div., East Hartford, CT) AIAA, Annual Meeting and International Aerospace Exhibit, Arlington, VA, Apr. 29-May 1, 1986. 12 p.

(AIAA PAPER 86-1134)

The advantages and disadvantages of coproduction of propulsion systems are examined. The international cooperation programs allow the transfer of technical knowledge, and risk and revenue sharing. The potential competition that may result from joint R&D programs is considered. Examples of successful coproduction projects, in particular those of the International Aero Engine consortium, are discussed.

N86-11107# Perkin-Elmer Corp., Danbury, Conn. FUTURE SPACE TELESCOPE DESIGN CONCEPTS

In ESA Colloq. on Kilometric Opt. Arrays in Apr. 1985 refs A. N. BUNNER Space p 71-76

Avail: NTIS HC A09/MF A01 Five generically-different approaches to a high resolution, high sensitivity space telescope covering the options of focal and afocal collectors, filled apertures and dilute apertures and one-dimensional and two-dimensional arrays are described. These concepts are compared, given equal collecting area and equal observing time, on the basis of angular resolution and sensitivity to faint point sources and extended sources in the presence of photon statistics, zodical background light, and other sources in the field. Technology development issues involved in the realization of advanced telescopes are listed. Author (ESA)

N86-11216*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

HEAVY LIFT LAUNCH VEHICLES FOR 1995 AND BEYOND

R. TOELLE, comp. Sep. 1985 149 p refs (NASA-TM-86520; NAS 1.15:86520) Avail: NTIS HC A07/MF A01 CSCL 22B

A Heavy Lift Launch Vehicle (HLLV) designed to deliver 300,000 Ib to a 540 n mi circular polar orbit may be required to meet national needs for 1995 and beyond. The vehicle described herein can accommodate payload envelopes up to 50 ft diameter by 200 ft in length. Design requirements include reusability for the more expensive components such as avionics and propulsion systems, rapid launch turnaround time, minimum hardware inventory, stage and component flexibility and commonality, and low operational costs. All ascent propulsion systems utilize liquid propellants, and overall launch vehicle stack height is minimized while maintaining a reasonable vehicle diameter. The ascent propulsion systems are based on the development of a new liquid oxygen/hydrocarbon booster engine and liquid oxygen/liquid hydrogen upper stage engine derived from today's SSME technology. Wherever possible, propulsion and avionics systems are contained in reusable propulsion/avionics modules that are recovered after each launch. Author

N86-11228*# LTV Aerospace and Defense Co., Dallas, Tex. Vought Aero Products Div.

THE FACTORY OF THE FUTURE

J. E. BYMAN In NASA. Langley Research Center Welding, Bonding and Fastening, 1984 p 1-9 Sep. 1985

Avail: NTIS HC A21/MF A01 CSCL 13H

A brief history of aircraft production techniques is given. A flexible machining cell is then described. It is a computer controlled system capable of performing 4-axis machining part cleaning, dimensional inspection and materials handling functions in an unmanned environment. The cell was designed to: allow processing of similar and dissimilar parts in random order without disrupting production; allow serial (one-shipset-at-a-time) manufacturing;

reduce work-in-process inventory; maximize machine utilization through remote set-up; maximize throughput and minimize labor. R.J.F.

N86-11394# Joint Publications Research Service, Arlington, Va. USSR REPORT: MACHINE TOOLS AND METALWORKING EQUIPMENT

73 p Transl. into ENGLISH from various Russian 4 Sep. 1985 articles

(JPRS-UMM-85-010) Avail: NTIS HC A04

Research advances in U.S.S.R. machine tools and metal working equipment are reported. Topics covered include automated lines and aggregated machining systems; robotics; and technology planning and management automation.

N86-11540*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

COMPUTATIONAL STRUCTURAL MECHANICS: A NEW ACTIVITY AT THE NASA LANGLEY RESEARCH CENTER

N. F. KNIGHT, JR. and W. J. STROUD Sep. 1985 39 p refs Presented at 22nd Ann. Tech. Meeting of the Soc. of Eng. Sci., University Park, Pa., 7-9 Oct. 1985

(NASA-TM-87612; NAS 1.15:87612) Avail: NTIS HC A03/MF A01 CSCL 20K

Complex structures considered for the late 1980's and early 1990's include composite primary aircraft structures and the space station. These structures are much more difficult to analyze than today's structures and necessitate a major upgrade in computerized structural analysis technology. A major research activity in computational structural mechanics (CSM) was initiated. The objective of the CSM activity is develop advanced structural analysis technology that will exploit modern and emerging computers such as computers with vector and/or parallel processing capabilities. The three main research activities underway in CSM include: (1) structural analysis methods development; (2) a software testbed for evaluating the methods; and (3) numerical techniques for parallel processing computers. The motivation and objectives of the CSM activity are presented and CSM activity is described. The current CSM research thrusts, and near and long term CSM research thrusts are outlined. E.A.K.

N86-13235*# National Academy of Sciences - National Research Council, Washington, D. C. Panel on Vehicle Applications. AERONAUTICAL TECHNOLOGY 2000: A PROJECTION OF **ADVANCED VEHICLE CONCEPTS**

1985 116 p (Contract NASW-3455)

(NASA-CR-176322; NAS 1.26:176322) Avail: NTIS HC A06/MF A01; also available from Aeronautics and Space Engineering Board, National Research Council, 2101 Constitution Ave., N.W., Washington, D.C. 20418 CSCL 05A

The Aeronautics and Space Engineering Board (ASEB) of the National Research Council conducted a Workshop on Aeronautical Technology: a Projection to the Year 2000 (Aerotech 2000 Workshop). The panels were asked to project advances in aeronautical technologies that could be available by the year 2000. As the workshop was drawing to a close, it became evident that a more comprehensive investigation of advanced air vehicle concepts than was possible in the limited time available at the workshop would be valuable. Thus, a special panel on vehicle applications was organized. In the course of two meetings, the panel identified and described representative types of aircraft judged possible with the workshop's technology projections. These representative aircraft types include: military aircraft; transport aircraft; rotorcraft; extremely high altitude aircraft; and transatmospheric aircraft. Improvements in performance, efficiency, and operational characteristics possible through the application of the workshop's year 2000 technology projections were discussed. The subgroups also identified the technologies considered essential and enhancing or supporting to achieve the projected aircraft B.W. improvements.

N86-13742# Joint Publications Research Service, Arlington, Va. USSR REPORT: MACHINE TOOLS AND METALWORKING EQUIPMENT

29 Oct. 1985 88 p Transl. into ENGLISH from various Russian articles

(JPRS-UMM-85-014) Avail: NTIS HC A05/MF A01

Articles from journals and other publications of the U.S.S.R. on machine tools and metalworking equipment are presented. They are divided into areas on industry planning and economics, metal cutting and metal forming machine tools, automated lines and aggregated machining systems, and robotics.

N86-13745# Joint Publications Research Service, Arlington, Va. USSR REPORT: MACHINE TOOLS AND METALWORKING EQUIPMENT

16 Oct. 1985 95 p Transl. into ENGLISH from various Russian articles

(JPRS-UMM-85-013) Avail: NTIS HC A05

Industry planning and economics, metal cutting and metal forming machine tools, robots, process controls and automation electronics, and technology planning and management automation are some areas into which the articles from Soviet journals and other publications are divided. Some titles of articles presented are: New Efforts to Intensify Machine Tool Production; Machine Tools Made In-House to Modernize Production; Determination of Effective Placement of Equipment in Flexible Automated Production Systems; Robot Control System Modified for Precision Movement; and Active Monitoring of Tool Wear by Acoustical Emissions.

N86-14710*# ECON, Inc., Princeton, N.J.

COMMERCIALIZATION OF THE LAND REMOTE SENSING SYSTEM: AN EXAMINATION OF MECHANISMS AND ISSUES J. K. CAULEY, C. GAELICK, J. S. GREENBERG, J. LOGSDON,

and T. MONK 1 Apr. 1983 146 p refs ERTS (Contract NASW-3339; NA-83-SAC-00658)

(E86-10008; NASA-CR-176337; NAS 1.26:176337; ECON-82-175) Avail: NTIS HC A07/MF A01 CSCL 05A

In September 1982 the Secretary of Commerce was authorized (by Title II of H.R. 5890 of the 97th Congress) to plan and provide for the management and operation of the civil land remote sensing satellite systems, to provide for user fees, and to plan for the transfer of the ownership and operation of future civil operational land remote sensing satellite systems to the private sector. As part of the planning for transfer, a number of approaches were to be compared including wholly private ownership and operation of the system by an entity competitively selected, mixed government/private ownership and operation, and a legislatively-chartered privately-owned corporation. The results of an analysis and comparison of a limited number of financial and organizational approaches for either transfer of the ownership and operation of the civil operational land remote sensing program to the private sector or government retention are presented.

Author

N86-15172*# Pennsylvania State Univ., University Park. Center for the Management of Technological and Organizational Change. NEW TECHNOLOGY IMPLEMENTATION: TECHNICAL, ECONOMIC AND POLITICAL FACTORS

J. W. DEAN, JR., G. I. SUSMAN, and P. S. PORTER *In* NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 165-175 1985 Avail: NTIS HC A25/MF A01 CSCL 05A

An analysis is presented of the process of implementing advanced manufacturing technology, based on studies of numerous organizations. This process is seen as consisting of a series of decisions with technical, economic, and political objectives. Frequency decisions involve specifications, equipment, resources/organization, and location. Problems in implementation are viewed as resulting from tradeoffs among the objectives, the tendency of decision makers to emphasize some objectives at the expense of others, and the propensity of problems to spread from one area to another. Three sets of recommendations, based on this analysis, are presented. Author N86-15197*# McDonnell-Douglas Technical Services Co., Inc., Houston, Tex. Descent Design Section.

SPACE SHUTTLE DESCENT DESIGN: FROM DEVELOPMENT TO OPERATIONS

T. J. CRULL and R. E. HITE, III *In* NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 450-459 1985

Avail: NTIS HC A25/MF A01 CSCL 05A

The descent guidance system, the descent trajectories design, and generating of the associated flight products are discussed. The programs which allow the successful transitions from development to STS operations, resulting in reduced manpower requirements and compressed schedules for flight design cycles are addressed. The topics include: (1) continually upgraded tools for the job, i.e., consolidating tools via electronic data transfers, tailoring general purpose software for needs, easy access to tools through an interactive approach, and appropriate flexibility to allow design changes and provide growth capability; (2) stabilizing the flight profile designs (I-loads) in an uncertain environment; and (3) standardizing external interfaces within performance and subsystems constraints of the Orbiter. E.A.K.

N86-16452*# Princeton Synergetics, Inc., N.J.

EVALUATION OF SPACECRAFT TECHNOLOGY PROGRAMS (EFFECTS ON COMMUNICATION SATELLITE BUSINESS VENTURES), VOLUME 2 Final Report

J. S. GREENBURG, M. KAPLAN (Spacetech, Inc.), J. FISHMAN, and C. HOPKINS (Econ, Inc., San Jose, Calif.) Sep. 1985 155 p 2 Vol.

(Contract NAS3-23886)

(NASA-CR-174979; NÁS 1.26:174979) Avail: NTIS HC A08/MF A01 CSCL 17B

The computational procedures used in the evaluation of spacecraft technology programs that impact upon commercial communication satellite operations are discussed. Computer programs and data bases are described. R.J.F.

N86-17227*# Ecosystems International, Inc., Crofton, Md. ASSESSMENT OF US INDUSTRY'S TECHNOLOGY TRENDS AND NEW TECHNOLOGY REQUIREMENTS Final Report

Oct. 1984 184 p (Contract NASW-3674)

(NASA-CR-176479; NÁS 1.26:176479) Avail: NTIS HC A09/MF A01 CSCL 05A

The utility and effectiveness of a novel approach (the Applications Development, or AD approach), intended to augment the efficiency of NASA's technology utilization (TU) through dissemination of NASA technologies and joint technology development efforts with U.S. industry is tested. The innovative AD approach consists of the following key elements: selection of NASA technologies appearing to have leading edge attributes; interaction with NASA researchers to assess the characteristics and quality of each selected technology; identification of industry's needs in the selected technology areas; structuring the selected technologies in terms of specifications and standards familiar to industry (industrial Spec. Sheets); identification and assessment of industry's interest in the specific selected NASA technologies, utilizing the greatly facilitated communication made possible by the availability of the industrial Spec. Sheets; and matching selected NASA technologies with the needs of selected industries.

Author

N86-19620# SRI International Corp., Menlo Park, Calif. MODELING AND PLANNING ROBOTIC MANUFACTURING Final Report

P. C. CHEESEMAN and W. T. PARK Mar. 1985 34 p (Contract N00014-83-C-0649)

(AD-A161014; AD-F620003) Avail: NTIS HC A03/MF A01 CSCL 13H

EXPLAN is a general-purpose automatic control system that uses domain-specific knowledge to guide its choices at every step. EXPLAN was debugged using an extended blocks world domain, which is a simplification of typical robot pick-and-place operations. EXPLAN is based on a new knowledge representation that associates a symbolic time interval and a truth value of true or false with every proposition about the world. As it builds a plan, EXPLAN uses these truth values and time intervals to discover all harmful interactions that could occur between parallel actions and to order these actions to remove potential conflicts. EXPLAN uses this explicit representation of truth values and time intervals to describe preconditions for actions, as well as the actions themselves. This allows EXPLAN to reason efficiently about temporal relationships that occur during planning. This is a different approach from that used with state-change operator representations, which are the basis of many other artificial GRA intelligence (A1) planning systems.

National Science Foundation, Washington, D.C. N86-23482# Div. of Science Resources Studies.

ACADEMIC SCIENCE/ENGINEERING: R AND D FUNDS, FISCAL YEAR 1983 (DETAILED STATISTICAL TABLES)

Apr. 1985 159 p

(PB86-120706; NSF-85-308) Avail: NTIS HC A08/MF A01 CSCL 05A

The report contains tabular data on 562 institutions of higher education regarding scientific and engineering (S/E) R and D expenditures that are separately budgeted. The survey includes institutions that offer a doctorate or master's degree in S/E programs, as well as those schools with \$50,000 or more in separately budgeted R and D expenditures. The 19 federally financed R and D centers also are included. Data are tabulated by: (1) sources of funds; (2) S/E disciplines; (3) character of work; (4) control of institution (public/private); (5) largest performers' ranking; (6) highest degree offered; (7) total and federally financed current fund expenditures for research equipment; and (8) capital expenditures for facilities and equipment for research, development, and instruction. Trend tables are included for most elements. The methodology and response rate are described and a reproduction of the survey instrument is included. GRA

N86-23749*# National Aeronautics and Space Administration, Washington, D.C.

CHINESE SPACE AND AVIATION INDUSTRIES SCORE MAJOR BREAKTHROUGHS

Apr. 1986 B HU 16 p Transl. into ENGLISH from Xiandai Junshi (Conmilit) (Hong Kong), v. 9, no. 11, 1 Jan. 1986 p 88-91 Transl. by Kanner (Leo) Associates, Redwood City, Calif. (Contract NASW-4005)

(NASA-TM-87973; NAS 1.15:87973) Avail: NTIS HC A02/MF A01 CSCL 13H

An overview of the current status of China's aviation and aerospace industries is presented, as well as planned future development and areas of importance for China's future space programs. The development of China's CZ-1, CZ-2 and CZ-3 rocket program is discussed, as well as China's satellite launch capabilities. China's first geostationary communications satellite STW-1 is also mentioned, and further development of the second and third communications satellites to be launched in 1987 are shown. Other developments include a seventh low Earth orbiting photographic reconnaissance satellite, plans for an image transmitting remote sensing satellite to be launched in 1988 to 1990, and other satellite developments. The Chinese-designed Y-10 transport aircraft is discussed, as well as the TU-16 bomber aircraft and the co-production agreement with McDonnell Douglas for the MD-82 passenger aircraft. Author

N86-24589# Logistics Management Inst., Washington, D. C DISCOUNTED CASH FLOW MODEL FOR THE INDUSTRIAL MODERNIZATION INCENTIVES PROGRAM

M. G. MYERS, P. R. MCCLENON, M. J. KONVALINKA, and G. GOTTSCHALK Nov. 1985 47 p

(Contract MDA903-85-C-0139)

(AD-A162968; LMI-RE301) Ávail: NTIS HC A03/MF A01 CSCL 05C

Determining the appropriate productivity savings reward under an Industrial Modernization Incentives Program agreement requires

identification of the total potential reduction in contract price. The contract price must be determined for each of two situations, one with business as usual and one after the proposed productivity enhancement. Finding these two sets of expected contract prices requires consideration of changes in direct and indirect cost and changes in profit objectives in each year of the period under analysis. Discounted cash flow analysis is the appropriate tool for evaluating the financial attractiveness to the contractor of a proposed investment. Contractor-related cash flow includes payments based on depreciation, imputed cost of money, and profit, which is influenced by cost and by facilities capital employed. Contractor return on investment is usually evaluated in after-tax terms, which implies a need to consider the accelerated cost recovery system and investment tax credit provisions of the Internal Revenue Code. The cash flow model documented in this report provides evaluations of proposed savings share provisions. It identifies the benefit to DOD and to the U.S. Government (including income tax effects). It measures the internal rate of return to the contractor. The parties are expected to evaluate several possible savings share arrangements in the process of developing an equitable contractural agreement. GRA

N86-26262# Oak Ridge National Lab., Tenn.

USE OF BROKER ORGANIZATIONS IN TECHNOLOGY TRANSFER AND RESEARCH UTILIZATION FOR THE **BUILDINGS INDUSTRY**

E. D. COPENHAVER Dec. 1985 133 p (Contract DE-AC05-84OR-21400)

(DE86-004674; ORNL/TM-9581) Avail: NTIS HC A07/MF A01 Several broker organizations are already an active part of the technology transfer and research utilization activities of DOE's Building Systems Division. These interactions often take the form of service on broker organization or DOE task forces and review committees, joint sponsorship of meetings and workshops, subcontracts for research and/or information dissemination to brokers, publication of documents, code and standards setting activities, and congressional testimony. Recommendations for additional research on technology transfer utilizing brokers are also outlined. DOF

National Aeronautics and Space Administration. N86-26277*# Ames Research Center, Moffett Field, Calif.

SUMMARY OF RESULTS OF NASA F-15 FLIGHT RESEARCH PROGRAM

F. W. BURCHAM, JR., G. A. TRIPPENSEE, D. F. FISHER, and T. W. PUTNAM Apr. 1986 34 p refs Presented at the AIAA 3rd Flight Testing Conference, Las Vegas, Nevada, 2-4 Apr. 1986 (NASA-TM-86811; H-1341; NAS 1.15:86811; AIAA-86-9761) Avail: NTIS HC A03/MF A01 CSCL 01B

NASA conducted a multidisciplinary flight research program on the F-15 airplane. The program began in 1976 when two preproduction airplanes were obtained from the U.S. Air Force. Major projects involved stability and control, handling qualities. propulsion, aerodynamics, propulsion controls, and integrated propulsion-flight controls. Several government agencies and aerospace contractors were involved. In excess of 330 flights were flown, and over 85 papers and reports were published. This document describes the overall program, the projects, and the key results. The F-15 was demonstrated to be an excellent flight research vehicle, producing high-quality results. Author

N86-28326# Naval Ocean Systems Center, San Diego, Calif. SUGGESTIONS FOR DESIGNERS OF NAVY ELECTRONIC EQUIPMENT. REVISION A. 1985 EDITION May 1985 158 p

(AD-A165697; NOSC/TD-250-REV-A) Avail: NTIS HC A08/MF A01 CSCL 09E

The engineer is provided with common sense recommendations which will increase the reliability of a system in military environments and provides suggestions which will make operation and maintenance of these equipments easier for Navy personnel.

N86-29871*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ADĂPTIVE WALL WIND TUNNELS: A SELECTED, ANNOTATED **BIBLIOGRAPHY**

M. H. TUTTLE (Vigyan Research Associates, Inc., Hampton, Va.) and R. E. MINECK Aug. 1986 55 p (NASA-TM-87639; L-16084; NAS 1.15:87639) Avail: NTIS HC

A04/MF A01 CSCL 14B

This bibliography, with abstracts, consists of 257 citations arranged in chronological order. Selection of the citations was made for their value to researchers working to solve problems associated with reducing wall interference by the design, development, and operation of adaptive wall test sections. Author, source, and subject indexes are included. Author

N86-29872*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

CRYOGENIC WIND TUNNELS FOR HIGH REYNOLDS NUMBER TESTING

P. L. LAWING, R. A. KILGORE, and P. D. MCGUIRE May 1986 95 p

(NASA-TM-87743; NAS 1.15:87743) Avail: NTIS HC A05/MF À01 CSCL 14B

A compilation of lectures presented at various Universities over a span of several years is discussed. A central theme of these lectures has been to present the research facility in terms of the service it provides to, and its potential effect on, the entire community, rather than just the research community. This theme is preserved in this paper which deals with the cryogenic transonic wind tunnels at Langley Research Center. Transonic aerodynamics is a focus both because of its crucial role in determining the success of aeronautical systems and because cryogenic wind tunnels are especially applicable to the transonics problem. The paper also provides historical perspective and technical background for cryogenic tunnels, culminating in a brief review of cryogenic wind tunnel projects around the world. An appendix is included to provide up to date information on testing techniques that have been developed for the cryogenic tunnels at Langley Research Center. In order to be as inclusive and as current as possible, the appendix is less formal than the main body of the paper. It is anticipated that this paper will be of particular value to the technical layman who is inquisitive as to the value of, and need for, cryogneic tunnels. Author

N86-30720*# National Aeronautics and Space Administration, Washington, D.C.

NASA AND GENERAL AVIATION

J. L. ETHELL 1986 140 p Original contains color illustrations (NASA-SP-485; NAS 1.21:485) Avail: SOD HC \$6.50 as 033-000-00984-4; NTIS MF A01 CSCL 01C

General aviation remains the single most misunderstood sector of aeronautics in the United States. A detailed look at how general aviation functions and how NASA helps keep it on the cutting edge of technology in airfoils, airframes, commuter travel, environmental concerns, engines, propellers, air traffic control, agricultural development, electronics, and safety is given. Author

N86-31563*# National Aeronautics and Space Administration, Washington, D.C.

MISSION ADAPTIVE WING SOARS AT NASA FACILITY

D. RAHN and L. REINERTSON (National Aeronautics and Space Administration. Dryden (Hugh L.) Flight Research Center, Edwards, Calif.) 29 Aug. 1986 2 p

(P86-10182) Avail: NTIS HC A02/MF A01 CSCL 01C

Research pilots have flown the Mission Adaptive Wing (MAW) aircraft, a highly modified F-111 jet fighter, from subsonic speeds up to Mach 1.4 in initial flight tests. The initial test flights are clearing the envelope with the wings flexed at various curvatures. This process allows further research data to be safely gathered so that designers of future variable camber wing aircraft have the best information possible. The altitude envelope was cleared from 27,500 down to 7,500 feet where denser air can cause more stress on the aircraft. Testing with the aircraft was conducted

with wing sweep angles of 26 and 58 degrees. At the conclusion of the performance tests in the manual configuration, the system will be reconfigured for automatic mode tests. The limited automatic modes include maneuver camber control where the wings are deflected automatically to the best lift versus drag combination for a particular speed; cruise camber control which can help protect the aircraft from high G stresses; and maneuver enhancement/gust alleviation which is designed to improve the aircraft's up and down movement response to pilot commands and reduce the aircraft response to turbulence. B.G

N86-31585*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio. AEROPROPULSION OPPORTUNITIES FOR THE 21ST CENTURY

W. C. STRACK 1986 32 p Presented at the Scenario for 21st Century Aero Engine Design Seminar, Bristol, England, 16-17 May 1986; sponsored by the Institute of Mechanical Engineers (NASA-TM-88817; E-3177; NAS 1.15:88817) Avail: NTIS HC A03/MF A01 CSCL 21E

A large number of novel aeropropulsion system concepts are presented for subsonic through hypersonic applications offering large potential improvements. Collectively, these examples illustrate the revolutionary opportunities and challenges that could enable truly revolutionary aircraft capabilities in the future. Certainly not all of these concepts will ultimately prove fruitful. Nevertheless, the sheer number of existing concepts, including many unmentioned herein, is so large and the applications so vast, that the prognosis for the future of aeropropulsion is very encouraging indeed.

Author

N86-32327# Air Force Systems Command, Bolling AFB, Washington, D.C.

GUIDE TO CANADIAN AEROSPACE RELATED INDUSTRIES D. J. PEARSON and J. R. NILES 28 Feb. 1986 131 p (AD-A167794; AFSC-TR-86-001) Avail: NTIS HC A07/MF A01

CSCL 05C

Ths guide is a contracting source list of Canadian aerospace related industries to be used by USAF procurement offices, program manageres, project engineers, and scientists. It provides company profiles, a company keyword index, and contact points for each company. GRA

N86-32330# Technische Hogeschool, Eindhoven (Netherlands). CALCULATING WORKLOAD NORMS FOR JOB SHOPS J. W. M. BERTRAND Apr. 1984 5 p

(BDK/KBS/84-04; ETN-86-97689) Avail: NTIS HC A02/MF A01

A job scheduling and due date assignment rule that adapts the flow time allowance per operation to the time-aggregated remaining workload per work center is described. The method is valid for jobs requiring a linear sequence of operations as well as for single and multilevel assembly types of jobs. Flow time allowances are based on the remaining workload for the work center where the operation is to be performed. To determine an initial schedule, each operation of a job is given an operation due date, which is equal to the maximum operation due date of the previous operation(s), plus the flow time allowance. FSA

N86-32332# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Industrial Engineering and Management Science. THE STRUCTURING OF PRODUCTION CONTROL SYSTEMS J. W. M. BERTRAND and J. WIJNGAARD May 1984 46 p (THE/BDK/ORS/84/10; ETN-86-97691) Avail: NTIS HC A03/MF A01

A qualitative methodology for designing hierarchically structured production control systems for complex production situations is presented. The methodology is based on the assumption that complexity should be reduced by defining self-contained subsystems with clear and well-defined operational characteristics. Interactions between the subsystems should be simple and restricted. The production unit (PU) is introduced as a basic control entity. From the perspective of goods flow control the PU's are black boxes having certain operational characteristics. The objective of goods flow control is to realize a delivery performance, taking into account the PU-operational constraints. The main elements in the goods flow control structure developed are master planning, material coordination, workload control and work order release. ESA

N86-32333# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Industrial Engineering and Management Science. **DUE-DATE RELIABILITY IN A REPAIR SHOP: IMPLICATIONS**

FOR ORGANIZATIONAL AND WORK DESIGN

H. KUIPER, P. REINKING, and J. C. WORTMANN Jul. 1984 29 p

(THE/BDK/KBS/84-14; ETN-86-97692) Avail: NTIS HC A03/MF A01

The design and introduction of a work-order control system in a repair shop to increase the shop's due-date reliability under conditions of uncertainty are discussed. The consequences of the control system for organizational structure and work design are illustrated. The system has far reaching implications for the responsibilities and tasks of employees at each level. Organizational changes, based on notions of the contingency approach are described. Task-design and group-design theory is used to analyze the task-content implications. ESA

N86-32334# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Industrial Engineering and Management Science. **STRUCTURING THE PRODUCTION CONTROL PROBLEM IN A**

REPAIR SHOP J. C. WORTMANN and K. TOL Aug. 1984 9 p

(THE/BDK/KBS/84-16; ETN-86-97693) Avail: NTIS HC A02/MF A01

The production control system in a repair shop was improved by structuring the control problem, i.e., decomposing the problem into a number of weakly interdependent subproblems. The proposed control structure distinguishes a master planning level, that sets due-dates for major phases of a repair order; a materials coordination level, that coordinates suborders; and a departmental control level to deal with suborders. A decomposition of the information system into a master planning system and a detailed planning system follow from the control structure. ESA

N86-32703*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ADVANCED INSTRUMENTATION FOR AERONAUTICAL PROPULSION RESEARCH

M. J. HARTMANN 1986 23 p Presented at the Symposium on Propulsion Instrumentation, Jiangyou, China, 6-10 Oct. 1986; sponsored by NASA and Chinese Aeronautical Establishment (NASA-TM-88853; E-3244; NAS 1.15:88853) Avail: NTIS HC A02/MF A01 CSCL 14B

The development and use of advanced instrumentation and measurement systems are key to extending the understanding of the physical phenomena that limit the advancement of aeropropulsion systems. The data collected by using these systems are necessary to verify numerical models and to increase the technologists' intuition into the physical phenomena. The systems must be versatile enough to allow their use with older technology measurement systems, with computer-based data reduction systems, and with existing test facilities. Researchers in all aeropropulsion fields contribute to the development of these systems. Author

04

ROBOTICS AND EXPERT SYSTEMS

Includes Artificial Intelligence, Robots and Robotics, Automatic Control and Cybernetics, Expert Systems, Automation Applications, Computer-Aided Design (CAD), Computer-Aided Manufacturing.

A86-10200#

AUTOMATION AND ROBOTICS FOR THE SPACE STATION - RECOMMENDATIONS

IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-21, Sept. 1985, p. 735-743.

An executive summary is given of the recommendations of the NASA advisory panel on robotics and automation technologies for the Space Station. Consideration is given to the technologies needed for the Initial Operational Capability (IOC) Space Station, including efficient man/machine interfaces for supervisory control of robots; problem oriented computer languages; integrated computer-aided engineering, and an on-site fabrication capability. A hypothetical time-line is given which describes the recommended funding guidelines of the Automation And Robotics Technology Advancement Program for the period 1985-1992. Some ways in which NASA can lead, leverage, and exploit the development of automation and robotics technologies for the IOC Space Station are briefly reviewed.

A86-10560 ROBOTICS FOR ENGINEERS

Y. KOREN (Technion - Israel Institute of Technology, Haifa) New

York, McGraw-Hill Book Co., 1985. 365 p. refs The basic concepts of robotics are reviewed along with the classification and structure of robotic systems. In particular, attention is given to the design of control loops, kinematics, trajectory interpolators, applications, programming methods, and sensors. A systematic method is then presented for selecting the most appropriate robot for a particular job in a plant. The link between robotics and related fields, such as computer-aided design and manufacturing, and the integration of robots into flexible manufacturing systems are discussed. Finally, some future trends in the development of industrial robots are examined. V.L.

A86-11407*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE BLACKBOARD MODEL - A FRAMEWORK FOR INTEGRATING MULTIPLE COOPERATING EXPERT SYSTEMS W. K. ERICKSON (NASA, Ames Research Center, Moffett Field, CA) IN: Computers in Aerospace Conference, 5th, Long Beach, CA, October 21-23, 1985, Technical Papers . New York, AIAA, 1985, p. 33-40. refs

(AIAA PAPER 85-5045)

The use of an artificial intelligence (AI) architecture known as the blackboard model is examined as a framework for designing and building distributed systems requiring the integration of multiple cooperating expert systems (MCXS). Aerospace vehicles provide many examples of potential systems, ranging from commercial and military aircraft to spacecraft such as satellites, the Space Shuttle, and the Space Station. One such system, free-flying, spaceborne telerobots to be used in construction, servicing, inspection, and repair tasks around NASA's Space Station, is examined. The major difficulties found in designing and integrating the individual expert system components necessary to implement such a robot are outlined. The blackboard model, a general expert system architecture which seems to address many of the problems found in designing and building such a system, is discussed. A progress report on a prototype system under development called DBB (Distributed BlackBoard model) is given. The prototype will act as a testbed for investigating the feasibility, utility, and efficiency of MCXS-based designs developed under the blackboard model. Author

A86-13529

COMPUTER ARCHITECTURE FOR INTELLIGENT ROBOTS

Y. KANAYAMA and S. YUTA (Tsukuba, University, Sakura, Japan) Journal of Robotic Systems (ISSN 0741-2223), vol. 2, Fall 1985, p. 237-251. refs

This article proposes a computer architecture suitable for intelligent robots, especially for self-contained intelligent mobile robots. The robot should be a mulitprocessor system with a master, several slave modules and a console. A simple star connection is employed. The master carries user's programs written in a high level language with which a programmer is able to use all basic functions in the robots. It should have a special purpose operating system. Each module is an independent microcomputer system loosely coupled to the master and dedicated to an elementary function such as manipulation, locomotion, sensing, or planning. A serial TTL level or RS232C interface is employed between the master and each module. Two self-contained robots, Yamabico 9 and 10, constructed under these design principles have demonstrated the effectiveness of this proposed architecture.

Author

A86-14434*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERT SYSTEMS AND THEIR USE IN AUGMENTING DESIGN OPTIMIZATION

G. H. KIDWELL and M. A. ESKEY (NASA, Ames Research Center, Moffett Field, CA) AIAA, AHS, and ASEE, Aircraft Design Systems and Operations Meeting, Colorado Springs, CO, Oct. 14-16, 1985. 16 p. refs

(AIAA PAPER 85-3095)

The challenging requirements that are evolving for future aircraft demand that each design be optimally integrated, for the penalties imposed by nonoptimal performance are significant. Classic numerical optimization algorithms have been and will continue to be important tools for aircraft designers. These methods are, however, limited to certain categories of aircraft design variables, leaving the remainder to be determined by the user. A method that makes use of knowledge-based expert systems offers the potential for aiding the conceptual design process in a way that is similar to that of numerical optimization, except that it would address discrete, discontinuous, abstract, or any other unoptimized aspect of vehicle design and integration. Other unique capabilities such as automatic discovery and learning in design may also be achievable in the near term. This paper discusses current practice in conceptual aircraft design and knowledge-based systems, and how knowledge-based systems can be used in conceptual design. Author

A86-14548* SRI International Corp., Menlo Park, Calif. EXPERT SYSTEMS FOR SPACE STATION AUTOMATION M. P. GEORGEFE and O. FIRSCHEIN (SRI International Art

M. P. GEORGEFF and O. FIRSCHEIN (SRI International Artificial Intelligence Laboratory, Menlo Park, CA) IEEE Control Systems Magazine (ISSN 0272-1708), vol. 5, Nov. 1985, p. 3-8. refs (Contract NAS2-11864)

The expert systems required for automating key functions of the Manned Space Station (MSS) are explored. It is necessary that the expert systems developed be flexible, degrade gracefully in the case of a failure, and be able to work with incomplete data. The AI systems will have to perform interpretation and diagnosis, design, prediction and induction, and monitoring and control functions. Both quantitative and qualitative reasoning capabilities need improvements, as do automatic verification techniques, explanation and learning capabilities, and the use of metaknowledge, i. e., knowledge about the knowledge contained in the knowledge base. Information retrieval, fault isolation and manufacturing process control demonstrations are needed to validate expert systems for the MSS. M.S.K.

A86-14847

ENHANCED MAINTENANCE AND EXPLANATION OF EXPERT SYSTEMS THROUGH EXPLICIT MODELS OF THEIR DEVELOPMENT

R. NECHES, W. R. SWARTOUT, and J. D. MOORE (Southern California, University, Marina del Rey) IEEE Transactions on Software Engineering (ISSN 0098-5589), vol. SE-11, Nov. 1985, p. 1337-1351. refs

(Contract MDA903-81-C-0335)

Principled development techniques could greatly enhance the understandability of expert systems for both users and system developers. Current systems have limited explanatory capabilities and present maintenance problems because of a failure to explicitly represent the knowledge and reasoning that went into their design. This paper describes a paradigm for constructing expert systems which attempts to identify that tacit knowledge, provide means for capturing it in the knowledge bases of expert systems, and apply it towards more perspicuous machine-generated explanations and more consistent and maintainable system organization. Author

A86-14850

EXPERT SYSTEMS AND THE 'MYTH' OF SYMBOLIC REASONING

J. DOYLE (Carnegie-Mellon University, Pittsburgh, PA) IEEE Transactions on Software Engineering (ISSN 0098-5589), vol. SE-11, Nov. 1985, p. 1386-1390. refs

(Contract F33615-81-K-1539)

Elements of the artificial intelligence approach to expert systems offer great productivity advantages over traditional approaches to application systems development, even though the end result may be a program employing no AI techniques. These productivity advantages are the hidden truths behind the 'myth' that symbolic reasoning programs are better than ordinary ones. Author

A86-15278

APPLICATIONS OF ARTIFICIAL INTELLIGENCE; PROCEEDINGS OF THE MEETING, ARLINGTON, VA, MAY 3, 4, 1984

J. F. GILMORE, ED. (Georgia Institute of Technology, Atlanta) Meeting sponsored by SPIE - The International Society for Optical Engineering. Bellingham, WA, SPIE - The International Society for Optical Engineering (SPIE Proceedings. Volume 485), 1984, 243 p. For individual items see A86-15279 to A86-15285. (SPIE-485)

Subjects related to expert systems are discussed, taking into account a context dependent automatic target recognition system, computer understanding of air traffic control displays, the role of the image analyst in computer vision, a demonstration of an ocean surveillance information fusion expert system, and the location of multiple faults by diagnostic expert systems. Other topics explored are concerned with knowledge-based systems, autonomous vehicles, and image understanding. Attention is given to aspects of interfacing an intelligent decision-maker to a real-time control system, a reasoning system for computer aided engineering, an 'intelligent' optical design program, an adaptive interpolator algorithm for area-array fine guidance sensors, terrain navigation concepts for autonomous vehicles, the autonomous helicopter system, an autonomous vehicle navigation algorithm, the planning of strategic paths through variable terrain data, the contextual analysis of tactical scenes, and a structural target analysis and recognition system. G.R.

A86-15623*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

AUTOMATION AND ROBOTICS - KEY TO PRODUCTIVITY

A. COHEN (NASA, Johnson Space Center, Houston, TX) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 7 p.

(IAF PAPER 85-32)

The automated and robotic systems requirements of the NASA Space Station are prompted by maintenance, repair, servicing and assembly requirements. Trend analyses, fault diagnoses, and subsystem status assessments for the Station's electrical power,

04 ROBOTICS AND EXPERT SYSTEMS

guidance, navigation, control, data management and environmental control subsystems will be undertaken by cybernetic expert systems; this will reduce or eliminate on-board or ground facility activities that would otherwise be essential, enhancing system productivity. Additional capabilities may also be obtained through the incorporation of even a limited amount of artificial intelligence in the controllers of the various Space Station systems. O.C.

A86-20426* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

FUTURE USES OF MACHINE INTELLIGENCE AND ROBOTICS FOR THE SPACE STATION AND IMPLICATIONS FOR THE U.S. ECONOMY

A. COHEN and J. D. ERICKSON (NASA, Johnson Space Center, Houston, TX) (IEEE, International Conference on Robotics and Automation, St. Louis, MO, Mar. 25-28, 1985) IEEE Journal of Robotics and Automation (ISSN 0882-4967), vol. RA-1, Sept. 1985, p. 117-123. refs

The exciting possibilities for advancing the technologies of artificial intelligence, robotics, and automation on the Space Station is summarized. How these possibilities will be realized and how their realization can benefit the U.S. economy are described. Plans, research programs and preliminary designs that will lead to the realization of many of these possibilities are being formulated.

Author

A86-20507

ROBOTICS AND THE SPACE STATION

J. N. GOWDY (Clemson University, SC) and R. S. WALLACE (Carnegie-Mellon University, Pittsburgh, PA) IN: SOUTHEASTCON '84; Proceedings of the Conference, Louisville, KY, April 8-11, 1984. New York, Institute of Electrical and Electronics Engineers, 1984, p. 173-176.

This paper is based on the authors' activities associated with the NASA/ASEE summer study 'Autonomy and the Human Element in Space' at Stanford University in 1983. The paper considers proposed tasks for robots in connection with space station activities. Generic capabilities needed to execute these tasks are also discussed. It is argued that NASA should sponsor robotics research which is directly connected with space activities.

Author

A86-21889

INTELLIGENT INTERFACES FOR HUMAN CONTROL OF ADVANCED AUTOMATION AND SMART SYSTEMS

A. M. MADNI and A. FREEDY (Perceptronics, Inc., Woodland Hills, CA) IN: EASCON '84; Proceedings of the Seventeenth Annual Electronics and Aerospace Conference, Washington, DC, September 10-12, 1984. New York, Institute of Electrical and Electronics Engineers, 1984, p. 227-232. refs

Today, an important part of robotics research is directed toward the development of intelligent systems which are capable of performing and/or cooperating with the human operator in some of the higher level cognitive functions. The present paper is concerned with the need to incorporate an 'Intelligent Interface' (II) in the considered systems. It is the objective of the II to maximize the performance of an operator-robot system for a given degree of intelligence of the robot and a given level of operator capability. Attention is given to the specific goals of the II, its design architecture, information management aids, tailored feedback, high-level command and query languages, explanation facility, operator-robot task allocation, personalized responses, task performance monitoring and contingency handling, and default responses in structured situations. G.R.

A86-21895#

CAD/CAM DESIGNER - JACK OF ALL TRADES

C. F. HERNDON and R. L. GALLO (General Dynamics Corp., Fort Worth, TX) Aerospace America (ISSN 0740-722X), vol. 24, Jan. 1986, p. 52-54, 56.

Aerospace design engineers are increasingly required to have more extensive knowledge of CAD/CAM tooling and manufacturing methods, in order to ensure that datasets can yield error-free components and assemblies. For structural concept design, engineers will work at the same CAD/CAM workstation on which the final component will be defined, controlling methods that yield the optimum solution for each member of a structural system from the viewpoints of both weight (for given strength) and producibility. O.C.

A86-25033

ASSESSING THE ARTIFICIAL INTELLIGENCE CONTRIBUTION TO DECISION TECHNOLOGY

J. W. SUTHERLAND IEEE Transactions on Systems, Man, and Cybernetics (ISSN 0018-9472), vol. SMC-16, Jan.-Feb. 1986, p. 3-20. refs

The proposition that artificial intelligence (AI) technology is not in fact able to reach to any unique level of analytical authority is presented. Three propositions, in particular, will be elaborated and defended: (1) it has not been demonstrated in the field (nor can it be asserted axiomatically) that AI constructs can endogenously perform the sorts of inference operations that stochastic decision exercises demand; (2) lacking such a capability, AI constructs cannot transcend, but rather must compete with, instruments of the type available from the traditional decision disciplines; and (3) in many instances of such competition, certain properties common to AI constructs might often place them at an efficiency disadvantage relative to alternative technical approaches. On the positive side, however, it also is asserted that many of the more troublesome technical provisions built into AI constructs are merely paradigmatic preferences, not methodological imperatives.

Author

A86-26070#

ARTIFICIAL INTELLIGENCE - THE EMERGING TECHNOLOGY R. P. SHENOY (Electronics and Radar Development Establishment, Bangalore, India) Defence Science Journal (ISSN 0011-748X), vol. 35, April 1985, p. 135-149. refs

The concept of artificial intelligence (AI) is explained, and its potential uses are discussed, with emphasis on the defense applications. The present uses of AI in the areas of target classification and identification, information fusion, land-traversing mobile intelligent robots, and air defense networks are described. The principles and the technology involved in expert systems and computer vision are discussed in detail. I.S.

A86-27167

PERSPECTIVES ON ARTIFICIAL INTELLIGENCE PROGRAM-MING

D. G. BOBROW and M. J. STEFIK (Xerox Research Center, Palo Alto, CA) Science (ISSN 0036-8075), vol. 231, Feb. 28, 1986, p. 951-957. refs

Issues influencing the choice of programming styles for artificial intelligence (AI) applications are discussed. Attention is given to programming language styles based on procedures, objects, logic, rules, and constraints. Programming styles which incorporate multiple-paradigm approach for complex data analysis in physical experiments are also discussed. The development of knowledge-based compilers for planning applications is briefly considered. I.H.

A86-28073* California Univ., La Jolla.

ROBOTICS FOR THE UNITED STATES SPACE STATION J. R. ARNOLD, D. R. CRISWELL (California, University, La Jolla), R. CANNON (Stanford University, CA), R. CLIFF (DARPA, Arlington,

VA), A. COHEN (NASA, Johnson Space Center, Houston, TX) et al. Robotics (ISSN 0167-8493), vol. 1, Dec. 1985, p. 205-222.

Advances in robotics technology that will be necessary for the NASA Space Station to achieve its optimal level of automation are examined. The present state and emerging trends in teleoperator systems, hybrid teleoperated robots, and autonomous robots are reviewed, and scenarios of assembly, inspection, satellite servicing, and manufacturing are presented in order to illustrate potential uses of automation and robotics on the Space Station. Individual important technology development areas for Space Station robotics are surveyed, including end effectors and mechanization, control systems, telepresence and human factors, preception, manipulation in space, operation planning and data bases, and hardware maintenance. C.D.

A86-28497#

EXPERT SYSTEMS FOR SATELLITE STATIONKEEPING

M. M. MEKARU (USAF, Institute of Technology, Wright-Patterson AFB, OH) and M. A. WRIGHT (Electronics Security Command, Fort Meade, MD) IN: NAECON 1985; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1985. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1985, p. 1418-1424. refs

The feasibility of implementing artificial intelligence on satellites is evaluated, with the aim of using an onboard expert system to perform effective stationkeeping functions without assistance from the ground. The Defense Satellite Communication System (DSCS III) is used as an example. The cost for implementing a satellite stationkeeping expert system is analyzed. A ground-based expert system could reduce the current number of support personnel for the stationkeeping task. Results of analyzing a possible flight system are quite promising. An expert system for satellite stationkeeping seems feasible, appears cost-effective, and offers increased satellite endurance through autonomous operations.

D.H.

A86-28498

KNOWLEDGE ENGINEERING FOR A FLIGHT MANAGEMENT EXPERT SYSTEM

 B. M. ANDERSON, J. M. BEAL, C. MCNULTY, and R. C. STERN (Texas Instruments, Inc., Dallas) IN: NAECON 1985; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1985. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1985, p. 1431-1435. refs The development of an F-16 emergency procedures knowledge

The development of an F-16 emergency procedures knowledge base for EPES (emergency procedures expert system) is described. A detailed view of the knowledge acquisition problems is presented, followed by a methodology for efficiently building a knowledge base for emergency procedures. A multiple emergency example is considered (loss of canopy and towershaft failure while cruising at 400 knots above 40,000 feet), where the inference engine resolves a conflict in procedures. D.H.

A86-28515

THE CREW STATION INFORMATION MANAGER - AN AVIONICS EXPERT SYSTEM

L. D. POHLMANN (Boeing Military Airplane Co., Wichita, KS), P. S. MARKS, and M. R. FEHLING (Advanced Information and Decision Systems, Mountain View, CA) IN: NAECON 1985; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1985. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1985, p. 1576-1582. refs

(Contract F33615-83-C-1083)

Progress to date is reported on the development of CSIM, the Crew Station Information Manager, which is a prototype avionics expert system being designed and developed under contract to the Air Force Avionics Laboratory. The function of CSIM is to manage the interface between the pilot and the avionics suite of a future tactical aircraft. A review is given of program motivation and objectives, and a set of avionics expert system candidates is identified. Preliminary development and early simulation are discussed, and near-term plans are outlined in connection with a contract extension sponsored by DARPA. D.H. A86-32538*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. ARTIFICIAL INTELLIGENCE - NASA

J. D. ERICKSON (NASA, Johnson Space Center, Houston, TX) IN: EASCON '85: National space strategy - A progress report; Proceedings of the Eighteenth Annual Electronics and Aerospace Systems Conference, Washington, DC, October 28-30, 1985. New York, Institute of Electrical and Electronics Engineers, Inc., 1985, p. 145-150. refs

Artificial Intelligence (AI) represents a vital common space support element needed to enable the civil space program and commercial space program to perform their missions successfully. It is pointed out that advances in AI stimulated by the Space Station Program could benefit the U.S. in many ways. A fundamental challenge for the civil space program is to meet the needs of the customers and users of space with facilities enabling maximum productivity and having low start-up costs, and low annual operating costs. An effective way to meet this challenge may involve a man-machine system in which artificial intelligence, robotics, and advanced automation are integrated into high reliability organizations. Attention is given to the benefits, NASA strategy for AI, candidate space station systems, the Space Station as a stepping stone, and the commercialization of space. G.R.

A86-33188

EXPERT COMPUTER AIDED DECISION IN SUPERVISORY CONTROL

A. BISSERET (Institut National de Recherche en Informatique et en Automatique, Le Chesnay, France) IN: A bridge between control science and technology. Volume 5. Oxford and New York, Pergamon Press, 1985, p. 2621-2626. refs

Supervisory control is changing from surveillance on large classical control panels to a surveillance on computer displays with the use of man-computer dialogues. The displayed information of course can be sophisticated, and interesting efforts currently pursued in this direction are presented. But moreover it should become possible to have the computer participate directly to the decision activities. The concept of expert system might be promising but only for already expert activity. This paper insists on the non-expert but necessary problem solving activity of the supervisors facing unforeseen situations. The development of research towards computer aid specific to this activity is stressed. Examples of recent advances in cognitive psychology and artificial intelligence are suggested as directions for this development. Author

A86-34986* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocca Beach, Fla.

ARTIFICIAL INTELLIGENCE - NEW TOOLS FOR AEROSPACE PROJECT MANAGERS

D. C. MOJA (NASA, Kennedy Space Center, Cocoa Beach, FL) IN: Space and society - Progress and promise; Proceedings of the Twenty-second Space Congress, Cocoa Beach, FL, April 23-26, 1985 . Cape Canaveral, FL, Canaveral Council of Technical Societies, 1985, p. 12-1 to 12-6. refs

Artificial Intelligence (AI) is currently being used for business-oriented, money-making applications, such as medical diagnosis, computer system configuration, and geological exploration. The present paper has the objective to assess new Al tools and techniques which will be available to assist aerospace managers in the accomplishment of their tasks. A study conducted by Brown and Cheeseman (1983) indicates that AI will be employed in all traditional management areas, taking into account goal setting, decision making, policy formulation, evaluation, planning, budgeting, auditing, personnel management, training, legal affairs, and procurement. Artificial intelligence/expert systems are discussed, giving attention to the three primary areas concerned with intelligent robots, natural language interfaces, and expert systems. Aspects of information retrieval are also considered along with the decision support system, and expert systems for project planning and scheduling. G.R.

04 ROBOTICS AND EXPERT SYSTEMS

A86-37047*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SPACE TELEROBOTICS - A FEW MORE HURDLES

J. E. PENNINGTON (NASA, Langley Research Center, Hampton, VA) IEEE, International Conference on Robotics and Automation, San Francisco, CA, Apr. 8-10, 1986, Paper. 5 p. refs

In the early 1990's, a telerobotic work system which can be used with the Mobile Remote Manipulator System (MRMS) on the Space Station is to become available. However, a number of difficulties have to be overcome before these plans can be realized. The word 'telerobotics' is used in connection with a system which can function as teleoperator, and which, in addition, has also autonomous functions. Thus, as a robot, the system would automatically perform selected operations using multisensory internal feedback for control. A role for telerobotics is defined, taking into account EVA servicing and repair work, remote satellite refueling, and operations during the Space Station development period. Attention is also given to the definition of a telerobotic system, the definition of the telerobotics technology set, and approaches related to the development of a telerobotic system.

G.R.

A86-37624 SMART ROBOTS: A HANDBOOK OF INTELLIGENT ROBOTIC SYSTEMS

 V. D. HUNT New York, Chapman and Hall, 1985, 396 p. refs Smart robots, designed to improve the quality and increase both the productivity and profitability of manufactured goods, are discussed in detail. Attention is focused on: (1) artificial intelligence for smart robots, (2) smart robot systems, (3) sensor-controlled robots, (4) machine vision systems, (5) robot manipulators, (6) locomotion, (7) natural languagae processing, (8) expert systems, and (9) computer integrated manufacturing. Photographs, charts and diagrams illustrate the systems covered. Areas of successful application to date include the automobile industry, textiles, forging, die casting and electronics.

A86-38556

SPACECRAFT SOFTWARE COST ESTIMATION - STRIVING FOR EXCELLENCE THROUGH PARAMETRIC MODELS (A REVIEW) R. SETZER (Rockwell International Corp., Space Transportation Systems Div., Downey, CA) IN: Spacecraft design and operational

problems; Proceedings of the Aerospace Technology Conference and Exposition, Long Beach, CA, October 14-17, 1985. Warrendale, PA, Society of Automotive Engineers, Inc., 1985, p. 47-55. Research supported by the Rockwell International Corp. refs

(SAE PAPER 851907)

This paper provides an overview of software cost estimation, with particular reference to the software of embedded computer systems in spacecraft. The paper provides access to literature on the subject, reviews the major software estimation models with commercially avaiable automated supporting tools, and indicates data indicates data items necessary for accurate estimation. A brief comment on the impact of the introduction of the Ada language on future software development costs and sources of continuing information on software costing conclude this presentation.

Author

A86-40831#

SHARPENING THE SENSES OF INDUSTRIAL ROBOTS

P. K. WRIGHT and P. J. ENGLERT (Carnegie-Mellon University, Pittsburgh, PA) Mechanical Engineering (ISSN 0025-6501), vol. 108, May 1986, p. 58-63.

The capabilities of state-of-the art robotic systems are outlined as well as the improvements needed in the area of external sensing. The hierarchy of abilities for force/torque and tactile feedback is indicated schematically, and it is noted that a robot arm capable of repetitive pick-and-place operations is now well established in industry. Attention is given to these simple sensor and passive compliance robots as well as to active robots which require sensors that give data on local position at the wrist or finger. An active hand that can imitate a human three-fingered grip and allow its active reorientation based on local sensor information is currently the focus of attention. The characteristics, costs and applications of vision systems are also presented, and it is noted that a compromise must be reached between the performance index and processing speed. K.K.

A86-41000

EVALUATING SPACE STATION APPLICATIONS OF AUTOMATION AND ROBOTICS

J. F. BARD (Texas, University, Austin) IEEE Transactions on Engineering Management (ISSN 0018-9391), vol. EM-33, May 1986, p. 102-111. refs

A methodology is presented which can be used to evaluate and rank different approaches to the automation of functions and tasks planned for the NASA Space Station, giving attention to the impact of advanced automation on human productivity. The Analytic Hierarchy Process employed by the methodology allows the introduction of individual judgment to resolve the conflict that arises when incomparable criteria underlie the selection process. The problem is decomposed into simpler subproblems that focus on human productivity, economics, design, and operations. The results from each are then combined to yield final rankings. The selection of an on-orbit assembly system is treated as an illustrative example that encompasses five possible alternatives, yielding computation results and their implications.

A86-41648

WHY COMPUTERS MAY NEVER THINK LIKE PEOPLE

H. DREYFUS and S. DREYFUS (California, University, Berkeley) Technology Review (ISSN 0040-1692), vol. 89, Jan. 1986, p. 42-61.

The problems with computer expert systems based on artificial intelligence are studied. The inability of computers to use intuitive intelligence, which humans learn through experience, is examined. Human thinking with images (holograms) is described. Computers use rules to make logical inferences about facts and can not separate relevant operations from irrelevant ones, and can not compensate for changes. Many computer systems are useful for special functions (microworlds); however, they are not applicable universally. The development expert systems perform better than human beginners; however, they do not equal the skill level of human experts. The successful use of computers in fields such as telecommunications is discussed. The application of artificial intelligence computer systems to military equipment, business fields, and the classroom is analyzed.

A86-42983* Massachusetts Inst. of Tech., Cambridge. TIME OPTIMAL ROBOTIC MANIPULATOR MOTIONS AND WORK PLACES FOR POINT TO POINT TASKS

S. DUBOWSKY (MIT, Cambridge, MA) and T. D. BLUBAUGH (General Motors Corp., Warren, OH) IN: Conference on Decision and Control, 24th, Fort Lauderdale, FL, December 11-13, 1985, Proceedings. Volume 3 . New York, Institute of Electrical and Electronics Engineers, Inc., 1985, p. 1533-1538. refs (Contract NAG1-489)

High productivity requires that manipulators perform complex tasks quickly. Recently, optimal control algorithms have been developed which enable manipulators to move quickly, but only for simple motions. A method is presented here which combines simple time optimal motions in an optimal manner to yield the minimum time motions for an important class of complex manipulator tasks composed of point to point moves, such as assembly, electronic component insertion and spot welding. This method can also be used to design manipulator actions and work places so that tasks can be completd in minimum time. The method has been implemented in a CAD software package. Examples are presented which show the methods effectiveness. Author

A86-43061

A STUDY ON ROBOT PATH PLANNING FROM A SOLID MODEL

Y. ITOH (Onoda Cement Co., Ltd., Tokyo, Japan), M. IDESAWA, and T. SOMA (Institute of Physical and Chemical Research, Wako, Journal of Robotic Systems (ISSN 0741-2223), vol. 3, Japan) Summer 1986, p. 191-203. refs

In an effort to improve current CAD/CAM circumstances, a trial CAE system which generates the operation path of a robot from a solid-model built-in CAD process, has been examined. In this system, solid models are built by performing set operations such as addition, subtraction, and intersection between several primitives or solid models. Processing is made for a solid model represented by B-rep (boundary representation). To ease the processing, curved faces such as spherical, cylindrical, or conical surfaces, are approximated by several flat planes. As a first step, by assuming Gaussian spatial distribution for a painting gun, path planning of a painting robot for a convex solid body has been examined. A scanning plane is defined for each flat plane and a path of robot effector is generated on this plane. Author

A86-43884

STATE OF THE ART IN INTELLIGENT/BRILLIANT ROBOTS

R. HONG (Grumman Aerospace Corp., Bethpage, NY) IN AUTOTESTCON '85; Proceedings of the International Automatic Testing Conference, Uniondale, NY, October 22-24, 1985 . New York, Institute of Electrical and Electronics Engineers, 1985, p. 75-80. refs

The state of the art of intelligent/brilliant robots of various types which will be in operation in the next decades is addressed. These are robots which will possess human-like capabilities and beyond. As such, they will generally be implemented with artificial intelligence technology such as knowledge based/expert systems. Learning and self adaptive capabilities are also being applied to these future robots. Author

N86-11194*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERT SYSTEMS DEVELOPMENT AND APPLICATION

E. L. DUKE and V. A. REGENIE Oct. 1985 8 p Presented at the IEEE Symp. on Expert Systems in Govt., McLean, Va., 23-25 Oct. 1985

(NASA-TM-86746; H-1310; NAS 1.15:86746) Avail: NTIS HC A02/MF A01 CSCL 01C

Current research in the application of expert systems to problems in the flight research environment is discussed. In what is anticipated to be a broad research area, a real time expert system flight status monitor has been identified as the initial project. This real time expert system flight status monitor is described in terms of concept, application, development, and schedule.

Author

N86-11195*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DESCRIPTION OF AN EXPERIMENTAL EXPERT SYSTEM FLIGHT STATUS MONITOR

E. L. DUKE and V. A. REGENIE Oct. 1985 11 D refs Presented at the 5th AIAA Computers in Aerospace Conf., Long Beach, Calif., 21-23 Oct. 1985

(NASA-TM-86791; H-1317; NAS 1.15:86791; AIAA-85-6042-CP) Avail: NTIS HC A02/MF A01 CSCL 01C

This paper describes an experimental version of an expert system flight status monitor being developed at the Dryden Flight Research Facility of the NASA Ames Research Center. This experimental expert system flight status monitor (ESSFSM) is supported by a specialized knowledge acquisition tool that provides the user with a powerful and easy-to-use documentation and rule construction tool. The EESFSM is designed to be a testbed for concepts in rules, inference mechanisms, and knowledge structures to be used in a real-time expert system flight status monitor that will monitor the health and status of the flight control system of state-of-the-art, high-performance, research aircraft. Author

N86-13027# Allied Bendix Corp., Kansas City, Mo. KNOWLEDGE-BASED SYSTEMS: HOW WILL THEY AFFECT MANUFACTURING IN THE 80'S

M. S. KING, S. L. BROOKS, and R. M. SCHAEFER Apr. 1985 19 p refs Presented at the ASME Intern. Computers in Eng. Conf. and Exhibition, Boston, 4 Aug. 1985

(Contract DE-AC04-76DP-00613)

(DE85-010601; BDX-613-3185; CONF-850862-1) Avail: NTIS HC A02/MF A01

Knowledge-based or expert systems have been in various stages of development and use for a long time in the academic world. Some of these systems have come out of the lab in recent years in the fields of medicine, geology, and computer system design. The use of knowledge-based systems in conjunction with manufacturing process planning and the emerging CAD/CAM/CAE technologies promises significant increases in engineering productivity. Areas in manufacturing where knowledge-based systems could most benefit the engineer and industry are emphasized. DOE

N86-14611# Joint Publications Research Service, Arlington, Va. IMPLEMENTATION OF COMPUTER-AIDED PRODUCTION SYSTEMS DETAILED

G. ZEMANN In its East Europe Report: Science and Technology (JPRS-ESA-85-034) p 34-40 18 Nov. 1985 Transl. into ENGLISH from Fertigungstechnik und Betrieb (East Berlin), v. 35, no. 6, 1985 p 329-331 Avail: NTIS HC A05/MF A01

Metal-forming combine technique, the material and technical basis of prouction was continually expanded and modernized. Today nearly every fifth machine tool involved in primary production is an numerical control(NC) or computer numerical control (CNC) machine. Complex, automated technological solutions, e.g., the cutting and precise machining of flat plate-type components in the production of large welded machine assemblies, can be compared with corresponding technologies of any manufacturer in this branch of industry. The software packages developed during the past 15 years, cover many different areas of application, such as graphics capability for design-related and technological problems, data base systems for managing technical source data, interactive work station for complex planning and balance sheet models, process data systems for production control problems and many more. Since the first electronic data processing systems were introduced at the end of the 1960's production volume has increased five times. Two generations of metal-forming machines are added in the meantime. E.A.K.

N86-18053# Los Alamos National Lab., N. Mex. EXPERT SYSTEMS FOR DESIGN AND SIMULATION

J. ALDRIDGE, J. CERUTTI, W. DRAISIN, and M. STEUERWALT Presented at the AIAA/NASA Symposium on 1985 43 p Automation, Robotics and Advanced Computing for the National Space Program, Washington, D.C., 4 Sep. 1985 (Contract W-7405-ENG-36)

(DE85-017565; LA-UR-85-2838; CONF-8509149-1) Avail: NTIS HC A03/MF A01

We discuss work in progress on two expert systems. We are developing systems that use artificial intelligence techniques to simplify the use of large simulation codes and to help design complicated physical devices. The simulation codes are used in analyzing and designing weapons, and the devices are themselves part of weapon systems. But we focus not only on the particular applications, but also on the broader issues common to design problems: large solution spaces and tentative reasoning. We also discuss some practical difficulties encountered during the project. One expert system provides an interface between users and several simulation codes. It checks input for errors, builds input files for the codes, and submits jobs to a central computing facility. The other expert system helps turn a description of a device into a particular design. Currently this expert system includes three major parts: a translator of descriptions into designs, a graphics interface that presents the design to the user and allows him to manipulate

04 ROBOTICS AND EXPERT SYSTEMS

it, and a refiner of designs. The latter is the smartest part of the system, and the target of much of our present efforts. DOE

N86-18736# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

A ROBUST LAYERED CONTROL SYSTEM FOR A MOBILE ROBOT

R. A. BROOKS Sep. 1985 28 p

(Contract N00014-82-K-0334; N00014-80-C-0505)

(AD-A160833; AI-M-864) Avail: NTIS HC A03/MF A01 CSCL 09B

We describe a new architecture for controlling mobile robots. Layers of control system are built to let the robot operate at an increasing level of competence. Layers are made up of asynchronous modules which communicate over low bandwidth channels. Each module is an instance of a fairly simple computational machine. Higher level layers can subsume the roles of lower levels by suppressing their outputs. However, lower levels continue to function as higher levels are added. The result is a robust and flexible robot control system. The system is intended to control a robot that wanders the office areas of our laboratory, building maps of its surroundings. In this paper, we demonstrate the system controlling a detailed simulation of the robot. GRA

Royal Signals and Radar Establishment, Malvern N86-19634# (England). Integrated Air Defence Systems Div. APPLICATIONS OF EXPERT SYSTEMS

P. R. WETHERALL In AGARD Artificial Intelligence and Robotics Sep. 1985 refs 17 p

Avail: NTIS HC A07/MF A01

An Expert System contains a knowledge base, an inference engine, an explanation system, a model of the real world and a man machine interface. The types of reasoning include interpretation, monitoring, prediction and design, together with specializations of these, such as diagnosis and planning, and aggregations, such as debugging, instruction and control. A range of possible applications are described to illustrate these general tasks. The nature of the knowledge available, and some implementation problems, are identified. The applications include examples in the area of tactical decision aids, specifically sensor data interpretation, data fusion, threat assessment and resource allocation. Other topics include cockpit environments and intelligent tutoring. Finally, some of the problems that limit the immediate widespread adoption of the technology are discussed. Author

N86-20014# IIT Research Inst., Chicago, III. Manufacturing Technology Information Analysis Center. APPLICATIONS ARTIFICIAL INTELLIGENCE IN

MANUFACTURING R. H. COOK Oct. 1985 59 p

(Contract DLA900-84-C-1508)

(AD-A161161; MTIAC-TA-85-01) Avail: NTIS HC A04/MF A01 ČSCL 09B

Developments in the field of artificial intelligence hold great promise for applications in the factory of the future. However, the technology and applications are still in an early stage of emergence. The literature of the last few years has been surveyed to develop a profile of the state of this emergence. This, coupled with interviews with workers heavily involved in the application of Al, shows that within the AI family of technologies expert systems dominate current applications. The next year promises to be very active as true production expert systems begin to appear. This won't be without problems, however. Several references are recommended for initial reading in AI, and lists of products, programs, and players in the field are included. Author (GRA)

N86-21220*# VAIR, Inc., Williamsburg, Va.

IMPLEMENTATION OF ARTIFICIAL INTELLIGENCE RULES IN A DATA BASE MANAGEMENT SYSTEM

S. FEYOCK Feb. 1986 64 p refs (Contract NAS1-18002)

(NASA-CR-178048; NAS 1.26:178048) Avail: NTIS HC A04/MF A01 CSCL 09B

The intelligent front end prototype was transformed into a RIM-integrated system. A RIM-based expert system was written which demonstrated the developed capability. The use of rules to produce extensibility of the intelligent front end, including the concept of demons and rule manipulation rules were investigated. Innovative approaches such as syntax programming were to be considered. B.G.

N86-22955# Sandia National Labs., Albuquerque, N. Mex. ALLOCATION OF TASKS TO ROBOTS FOR IMPROVED SAFETY

D. S. KESSEL Oct. 1985 8 p refs Presented at the National Safety Council Congress, New Orleans, La., 30 Oct. 1985

(Contract DE-AC04-76DP-00789)

(DE86-002366; SAND-85-2386C; CONF-8510193-1) Avail: NTIS HC A02/MF A01

The paper points out the potential contributions of industrial robots to the improvement of safety in the workplace. Ergonomic evaluation techniques were identified which may be used to identify overly stressful tasks which may result in overexertion injuries.

DOE

N86-23603*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DEVELOPMENT EXPERIENCE WITH A SIMPLE EXPERT DEMONSTRATOR FOR PILOT EMERGENCY SYSTEM PROCEDURES

M. VANNORMAN and D. A. MACKALL Feb. 1986 17 p refs (NASA-TM-85919; H-1272; NAS 1.15:85919) Avail: NTIS HC A02/MF A01 CSCL 01C

Expert system techniques, a major application area of artificial intelligence (AI), are examined in the development of pilot associate to handle aircraft emergency procedures. The term pilot associate is used to describe research involving expert systems that can assist the pilot in the cockpit. The development of expert systems for the electrical system and flight control system emergency procedures are discussed. A simple, high-level expert system provides the means to choose which knowledge domain is needed. The expert systems were developed on a low-cost. FORTH-based package, using a personal computer. Author

N86-23954# New Mexico Univ., Albuquerque.

TASK PLANNING FOR CONTROL OF A SENSOR-BASED ROBOT

R. C. LENNOX, G. F. LUGER, and R. W. HARRIGAN Dec. 1985 36 p Prepared in cooperation with Sandia National Labs., Albuquerque, N. Mex.

(Contract DE-AC04-76DP-00789)

(DE86-004225; SAND-85-0958) Avail: NTIS HC A03/MF A01

This paper is divided into four major sections. The first is an introduction to the research area. The second provides a brief overview of the history of planning in artificial intelligence (AI), while the third part of the paper describes the representational power of very-high-level computer languages and how this power may be brought to planning in robotics research. Finally, we describe our PROLOG-driven Planner for controlling a PUMA arm used for object manipulation and note the future directions of this DOE work.

N86-24687*# National Aeronautics and Space Administration. Dryden (Hugh L.) Flight Research Center, Edwards, Calif. AN ENGINEERING APPROACH TO THE USE OF EXPERT

SYSTEMS TECHNOLOGY IN AVIONICS APPLICATIONS

E. L. DUKE, V. A. REGENIE, M. BRAZEE, and R. W. BRUMBAUGH (PRC Kentron, Edwards, Calif.) May 1986 12 p refs Presented at the IEEE National Aerospace and Electronics Conference (NAECON), Dayton, Ohio, 19-23 May 1986

(NASA-TM-88263; H-1364; NAS 1.15:88263) Avail: NTIS HC A02/MF A01 CSCL 01D

The concept of using a knowledge compiler to transform the knowledge base and inference mechanism of an expert system into a conventional program is presented. The need to accommodate real-time systems requirements in applications such as embedded avionics is outlined. Expert systems and a brief comparison of expert systems and conventional programs are reviewed. Avionics applications of expert systems are discussed before the discussions of applying the proposed concept to example systems using forward and backward chaining. Author

N86-25173# Stanford Univ., Calif. Dept. of Computer Science. **DECISION PROCEDURES**

M. I. GINSBERG May 1985 24 p

(Contract N00014-81-K-0004)

(AD-A163049; SU-STAN-CS-85-1064) Avail: NTIS HC A02/MF A01 CSCL 12A

Distributed artificial intelligence is the study of how a group of individual intelligent agents can combine to solve a difficult global problem; the usual approach is to split the original problem into simpler ones and to attack each of these independently. This paper discusses in very general terms the problems which arise if the subproblems are not independent, but instead interrelate in some way. We are led to a single assumption, which we call common rationality, that is provably optimal (in a formal sense) and which enables us to characterize precisely the communication needs of the participants in multi-agent interactions. An example of a distributed computation using these ideas is presented.

GRA

N86-25808# Massachusetts Univ., Amherst. Dept. of Mechanical Engineering.

ECONOMIC APPLICATIONS OF ASSEMPLY ROBOTS. ECONOMIC ANALYSIS AND CLASSIFICATION SYSTEMS FOR **ROBOT ASSEMBLY**

Y. S. HO and G. BOOTHROYD Feb. 1985 149 p refs

(Contract NSF MEA-81-11917)

(PB86-154465; NSF/ENG-85044; REPT-5) Avail: NTIS HC A07/MF A01 CSCL 131

The report concerns production costs and focuses on the importance of giving proper consideration to manufacturing and assembly during the part and product design process. Types of robots and robot assembly systems are identified. Part design rules and corresponding classification systems for products to be assembled on these systems are described. Worksheets and equations for the draft design for robot assembly techniques are presented; their use is illustrated; and the effect of product redesign is discussed. A case study is included and a comparison of assembly costs and cycle times for various types of assembly systems is given. Author (GRA)

N86-26062# Joint Publications Research Service, Arlington, Va. ROLE OF ROBOTICS IN SOLVING PRODUCTION, SOCIAL PROBLEMS

Y. P. POPOV In its USSR Report: Science and Technology Policy (JPRS-UST-86-011) p 60-71 31 Mar. 1986 refs Avail: NTIS HC A04

The implementation of automation and information policies by robotic systems is discussed. The robotic systems are divided into four different groups: (1) manipulation; (2) mobility; (3) information; and (4) control. The use of industrial robots to replace people and also to solve the shortage of human resources is outlined. The use of special instrument complexes in the development of the information part of the control systems of

adaptive robots and their software is outlined. The role of information science in the development of industrial robotics, in general, and in flexible machine systems, in particular, is enumerated. eak

N86-27663# Commerce Dept., Washington, D.C. **ROBOT END EFFECTOR Patent Application**

A. SLOCOM, (inventors to Commerce) and P. JURGENS, (inventors to Commerce) 13 Feb. 1986 19 p

(PB86-166042; US-PATENT-APPL-SN-6-829052) Avail: NTIS HC A02/MF A01 CSCL 131

The invention relates to manipulating devices, and in particular relates to an end effector or gripper attachable to a robot for mechanically grasping and orienting objects. GRA

N86-29120# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

EXPLOITING SEQUENTIAL PHONETIC CONSTRAINTS IN **RECOGNIZING SPOKEN WORDS**

D. P. HUTTENLOCHER Oct. 1985 28 p

(Contract N00014-80-C-0505)

(AD-A165913; AI-M-867) Avail: NTIS HC A03/MF A01 CSCL 05H

Machine recognition of spoken language requires developing more robust recognition algorithms. A recent study by Shipman and Zue suggest using partial descriptions of speech sounds to eliminate all but a handful of word candidates from a large lexicon. The current paper extends their work by investigating the power of partial phonetic descriptions for developing recognition algorithms. First, we demonstrate that sequences of manner of articulation classes are more reliable and provide more constraint than certain other classes. Alone these results are of limited utility, due to the high degree of variability in natural speech. This variability is not uniform however, as most modifications and deletions occur in unstressed syllables. Comparing the relative constraint provided by sounds in stressed versus unstressed syllables, we discover that the stressed syllables provide substantially more constraint. This indicates that recognition algorithms can be made more robust by exploiting the manner of articulation information in stressed syllables. GRA

N86-29220# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

SENSING STRATEGIES FOR DISAMBIGUATING AMONG **MULTIPLE OBJECTS IN KNOWN POSES**

W. E. L. GRIMSON Aug. 1985 38 p (Contract N00014-80-C-0505; N00014-82-K-0334)

(AD-A165912: AI-M-855) Avail: NTIS HC A03/MF A01 CSCL 12A

The need for intelligent interactions of a robot with its environment frequently requires sensing of the environment. Further, the need for rapid execution requires that the interaction between sensing and action take place using as little sensory data as possible, while still being reliable. Previous work has developed a technique for rapidly determining the feasible poses of an object from sparse, noisy, occluded sensory data. This paper examines techniques for acquiring position and surface orientation data about points on the surface of objects, with the intent of selecting sensory points that will force a unique interpretation of the pose of the object with as few data points as possible. Under some simple assumptions about the sensing geometry a technique for predicting optimal sensing positions is derived. The technique has been implemented and tested. To fully specify the algorithm, needed are estimates of the error in estimating the position and orientation of the object, and derived are analytic expressions for such error for the case of one particular approach to object Author (GRA) recognition.

N86-29229# Los Alamos National Lab., N. Mex.

APPLICATION OF TELEOPERATOR EXPERTISE TO ROBOTICS

D. L. GRISHAM and J. E. LAMBERT 1985 10 p Presented at the Robots Conference, Chicago, Ill., 20 Apr. 1986 (Contract W-7405-ENG-36)

(DE86-003659; LA-UR-85-4066; CONF-860487-3) Avail: NTIS HC A02/MF A01

The evolution, capabilities and accomplishments of the Monitor remote handling system are discussed. It is suggested that the equipment and operational expertise can be applied to robotic systems in radioactive and other hostile environments. The Monitor methods of operation, the tooling devised and employed and the applications of these methods to robotic systems are described. DOE

N86-29234# Lawrence Livermore National Lab., Calif. VARIABLE STRUCTURE MODEL FOLLOWING CONTROL DESIGN FOR ROBOTICS APPLICATIONS

K. D. YOUNG Feb. 1986 17 p Presented at the IEEE International Conference on Robotics and Automation, San Francisco, Calif., 14 Apr. 1986

(Contract W-7405-ENG-48)

(DE86-008136; UCRL-94074; CONF-860434-6) Avail: NTIS HC A02/MF A01

The increased demand on robotic system performance leads to the use of advanced control strategies. In this paper a variable structure model following control design is proposed for robotics applications. DOE

N86-29513*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SPACE TELEOPERATION RESEARCH. AMERICAN NUCLEAR SOCIETY EXECUTIVE CONFERENCE: REMOTE OPERATIONS AND ROBOTICS IN THE NUCLEAR INDUSTRY; REMOTE MAINTENANCE IN OTHER HOSTILE ENVIRONMENTS

A. J. MEINTEL, JR. and R. W. WILL 1985 51 p Presented at the Executive Conference on Remote Operations and Robotics in the Nuclear Industry, Pine Mountain, Ga., 21 Apr. 1985 (NASA-TM-89234; NAS 1.15:89234; DE85-902186;

CONF-850425-5) Avail: NTIS HC A04/MF A01 CSCL 05H

This presentation consists of four sections. The first section is a brief introduction to the NASA Space Program. The second portion summarized the results of a congressionally mandated study of automation and robotics for space station. The third portion presents a number of concepts for space teleoperator systems. The remainder of the presentation describes Langley Research Center's teleoperator/robotic research to support remote space operations. DOE

N86-29557# Los Alamos National Lab., N. Mex. EXPERT ASSISTANTS FOR DESIGN

J. ALDRIDGE, J. CERUTTI, W. DRAISIN, and M. STEUERWALT 1986 12 p Presented at the 1st International Conference on Applications of AI to Engineering Problems, Southhampton, England, 1 Apr. 1986

(Contract W-7405-ENG-36)

(DE86-003679; LA-UR-85-3970; CONF-860472-1) Avail: NTIS HC A02/MF A01

Two expert programs currently under development at the Los Alamos National Laboratory, PROCON and the Designer's Apprentice, are briefly described. Both codes define interface to simulations that provide a wide variety of information about the performance of complex devices. DOE

N86-30387# Allied Bendix Corp., Kansas City, Mo. INTELLIGENT N/C CONTROLLERS

V. E. GROSS Oct. 1985 4 p Presented at the Joint Meeting of the CAM-I Advance Numerical Control (ANC), Process Planning (PP), and Quality Assurance Programs, Arlington, Tex., 30 Oct. 1985

(Contract DE-AC04-76DP-00613)

(DE86-003132; BDX-613-3398; CONF-8510211-1) Avail: NTIS HC A02/MF A01

The objective of this presentation is to initiate the discussion for the eventual preparation of a specification for intelligent numerical control N/C controllers. The items in this presentation are not intended to be all inclusive. This is a starting point for the research and preparation required to develop a specification. The intelligent N/C controller is defined and requirements, standards, and benefits are discussed. Development of specifications is recommended. DOE

N86-30390# Allied Bendix Corp., Kansas City, Mo. ROBOTIC SIMULATION

B. L. PECK Feb. 1986 9 p

(Contract DE-AC04-76DP-00613)

(DE86-006517; BDX-613-3410) Avail: NTIS HC A02/MF A01

Simulation software offers great potential for cost savings and added assurance of maximum efficiency in manufacturing operations. It is estimated that 60 to 80% of a total robotic work cell implementation effort is involved in layout, equipment design, robot selection, and hardware mock up of the cell. The remainder of the effort is taken up with programming and final refinements made on the shop floor. Simulation techniques are also contributing significantly to development of offline programming. Simulation programs can offer a major cost savings. DOE

N86-30397# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.

REPORT ON THE AI TRIP R. P. VANDERIET Mar. 1984 51 p

(IR-82; ETN-86-97320) Avail: NTIS HC A04/MF A01

The imbedding of AI in the whole of computer science; equipment; communication; and VLSI in the UK, USA, and Canada are discussed. Contacts between universities and industry are treated. ESA

N86-30412# Sandia National Labs., Albuquerque, N. Mex. SENSOR DRIVEN ROBOT SYSTEMS TESTBED

R. W. HARRIGAN 1986 18 p Presented at the SPIE Technical Symposium on Applications of Artificial Intelligence, Orlando, Fla., 31 Mar. 1986

(Contract DE-AC04-76DP-00789)

(DE86-005892; SAND-85-2032C; CONF-860366-1) Avail: NTIS HC A02/MF A01

Intelligent robot systems which operate in a semiautonomous fashion (i.e., the operator serves only as a high level supervisor) require the integration of sensors and mechanisms coupled by intelligent software. Since robot systems operate in the real world with imperfect knowledge of that world, error recovery is an important aspect of any control strategy. Configured with a 6 degree-of-freedom robot manipulator, two dimensional vision and force sensing, the Sensor Driven Robot Systems Testbed offers an environment for the development of control concepts for intelligent machine systems. The Sensor Driven Robot Systems Testbed has led to the development of active sensing concepts using complementary sensors and a highly modular control software concept. Both concepts are currently being implemented within the testbed environment. N86-30581# Essex Corp., Goleta, Calif. Human Factors Research Div.

TECHNOLOGY TRANSFER AND ARTIFICIAL INTELLIGENCE R. R. MACKIE and C. D. WYLIE Dec. 1985 147 p (Contract N62269-83-D-0115) (AD-A166035; TR-51231-1) Avail: NTIS HC A07/MF A01 CSCL 05A

The purpose of this study was to identify critical user acceptance issues in applying artificial intelligence (AI) technology (e.g., expert systems) to military decision aids, and to develop a technology transfer plan. The application of new technology does not necessarily yield a good product, and even good products do not necessarily succeed on their own merits. Product development and introduction must consider the perspectives of potential users, especially when use of the innovation can be regarded as optional. The officers generally expressed optimism about the potential value of AI. However, negative beliefs held by many officers need to be considered carefully. A number of general design issues were identified, and several man-machine interface preferences were determined, including the desire for: display of historical data on request: use of probability estimates; embedded training and on-line tutorial; auto mode settings with user override; easy updating; suggestive rather than authoritative output; and brief rather than conversational output. A technology transfer plan based on the findings of this study is presented which stresses communications with potential users, involvement of users in design, design for acceptance, and demonstration. GRA

N86-31270# Argonne National Lab., III. AUTOMATED REASONING: BASIC RESEARCH PROBLEMS L. WOS Mar. 1986 40 p

(Contract W-31-109-ENG-38)

(DE86-009214; ANL/MCS-TM-67) Avail: NTIS HC A03/MF A01

In this paper, we present some of the open research problems in the field of automated reasoning. By collecting these problems in one place, we intend to stimulate research and thus reduce the time required to reach one of the primary objectives of the field. That objective is to design and implement a computer program that functions as a high-level automated reasoning assistant. This paper is intended for new researchers as well as those who have been active in the field. We therefore include an overview of automated reasoning itself, touching on the basic elements, various examples and some of its applications. The existence of single automated reasoning programs that have provided valuable assistance in answering open questions in mathematics and logic, designing superior circuits, validating existing circuit designs, and proving properties of computer programs establishes the usefulness and versatility of such programs. The degree of assistance future automated reasoning programs will offer depends on which of the open problems cited in this paper are solved. DOF

N86-31271# Oak Ridge National Lab., Tenn. REAL-TIME PRODUCTION SYSTEM FOR INTELLIGENT ROBOT CONTROL

G. DESAUSSURE, D. KAMMER, and C. R. WEISBIN 1986 13 p Presented at the National Conference on Artificial Intelligence, Philadelphia, Pa., 11 Aug. 1986

(Contract DE-AC05-84OR-21400)

(DE86-008501; CONF-860848-1) Avail: NTIS HC A02/MF A01

The use of a production system for the control of an autonomous robot presents several attractive features: the explicitness and homogeneity of the knowledge representation facilitates explaining, verifying and modifying the rules which determine the robot's behavior; it also permits the intremental extension of the domain of competence. However, real-time operation poses a number of challenges due to the dynamic nature of the data and because the system must frequently deal with a large knowledge base in a limited time. An implementation of a knowledge base is discussed where a large commercial real-time expert system originally designed for industrial process diagnostic was adapted to the control of an autonomous mobile robot planning, executing and monitoring a set of navigational tasks. DOE

COMPUTERS AND INFORMATION MANAGEMENT

Includes Information Systems and Theory, Information Dissemination and Retrieval, Management Information Systems, Database Management Systems and Databases, Data Processing, Data Management, Communications and Communication Theory, Documentation and Information Presentation, Software, Software Acquisition, Software Engineering and Management, Computer Systems Design and Performance, Configuration Management (Computers), Networking, Office Automation, Information Security.

A86-10948#

CONSIDERATIONS FOR THE IMPLEMENTATION OF INTELLIGENT WORKSTATION NETWORKS

H. JACOBSON and A. GORDON (Boeing Aerospace Co., Seattle, WA) AIAA, AHS, and ASEE, Aircraft Design Systems and Operations Meeting, Colorado Springs, CO, Oct. 14-16, 1985. 6 p. (AIAA PAPER 85-4001)

Intelligent workstations linked together in Local Area Networks (LANS) are ushering in a new era in engineering/scientific computing. Powerful interactive graphics software and high resolution output presentation capabilities can now be provided economically at the engineer's desk. Paperless electronic data flows between functions and departments are technically feasible. This paper describes the Boeing Aerospace Company's experiences with the initial deployment of intelligent workstations in LANS. The issues discussed include in-house customer relations, software vendors, user experiences, potential pitfalls, and future plans. Author

A86-11412#

THE DISCIPLINE OF SOFTWARE ACQUISITION

R. J. SYLVESTER (Mitre Corp., Bedford, MA) IN: Computers in Aerospace Conference, 5th, Long Beach, CA, October 21-23, 1985, Technical Papers . New York, AIAA, 1985, p. 92-95. (AIAA PAPER 85-5056)

This paper advocates the recognition of software acquisition within the context of system acquisition as a budding discipline worthy of specific study, research and promulgation. The paper focuses on the software related qualifications, tasks and responsibilities of an acquisition agent (either in government or industry) to assure a successful, contracted development. Issues of user expectation, requirements impacts, initial trade studies, project specification, and source selection are explored at a fundamental level. The need for 'in-house' and 'in-application' experience on the part of the acquisition agent is explored. The paper further discusses the relationship between the acquisition agent and the developing contractor from the perspective of software acquisition. The paper concludes with the definition of specific research needs in the areas of tools for predicting software efforts based on high level system requirements, methods for achieving low-risk and high performance designs, and guidelines for determining appropriate levels of testing during development and at acceptance. Author

A86-11445#

USING AUTOMATED TOOLS TO REDUCE SOFTWARE COSTS AND INSURE SYSTEM INTEGRITY

S. P. FRIED, D. R. STIRTZ, and B. DEVITT (General Electric Co., Space Systems Div., Philadelphia, PA) IN: Computers in Aerospace Conference, 5th, Long Beach, CA, October 21-23, 1985, Technical Papers . New York, AIAA, 1985, p. 333-348. refs (AIAA PAPER 85-6013)

The paper examines how software development productivity can be increased with cost reductions, while generating easily maintainable/reliable software. The traditional software development life cycle is examined, and a sampling is presented of automated tools currently on the market which are categorized by their functionality within the phases of the software life cycle. Finally, the concept, requirements, and implementation considerations are presented for an automated tool which incorporates the positive features of currently used development tools with additional features to enhance its general functionality. It is noted that this tool (termed the Total System Development Tool) will be fully able to incorporate the standards of contemporary large-scale projects and fourth-generation languages. **B.**1

A86-17769

SYSTEM ARCHITECTURE FOR PARTITION-TOLERANT DISTRIBUTED DATABASES

S. K. SARIN, C. W. KAUFMAN (Computer Corporation of America, Cambridge, MA), and B. T. BLAUSTEIN (Computer Corporation of America, Alexandria, VA) IEEE Transactions on Computers (ISSN 0018-9340), vol. C-34, Dec. 1985, p. 1158-1163. DARPA-supported research. refs

(Contract F30602-84-C-0112)

An overview is presented of an approach to distributed database design that emphasizes high availability in the face of network partitions and other communication failures. This approach is appropriate for applications that require continued operation and can tolerate some loss of integrity of the data. Each site presents its users and application programs with the best possible view of the data that it can, based on those updates that it has received so far. Mutual consistency of replicated copies of data is ensured by using timestamps to establish a known total ordering on all updates issued, and by a mechanism that ensures the same final result regardless of the order in which a site actually receives these updates. A mechanism is proposed, based on alerters and triggers, by which applications can deal with exception conditions that may arise as a consequence of the high-availability architecture. A prototype system that demonstrate this approach is near completion. Author

A86-21317

NEXT-GENERATION COMPUTERS

E. A. TORRERO, ED. New York, IEEE Press, 1985, 359 p. No individual items are abstracted in this volume.

Developments related to tomorrow's computers are discussed, taking into account advances toward the fifth generation in Japan, the challenge to U.S. supercomputers, plans concerning the creation of supersmart computers for the U.S. military, a U.S. industry response to the Japanese challenge, a survey of U.S. and European research, Great Britain, the European Common Market, codifying human knowledge for machine reading, software engineering, the next-generation softwave, plans for obtaining the million-transistor chip, and fabrication issues for next-generation circuits. Other topics explored are related to a status report regarding artificial intelligence, an assessment of the technical challenges, aspects of sociotechnology, and defense advanced research projects. Attention is also given to expert systems, speech recognition, computer vision, function-level programming and automated programming, computing at the speed limit, VLSI, and 'superpower' computers. G.R.

A86-21973* Honeywell, Inc., Bloomington, Minn. OPTICAL PROCESSING FOR FUTURE COMPUTER NETWORKS

A. HUSAIN, P. R. HAUGEN, L. D. HUTCHESON (Honeywell Physical Sciences Center, Bloomington, MN), J. WARRIOR (Honeywell Technology Strategy Center, Roseville, MN), N. MURRAY, and M. BEATTY (NASA, Langley Research Center, Hampton, VA) Optica Jan. 1986, p. 108-116. Optical Engineering (ISSN 0091-3286), vol. 25, refs (Contract NAS1-17657)

In the development of future data management systems, such as the NASA Space Station, a major problem represents the design and implementation of a high performance communication network which is self-correcting and repairing, flexible, and evolvable. To obtain the goal of designing such a network, it will be essential to incorporate distributed adaptive network control techniques. The present paper provides an outline of the functional and communication network requirements for the Space Station data management system. Attention is given to the mathematical representation of the operations being carried out to provide the required functionality at each layer of communication protocol on the model. The possible implementation of specific communication functions in optics is also considered. GR

A86-25999

SADDLE - A COMPUTER-AIDED STRUCTURAL ANALYSIS AND DYNAMIC DESIGN LANGUAGE. I - DESIGN SYSTEM. II -DATABASE MANAGEMENT SYSTEM

S. D. RAJAN (Arizona State University, Tempe) and M. A. BHATTI (Iowa, University, Iowa City) Computers and Structures (ISSN 0045-7949), vol. 22, no. 2, 1986, p. 185-212. refs This paper is concerned with the general-purpose, FEM-based

optimal design system SADDLE. SADDLE stands for Structural Analysis and Dynamic Design LanguagE. The term 'Dynamic' signifies that changes in design concepts can be reflected in the design system with a minimum of effort. The design system uses powerful features of database management, numerical techniques, computer graphics, finite element analysis, and nonlinear programming methods. The system is linked to preprocessors and postprocessors which ease input and display of user and computed data. Attention is given to system arrangement and capabilities, the execution modes, the user-interface for design, utility libraries, the creation of the design module, the optimization technique, numerical examples, and the shape optimal design of trusses.

G.R.

A86-26005

AUTOMATION IN THE COCKPIT - WHO'S IN CHARGE?

R. W. MOSS, J. M. REISING, and N. R. HUDSON (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) ĨN: Aerospace Behavioral Engineering Technology Conference, 3rd, Long Beach, CA, October 15-18, 1984, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 25-29. refs (SAE PAPER 841534)

This paper discusses levels of automation and decision making and arrives at an overall design philosophy for allocating tasks to the pilot and the computer. In order to produce a levels of automation matrix three categories of pilot-computer interface (pilot only, blended, and computer only) and three types of goals, (mission, functional and task), are identified. These two dimensions are then used to create a matrix which can be employed as a means of comparing automated systems. The options that the matrix produces are discussed and examples given. The overall design philosophy is to have the mission goals accomplished in a blended manner with both the pilot and computer contributing. Lower level goals are handled exclusively by the computer. The reasoning for this philosophy is to allow the pilot to operate in a rule-based environment so that he can optimally cope with the greatly increased amounts of information he will face in future missions. Author

A86-27166

COMPUTER NETWORKING FOR SCIENTISTS

D. M. JENNINGS, W. R. ADRION (NSF, Washington, DC), L. H. LANDWEBER (Wisconsin, University, Madison), I. H. FUCHS (Princeton University, NJ), and D. J. FARBER (Delaware, University, Science (ISSN 0036-8075), vol. 231, Feb. 28, 1986, p. Newark) 943-950. refs

The development of integrated computer networks for scientific computing and communications applications is described. Emphasis is given to efforts by the NASF Office of Advanced Scientific Computing (OASC) to develop a national supercomputer access network called NSFnet. NSFnet will incorporate existing local computing networks and a common set of networking protocol standards, which are based on the DARPA ARPANET protocol. ARPANET is an advanced networking R&D testbed for DARPA and an operational network supporting DARPA-sponsored researchers in universities, national laboratories, and industry. Computer networking for academic institutions not participating in ARPANET is provided by BITNET, a store-and-forward network which uses standard telephone links and has a capacity of 9600

bps. Specialized wide-area networks include the Magnetic Fusion Energy Research Network (MFENET) and the UUCP network, which provides electronic mail and file transfer between graphics workstations in the UNIX BSD 4.2 operating system. The development of state-wide and campus networks to connect microcomputers to distant supercomputing facilities is also discussed. I.H.

A86-28409

ADA INSTRUCTIONAL TECHNIQUES FOR MANAGERS AND PROGRAMMERS

B. NEBEN (SofTech, Inc., Fairborn, OH) IN: NAECON 1985; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1985. Volume 1 . New York, Institute of Electrical and Electronics Engineers, 1985, p. 691-698. refs

In February 1983, the military standard for Ada was adopted as an American National Standard, and DOD intends to accelerate its use of Ada. In this context, it is estimated that at least 400,000 persons in DOD need some software engineering with Ada awareness. The objective of Ada education and training is to ensure that quality software engineering is accomplished within DOD in order to reduce the life cycle cost of software development. Attention is given to the high and escalating cost of software, the histories of Higher Order Languages (HOLs) and differences related Ada, software engineering issues, aspects of program to construction, the transition to Ada and the need to use a special approach when teaching Ada, traditional software coding, the development of a complete recommended Ada curriculum, and the U.S. Army Model Ada Training Curriculum which defines a comprehensive set of training modules. G.R.

A86-28415

SOFTWARE QUALITY AND SOFTWARE PRODUCTIVITY

J. TSAI (Boeing Computer Services Co., Professional Services Group, Renton, WA) IN: NAECON 1985; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1985. Volume 1 . New York, Institute of Electrical and Electronics Engineers, 1985, p. 734-737. USAF-supported research. refs

The use of software quality metrics technology may permit an improved software products quality and lower its life-cycle costs. A software quality model was established in which hierarchical, user-oriented quality factors are at the top level, with more software-oriented criteria and metrics at the second and third levels, respectively. Metrics worksheets were designed for use in gathering the metrics data. Actual project data were gathered, and the resultant metrics data were analyzed. The reusability quality factor was evaluated on four major projects. Productivity figures from the projects were used to estimate the effort spent to reuse software; and good correlation between these productivity measures and system reusability metric scores were obtained. The effects of software quality on the software development are further analyzed. In conclusion, following the quality metrics methodology may not only reduce future software maintenance costs and produce better software products, but it can also improve software development productivity. Author

A86-28416

SOFTWARE AUTOMATION

W. J. BROWNLOW and J. R. ELSTON (Boeing Aerospace Co., Seattle, WA) IN: NAECON 1985; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1985. Volume 1 . New York, Institute of Electrical and Electronics Engineers, 1985, p. 738-744.

On the basis of trends regarding software supply and demand conditions, it appears imperative to implement overall software productivity improvement programs. Such programs are now needed by DOD and defense contractors. In this context, efforts should be undertaken to reduce the amount of manual involvement in the development of software. Improvements are needed with respect to the standardization of the development effort, the expanded use of automation, rapid prototyping, the employment of reusable software, and increased quality. An initiative established by senior management of an American aerospace company commits this company to a ten year program with the objective to increase productivity in the development of mission-critical and related software. A description is given of an automated software engineering (base) project. G.R.

A86-28422#

PLANNING FOR COST/SCHEDULE CONTROL IN A SOFTWARE DEVELOPMENT PROJECT

O. MACK, JR. (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) IN: NAECON 1985; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1985. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1985, p. 778-785. refs

The transition from an estimate of the size, cost, and schedule of a software development project to a manageable contract is examined with reference to a case study of a hypothetical company's proposal. The discussion covers the implications of the Cost/Schedule Control Systems Criteria and the impacts of the Price-S and COCOMO models. The processes presented here are based on the experiences of many current avionics software projects. V.L.

A86-28423

A SOFTWARE MANAGEMENT TOOL

H. VILLARREAL, JR. (Honeywell, Inc., Minneapolis, MN) IN: NAECON 1985; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1985. Volume 1 . New York, Institute of Electrical and Electronics Engineers, 1985, p. 786-793.

This paper describes a software management tool that enhances the Software Engineering Manager's ability to properly plan and control a software development project and properly report its progress. This tool has evolved as a result of experience on the Air Data, Fuel Quantity Indicating System and 737 IRS Digital-to-Analog Adapter projects at Honeywell's Commercial Aviation Division. The software management tool is: (1) easily automated using a microcomputer and modern spreadsheet program, (2) flexible for easy modification as it evolves during the project, and (3) readily adaptable to other types of development projects.

A86-28424

A NEW PERSPECTIVE ON SOFTWARE MANAGEMENT

K. B. HAWKS (General Electric Co., Aerospace Electronic Systems Dept., Utica, NY) IN: NAECON 1985; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1985. Volume 1 . New York, Institute of Electrical and Electronics Engineers, 1985, p. 794-797.

Typical problems associated with software development management are briefly reviewed, and an approach is proposed whereby software is viewed as a continuum of development. The allocation of requirements to software from overall system perspective, systems analysis, software scheduling, software design and coding, software testing, and maintenance are then discussed from the standpoint of the continuum concept. It is shown that the application of the continuum concept can significantly reduce the cost of software development and maintenance, while increasing its reliability. V.L.

A86-28425

SOFTWARE MANAGEMENT FOR INTEGRATED AVIONICS SYSTEMS

K. C. EDWARDS (Harris Corp., Government Aerospace Systems Div., Melbourne, FL) IN: NAECON 1985; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1985. Volume 1 . New York, Institute of Electrical and Electronics Engineers, 1985, p. 798-805. refs

Software engineering methodologies providing the level of control necessary to achieve cost effective software development for an integrated avionics software system are discussed with particular reference to the integrated software system for the

05 COMPUTERS AND INFORMATION MANAGEMENT

Agusta A-129 Light Attack Helicopter. The high level of control is required to maintain the functional independence of the different software elements (e.g., Automated Flight Controls, Engine Monitor, Operator Interface, Navigation, and others) in order to avoid unnecessary couplings that will drive the cost of the system development and maintenance up while reducing the reliability of the system. As a result of an implementation of this approach, the software development costs for the Agusta A-129 project have been comparable to less complex ground-based systems. V.L.

A86-28427

A PROVEN SOFTWARE PROJECT AUDIT METHODOLOGY

M. C. BRIDGES (General Dynamics Corp., St. Louis, MO) IN: NAECON 1985; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1985. Volume 1 . New York, Institute of Electrical and Electronics Engineers, 1985, p. 822-825. refs

Information is presented on how to conduct a software audit and report the current status and effectiveness of a software development project. Some of the more commonly observed problems in software development are outlined, and four sub-audit categories are described, including documentation audit, in-depth examination of software configuration management activities, evaluation of the code mechanization process, and assessment of the effectiveness of test planning and implementation. A schedule of a software audit and a sample report are described. The information presented in this paper can be used as a guide in performing a comprehensive yet concise software audit at any stage of software development. V.L.

A86-28482

THE ENGINEERING DATA MANAGEMENT AND ANALYSIS SYSTEM (EDMAS)

T. W. LEZNIAK (Boeing Military Airplane Co., Wichita, KS) IN: NAECON 1985; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1985. Volume 2 . New York, Institute of Electrical and Electronics Engineers, 1985, p. 1277-1284. USAF-supported research.

A large (several tens of thousands of program statements), integrated collection of computer programs, written primarily in Fortran 77, has been developed in connection with a program to flight test the Offensive Avionics Systems Block 0 improvements to the B-52 aircraft. This Engineering Data Management and Analysis System (EDMAS) was needed to provide timely data analysis when the testing schedule was accelerated to as many as three flights per week. The system turnaround interval from the time a routine data product is requested until it is recieved is less than 30 minutes. Primary functions are performed interactively with the user at a computer terminal. A library of general-purpose analysis programs is provided. Author

A86-28578* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SHUTTLE ENVIRONMENT DATABASE

M. LAURIENTE (NASA, Goddard Space Flight Center, Greenbelt, MD) and G. W. SHARP (Eyring Research Institute, Provo, UT) IN: Europe/United States space activities . San Diego, CA, Univelt, Inc., 1985, p. 25-36.

(AAS 85-103)

The proceedings of a workshop on the development of a data base for the Space Shuttle environment are summarized. The data base is intended for use by experimenters in designing scientific payloads for Shuttle missions. The status of currently available data on the Shuttle environment is reviewed, with emphasis given to ten specific topics which are believed to be of concern to Shuttle experiment designers. These topics include: flight dynamics, vibration and acoustics, orbiter motion effects, EMI, and thermal and humidity effects. Attention is also given to: the Shuttle particulate environment; surface interactions inside and on the exterior of the spacecraft, and the natural Shuttle environment. Recent experimental results concerning Vehicle Glow on the spacecraft surface material are discussed in detail. A schematic diagram describing the functional organization of computer hardware for the Shuttle environment data base is provided. I.H.

A86-34981

INFORMATION SYSTEMS IN SPACE

D. S. WEHRLY (IBM Corp., Endicott, NY) IN: Space and society - Progress and promise; Proceedings of the Twenty-second Space Congress, Cocoa Beach, FL, April 23-26, 1985 . Cape Canaveral, FL, Canaveral Council of Technical Societies, 1985, p. 9-11 to 9-13.

The application of information management techniques to space is proposed. Examples of ground-based industrial information systems are described. The development of space information system from existing ground-based designs, and the formation of a space-earth interface are examined.

A86-35657

ESTABLISHING SOFTWARE QA - AN EXERCISE IN FRUSTRATION

K. W. FROBERG (Bell Helicopter Textron, Fort Worth, TX) IN: American Helicopter Society, Annual Forum, 41st, Fort Worth, TX, May 15-17, 1985, Proceedings . Alexandria, VA, American Helicopter Society, 1985, p. 769-775. refs

A discussion is presented on experience obtained to date concerning the establishment of Software Quality Assurance (SQA) disciplines in new computer software-related ventures. Attention is given to guidelines established for the organization of personnel recruitment and the apportionment of responsibilities. SQA policies and procedures are outlined which may result in the prevention of serious cost and schedule overruns in software development efforts. O.C.

A86-38807#

ASTROS - AN ADVANCED SOFTWARE ENVIRONMENT FOR AUTOMATED DESIGN

D. L. HERENDEEN, R. L. HOESLY (Universal Analytics, Inc., Playa del Rey, CA), E. H. JOHNSON (Northrop Corp., Hawthorne, CA), and V. B. VENKAYYA (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN: Structures, Structural Dynamics and Materials Conference, 27th, San Antonio, TX, May 19-21, 1986, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1986, p. 59-66. refs (Contract F33615-83-C-3232)

(AIAA PAPER 86-0856)

The 'ASTROS' Automated Structural Optimization System combines a general purpose executive, a scientific data base management system, and a problem-oriented control language into a powerful and flexible tool for the design of engineering application software. The primary function of such software is the integration of specific functional modules from existing sources into a cohesive system for automated aerospace structure design; this encompasses, in addition to finite element methods, static and dynamic structural characteristics, aerodynamics, sensitivity analysis, optimization, and control systems. O.C.

A86-38868#

INTEGRATED STRUCTURAL ANALYSIS FOR RAPID DESIGN SUPPORT

D. G. WONG and C. R. FULLER (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: Structures, Structural Dynamics and Materials Conference, 27th, San Antonio, TX, May 19-21, 1986, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1986, p. 638-645. refs (AIAA PAPER 86-1010)

A system incorporating the latest developments in computer hardware and software has been implemented for the design support of advanced launch vehicle programs. The system requirements, hardware, and system and application software attributes are discussed in detail, and evidence demonstrating the effectiveness of the integrated structural analysis system is presented. The discussion includes a specific list of equipment, network communication links, system architecture, codings standards, and data structures for application software. The system has been operating successfully for two years. V.L.

A86-40845

ARTIFICIAL INTELLIGENCE APPLICATIONS ON SUPERCOM-PUTERS

R. J. DOUGLASS (Martin Marietta Corp., Denver, CO) Telematics and Informatics (ISSN 0736-5853), vol. 2, no. 4, 1985, p. 289-292. DOE-sponsored research. refs

In contrast to many scientific applications that perform computations on fixed-size arrays, symbolic programs process complex data structures represented as lists, sets, and graphs that are allocated and deallocated in a variable pattern during execution. Much of the processing in symbolic computation involves following linked lists by tracing chains of pointers through scattered locations in memory. Execution speeds for single serial processors are therefore limited by the time it takes to make random retrievals of individual words of data from memory. Author

A86-43905

THE IMPACT OF FIFTH GENERATION TECHNOLOGY ON TEST SOFTWARE

R. P. PATROVIC (Grumman Aerospace Corp., Bethpage, NY) IN: AUTOTESTCON '85; Proceedings of the International Automatic Testing Conference, Uniondale, NY, October 22-24, 1985. New York, Institute of Electrical and Electronics Engineers, 1985, p. 432-445. refs

Major advances in technology are occurring at a geometric rate. The so called 'Fifth Generation' will see superfast systems with new and very divergent architectures, at the heart of which will be highly dense chips of greater than one million semiconductors. Programming these systems and testing UUTs that incorporate this technology will become an increasingly complex challenge. A greater emphasis and reliance will be placed on software: concurrent programming, efficient algorithm development, and Artificial Intelligence. This paper discusses some of the implications Fifth Generation technology is having and will have on test software, both at the application level and at the system level. Author

A86-45470

ADVANCES IN SOFTWARE INSPECTIONS

M. E. FAGAN (IBM Thomas J. Watson Research Center, Yorktown Heights, NY) IEEE Transactions on Software Engineering (ISSN 0098-5589), vol. SE-12, July 1986, p. 744-751. refs

This paper presents new studies and experiences that enhance the use of the inspection process and improve its contribution to development of defect-free software on time and at lower costs. Examples of benefits are cited followed by descriptions of the process and some methods of obtaining the enhanced results. Software inspection is a method of static testing to verify that software meets its requirements. It engages the developers and others in a formal process of investigation that usually detects more defects in the product - and at lower cost - than does machine testing. Users of the method report very significant improvements in quality that are accompanied by lowwer development costs and greatly reduced maintenance efforts. Excellent results have been obtained by small and large organizations in all aspects of new development as well as in maintenance. There is some evidence that developers who participate in the inspection of their own product actually create fewer defects in future work. Because inspections formalize the development process, productivity and quality enhancing tools can be adopted more easily and rapidly. Author

A86-46104

PLANNING DESIGN AND IMPLEMENTATION OF A STATEWIDE GEOGRAPHIC INFORMATION SYSTEM

G. S. SMITH and W. G. HENDRIX (Vermont, University, Burlington) IN: ASP, Annual Meeting, 51st, Washington, DC, March 10-15, 1985, Technical Papers. Volume 2 Falls Church, VA, American Society of Photogrammetry, 1985, p. 576-584.

The planning, design, and implementation of a geographically referenced database are described. A geographic information system (GIS) is designed to store, retrieve, manipulate, analyze, and display spatial data; the advantages of a GIS are discussed. The procedures involved in the design of a GIS are: (1) an analysis of the information needs, (2) the categorization and evaluation of existing databases, (3) the specifications of the new database to be developed, (4) the selection of the system's hardware and software, and (5) the development of an implementation plan. The selection of data layers, base map parameters, and a georeferencing system is examined. Methods of data entry such as manual digitizing, raster scanning or video digitizing, the incorporation of existing computer data, and image processing are studied. A GIS for the state of Vermont with a database consisting of seven data layers (soil maps, land cover, transportation networks, political boundaries, stream and river courses, topography and watershed) was developed. 1 F

A86-46952#

AN OPERATIONS MANAGEMENT SYSTEM FOR THE SPACE STATION

H. G. ROSENTHAL (TRW, Inc., Redondo Beach, CA) AIAA, Space Station in the Twenty-first Century, Meeting, Reno, NV, Sept. 3-5, 1986. 10 p.

(AIAA PAPER 86-2329)

This paper presents an overview of the conceptual design of an integrated onboard Operations Management System (OMS). Both hardware and software concepts are presented and the integrated space station network is discussed. It is shown that using currently available software technology, an integrated software solution for Space Station management and control, implemented with OMS software, is feasible. Author

A86-49488* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

TOWARDS A SCIENCE OF EXPERT SYSTEMS

P. J. DENNING (NASA, Ames Research Center, Moffett Field, CA) IEEE Expert (ISSN 0885-9000), vol. 1, Summer 1986, p. 80-83. refs

(Contract NAS2-11530)

Developments in the field of AI are discussed. The components and applications of expert systems, which are computer systems designed to simulate the problem-solving behavior of a person expert in a narrow field, are examined. Two types of expert systems, shallow and deep, are described and examples are given. A logic programming system, rule-based system, and framed-based system are utilized as means of representing the expert system's data base. The limitations of expert systems are considered. I.F.

A86-49552*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

AUTOMATION AND ROBOTICS FOR SPACE STATION IN THE TWENTY-FIRST CENTURY

K. F. WILLSHIRE (NASA, Langley Research Center, Hampton, VA) and D. L. PIVIROTTO (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) AIAA, Space Station in the Twenty-first Century, Meeting, Reno, NV, Sept. 3-5, 1986. 7 p. refs

(AIAA PAPER 86-2300)

Space Station telerobotics will evolve beyond the initial capability into a smarter and more capable system as we enter the twenty-first century. Current technology programs including several proposed ground and flight experiments to enable development of this system are described. Advancements in the areas of machine vision, smart sensors, advanced control architecture, manipulator joint design, end effector design, and

05 COMPUTERS AND INFORMATION MANAGEMENT

artificial intelligence will provide increasingly more autonomous telerobotic systems. Author

A86-49872

THE RIGHT STUFF

J. S. ZIMMERMAN (OAO Corp., Hampton, VA) Datamation (ISSN 0011-6963), vol. 32, Jan. 15, 1986, p. 75-80.

Some of the lessons learned from working on the development of the software system for NASA's Earth Radiation Budget Experiment are discussed. The design strategy finally adopted during the system development included phased system releases, the use of rapid prototyping, and continuous and readily accepted changes in system specification. Based on the experience gained in the course of development, 16 recommendations are offered for future workers in the software development for projects of similar complexity. I.S.

A86-50280

FIFTH GENERATION COMPUTERS: CONCEPTS, IMPLEMENTATIONS AND USES

P. BISHOP (Peter Bishop Associates, Richmond, England) Chichester, England/New York, Ellis Horwood, Ltd./John Wiley and Sons, 1986, 166 p. refs

The advanced computers, incorporating artificial-intelligence and parallel-processing technologies, which are being developed in Japan, the U.S., and Europe for the 1990s are characterized in an introductory survey intended for students and users of information technology. Topics examined include artificial intelligence, fifth-generation programs, overall architectures, hardware, software engineering, programming languages, and intelligent knowledge-based systems. Consideration is given to intelligent user interfaces; the economic and military impact of fifth-generation computers; and their potential industrial, military, commercial, design, and educational applications. Diagrams, flow charts, sample command sequences, and a glossary of terms are provided.

N86-10841# Los Alamos Scientific Lab., N. Mex. FRAMEWORK FOR GENERATING EXPERT SYSTEMS TO PERFORM COMPUTER SECURITY RISK ANALYSIS

S. T. SMITH and J. J. LIM 1985 8 p Presented at the 1st Ann. AFCEA Symp. and Exposition on Phys. and Electron. Security, Philadelphia, 19 Aug. 1985

(Contract W-7405-ENG-36)

(DE85-014134; LA-UR-85-1933; CONF-850885-2) Avail: NTIS HC A02/MF A01

A framework to generate knowledge based expert systems for performing automated risk analyses upon a subject system was developed. The expert system is a computer program that models experts' knowledge about A topic, including facts, assumptions, insights, and decision rationale. The subject system is a member of the class of systems with three identifying characteristics: (1) a set of desirable assets (or targets); (2) a set of adversaries (or threats) desiring to obtain or to do harm to the assets; and (3) a set of protective mechanisms to safeguard the assets from the adversaries. Risk analysis evaluates both vulnerability to and the impact of successful threats against the targets by determining the overall effectiveness of the subject system safeguards, identifying vulnerabilities in that set of safeguards, and determining cost effective improvements to the safeguards. The inherent vulnerabilities and risks in a system of computer security safeguards are evaluated. The method considers safeguards protecting four generic targets. The automated procedure to assess the effectiveness of computer security safeguards differs from traditional risk analysis methods. DOF

N86-13224*# National Aeronautics and Space Administration, Washington, D.C.

INDEX TO NASA NEWS RELEASES AND SPEECHES, 1984 1985 163 p

(NASA-TM-87514; NAS 1.15:87514) Avail: NTIS HC A08/MF A01 CSCL 05B

The Index to NASA News Releases and Speeches (1984) contains selected speeches and news releases issued by NASA Headquarters during the year 1984. The index was prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautical and Space Administration by PRC Government Information Systems. F.M.R.

N86-15171*# McDonnell-Douglas Technical Services Co., Inc., Houston, Tex.

TECHNICAL AND MANAGEMENT INFORMATION SYSTEM: THE TOOL FOR PROFESSIONAL PRODUCTIVITY ON THE SPACE STATION PROGRAM

G. MONTOYA and P. BOLDON *In* NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 149-164 1985 refs

Avail: NTIS HC A25/MF A01 CSCL 05A

The Space Station Program is highly complex not only in its technological goals and requirements but also in its organizational structure. Eight Contractor teams supporting four NASA centers plus Headquarters must depend on effective exchange of information--the lifeblood of the program. The Technical and Management Information System (TMIS) is the means by which this exchange can take place. Value of the TMIS in increasing productivity comes primarily from its ability to make the right information available to whomever needs it when it is needed. Productivity of the aerospace professional and how it can be enhanced by the use of specifically recommended techniques and procedures for information management using the TMIS are discussed.

N86-15173*# Mitre Corp., Houston, Tex. COMPUTER SYSTEMS MEASURES

F. T. CRUCIAN *In* NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 177-191 1985

Avail: NTIS HC A25/MF A01 CSCL 09B

In determining the productivity of a computing capacity, two of the costs to be considered are: the cost of lost productivity (user lost time) due to inadequate computer resources; and the cost of increasing the capacity of the computer system to reduce user's lost time. This document presents the results of a study conducted at NASA/JSC. The purpose of the study was to relate the cost of users' lost time to the cost of increased computer resources. The goal of the study was to identify the overall least cost to the computing facility. The document describes a survey designed to identify the user's lost time and the computer resource requirement to the reduce lost time. The results of the survey are presented showing the trade off between user's lost time and cost of increasing system capacity.

N86-15174*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

OFFICE AUTOMATION: THE ADMINISTRATIVE WINDOW INTO THE INTEGRATED DBMS

G. H. BROCK *In* NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 192-201 1985

Avail: NTIS HC A25/MF A01 CSCL 05B

In parallel to the evolution of Management Information Systems from simple data files to complex data bases, the stand-alone computer systems have been migrating toward fully integrated systems serving the work force. The next major productivity gain may very well be to make these highly sophisticated working level Data Base Management Systems (DMBS) serve all levels of management with reports of varying levels of detail. Most attempts by the DBMS development organization to provide useful information to management seem to bog down in the quagmire of competing working level requirements. Most large DBMS development organizations possess three to five year backlogs. Perhaps Office Automation is the vehicle that brings to pass the Management Information System that really serves management. A good office automation system manned by a team of facilitators seeking opportunities to serve end-users could go a long way toward defining a DBMS that serves management. This paper will briefly discuss the problems of the DBMS organization, alternative approaches to solving some of the major problems, a debate about problems that may have no solution, and finally how office automation fits into the development of the Manager's Management Information System.

N86-15180*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

SOFTWARE PRODUCTIVITY IMPROVEMENT THROUGH SOFTWARE ENGINEERING TECHNOLOGY

F. E. MCGARRY *In* NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 249-263 1985 refs

Avail: NTIS HC A25/MF A01 CSCL 09B

It has been estimated that NASA expends anywhere from 6 to 10 percent of its annual budget on the acquisition, implementation and maintenance of computer software. Although researchers have produced numerous software engineering approaches over the past 5-10 years; each claiming to be more effective than the other, there is very limited quantitative information verifying the measurable impact that any of these technologies may have in a production environment. At NASA/GSFC, an extended research effort aimed at identifying and measuring software techniques that favorably impact productivity of software development, has been active over the past 8 years. Specific, measurable, software development technologies have been applied and measured in a production environment. Resulting software development approaches have been shown to be effective in both improving quality as well as productivity in this one environment. Author

N86-15183*# Arizona State Univ., Tempe. School of Public Affairs.

INFORMATION FLOW AND WORK PRODUCTIVITY THROUGH INTEGRATED INFORMATION TECHNOLOGY

R. T. WIGAND *In* NASA. Johnson (Lyndon B.) R and D Productivity: New Challenges for the US Space Program p 289-309 1985 refs

Avail: NTIS HC A25/MF A01 CSCL 05B

The work environment surrounding integrated office systems is reviewed. The known effects of automated office technologies is synthesized and their known impact on work efficiency is reviewed. These effects are explored with regard to their impact on networks, work flow/processes, as well as organizational structure and power. Particular emphasis is given to structural changes due to the introduction of newer information technologies in organizations. The new information technologies have restructed the average organization's middle banks and, as a consequence, they have shrunk drastically. Organizational pyramids have flattened with fewer levels since executives have realized that they can get ahold of the needed information via the new technologies quicker and directly and do not have to rely on middle-level managers. Power shifts are typically accompanied with the introduction of these technologies resulting in the generation of a new form of organizational power. B.W.

N86-18246# Oak Ridge National Lab., Tenn. INFORMATION SYSTEMS DEVELOPMENT AIDS M. L. EMRICH and R. BRYANT Aug. 1985 117 p (Contract DE-AC05-84OR-21400)

(DE85-018161; ORNL/TM-9647) Avail: NTIS HC A06/MF A01

Information engineers use a variety of techniques, procedures and methodologies to specify, design, program, test, and maintain Information Systems. Various automated tools are available for assisting the information engineer in this work. This document seeks to provide a general overview of the development life-cycle process and of tools available for assisting in that process. DOE N86-19022*# Maryland Univ., College Park. Dept. of Computer Science.

QUANTITATIVE EVALUATION OF SOFTWARE METHODOLOGY

V. R. BASILI Jul. 1985 22 p

(Contract NSG-5123; F49620-80-C-0001)

(NASA-CR-176522; NAS 1.26:176522; AD-A160202; CS-TR-1519; AFOSR-85-0803TR) Avail: NTIS HC A02/MF A01 CSCL 09B

This paper presented a paradigm for evaluating software development methods and tools. The basic idea is to generate a set of goals which are defined into quantifiable questions which specify metrics to be collected on the software development and maintenance process and product. These metrics can be used to characterize, evaluate; predict and motivate. They can be used in an active as well as passive way by learning from analyzing the data and improving the methods and tools based upon what is learned from that analysis. Several examples were given representing each of the different approaches to evaluation.

Author (GRA)

N86-19251# Sandia National Labs., Albuquerque, N. Mex. ESTABLISHING A SUCCESSFUL MANAGEMENT INFORMATION SYSTEM FOR PROJECT MANAGEMENT

D. M. JOHNSTON 1985 8 p Presented at the Project Management Institute Seminar, Denver, Colo., 7 Oct. 1985 (Contract DE-AC04-76DP-00789)

(DE85-018543; SAND-84-2401C; CONF-8510154-2) Avail: NTIS HC A02/MF A01

This paper presents the process we followed to achieve a successful management information system. Like many other organizations who decide to utilize a computer system to provide usable management information to aid in decision making, we found ourselves instead entangled in myriad of data items and details and complex and convoluted software programs, but no achievement of any management information, i.e., that which could be applied to aid in decision making. Since I have observed that this condition occurs in many organizations, our experience may provide insight to others struggling with nonexistent or cumbersome management information systems and guide them in the formulation of an effective MIS.

N86-19630# Lehigh Univ., Bethlehem, Pa. Inst. for Robotics. ROBOT SOFTWARE: CURRENT STATE-OF-THE-ART, AND FUTURE CHALLENGES

R. N. NAGEL and S. R. GARRIGAN *In* AGARD Artificial Intelligence and Robotics 9 p Sep. 1985 Avail: NTIS HC A07/MF A01

Robot software system and their complexity currently are growing at an incredible rate. A complexity hierarchy covering the simplest methods of robot programming up through first and second generation robot programming languages is defined. Methods o' graphical robot programming are described, and an assessment is made of the current state of the art of robotic software systems. The next generation of robot software systems which will be task level languages is described. That is, the elements of the programming language will be statements of tasks to be accomplished rather than statements with regard to robot motions. Technical challenges in achieving task level languages and current research approaches to overcoming these challenges are also described.

N86-19955# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Environmental Lab.

COMPUTER TECHNIQUES FOR PRODUCING COLOR MAPS Final Report

A. N. WILLIAMSON, JR. Aug. 1985 43 p Original contains color illustrations

(Contract DA PROJ. 4A1-62719-AT-40)

(AD-A161159; WES/MP/GL-85-13) Ávail: NTIS HC A03/MF A01 CSCL 08B

This report discusses a technique for encoding maps in a manner that permits rapid production of window maps and color separations. The discussion includes a description of equipment,

data processing procedures, and an example of their use for verifying quantitative terrain information for input to an analytical model. A derivation used to portray the output of the Army Mobility Model as a vehicle performance map is described in an appendix. Author (GRA)

National Aeronautics and Space Administration. N86-19965*# Goddard Space Flight Center, Greenbelt, Md.

A COMPARISON OF SOFTWARE VERIFICATION TECHNIQUES Apr. 1985 116 p refs

(NASA-TM-88585; NAS 1.15:88585; SEL-85-001) Avail: NTIS HC A06/MF A01 CSCL 09B

A controlled experiment performed by the Software Engineering Laboratory (SEL) to compare the effectiveness of code reading. functional testing, and structural testing as software verification techniques is described. The experiment results indicate that code reading provides the greatest error detection capability at the lowest cost, whereas structural testing is the least effective technique. The experiment plan is explained, the experiment results are described, related results from other studies are discussed. The application of these results to the development of software in the flight dynamics environment is considered. Appendices summarize the experiment data and list the test programs. Author

N86-19966*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. SOFTWARE VERIFICATION AND TESTING

Dec. 1985 65 p refs

(NASA-TM-88587; NAS 1.15:88587; SEL-85-005) Avail: NTIS HC A04/MF A01 CSCL 09B

General procedures for software verification and validation are provided as a guide for managers, programmers, and analysts involved in software development. The verification and validation procedures described are based primarily on testing techniques. Testing refers to the execution of all or part of a software system for the purpose of detecting errors. Planning, execution, and analysis of tests are outlined in this document. Code reading and static analysis techniques for software verification are also described. Author

N86-22168# Defense Systems Management School, Fort Belvoir, Va.

ARTIFICIAL INTELLIGENCE AND ITS USE IN COST TYPE ANALYSES WITH AND EXAMPLE IN COST PERFORMANCE MEASUREMENT

B. BERKOWITZ 1985 40 p Presented at the Annual Department of Defense Cost Analysis Symposium, Leesburg, Va., 17-20 Sep. 1985

(AD-A161817) Avail: NTIS HC A03/MF A01 CSCL 14A

With the advent of ARTIFICIAL INTELLIGENCE (AI), we are entering into a new age of man/machine/software combined effectiveness. AlL offers us, not only, user friendly application packages and interfaces, but a major boost in our effectiveness planes. The user friendliness is one aspect of AI, but there are other elements that make this technology a major extension of the human mind. This paper will explore just two applications and their use in the analysis world. The first aspect examined is: user friendliness. The other aspect discussed is expert systems. GRA

N86-23315*# National Aeronautics and Space Administration, Washington, D.C.

SPACE STATION: THE ROLE OF SOFTWARE

D. HALL In NASA. Langley Research Center Space Station Software Recommendations p 3-38 Dec. 1985 Avail: NTIS HC A07/MF A01 CSCL 09B

Software will play a critical role throughout the Space Station

Program. This presentation sets the stage and prompts participant interaction at the Software Issues Forum. The presentation is structured into three major topics: (1) an overview of the concept and status of the Space Station Program; (2) several charts designed to lay out the scope and role of software; and (3) information addressing the four specific areas selected for focus at the forum, specifically: software management, the software development environment, languages, and standards. NASA's current thinking is highlighted and some of the relevant critical Author issues are raised.

N86-24278# Administrative Sciences Corp., Alexandria, Va. **RISK ASSESSMENT PREPROCESSOR (RAPP)**

C. HAMMON, J. AUGUSTA, and S. FITZGERALD 1985 14 p Presented at the 19th Annual Dept. of Defense Cost Analysis Symposium, Leesburg, Va., 17-20 Sep. 1985 (AD-A161914) Avail: NTIS HC A02/MF A01 CSCL 09B

The Navy's Office for Acquisition Research tasked Administrative Sciences Corporation to develop a management oriented procedure to simplify the selection of the most appropriate risk assessment technique(s) so that project managers will use them to improve management of their programs. Under this tasking the different techniques available for risk assessment were examined and it was concluded that network simulation is both cost effective and feasible for use in almost all acquisition programs. As a result of a critical review of the existing procedures and available software packages, it was concluded that front-end help in getting started was necessary - specifically, assistance in network creation and data preparation and input. The risk assessment preprocessor (RAPP) was created to provide this help. The RAPP is a computer-based procedure for simplifying the process of creating networks and preparing the data for use with a network simulator. RAPP is interactive, easy to use software which will help the user create a network of program activities and input distribution parameters. It does not actually do the risk assessment. The RAPP's output is a data file which is input to one of the several currently available network simulators. It is a tool that makes risk assessment using Monte Carlo simulation easier and less expensive because it reduces the need for senior analysts to structure the network and prepare the data file for input to a risk assessment package. The RAPP allows risk assessment to be used more easily as a tool for project management. GRA

N86-24285# Lawrence Livermore National Lab., Calif. PASSCAL FIELD DATA MANAGEMENT PLAN (PFDMP)

J. SCHEIMER, G. PAVLIS, D. BLANKENSHIP, R. PHINNEY, S. MALONE, B. KARSH, C. JOHNSON, and W. PROTHERO Aug. 1985 28 p

(Contract W-7405-ENG-48)

(DE86-003192; UCID-20575) Avail: NTIS HC A03/MF A01

The PFDMP is the official planning document for PASSCAL in the area of field data management. It is to be revised and updated from time to time to reflect up-to-date status of the effort. This planning document is concerned less with hardware than with the functional requirements for the field computer systems. Given the rapid changes now happening in the technology of microcomputers and peripherals, it may be safety assumed that systems procured at diferent times will involve different vendors and have different capabilities, costs and specifications. A salient goal is to define the software and database environments with enough flexibility to allow these different models of field computers to function well in the overall data management environment. DOE

N86-24737*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A COMPUTER MODELING METHODOLOGY AND TOOL FOR ASSESSING DESIGN CONCEPTS FOR THE SPACE STATION DATA MANAGEMENT SYSTEM

W. R. JONES Apr. 1986 45 p refs

(NASA-TM-87647; NAS 1.15:87647) Avail: NTIS HC A03/MF A01 CSCL 22B

A computer modeling tool is being developed to assess candidate designs for the Space Station Data Management System (DMS). The DMS is to be a complex distributed computer system including the processor, storage devices, local area networks, and software that will support all processing functions onboard the Space Station. The modeling tool will allow a candidate design for the DMS, or for other subsystems that use the DMS, to be evaluated in terms of parameters. The tool and its associated modeling methodology are intended for use by DMS and subsystem designers to perform tradeoff analyses between design concepts using varied architectures and technologies. Author

N86-25999# Stanford Univ., Calif. Dept. of Statistics. DATA BASE MANAGEMENT: PROCEEDINGS OF A CONFERENCE

31 Jul. 1985 307 p refs Conference held in Monterey, Calif., 1-2 Nov. 1984

(Contract N00014-76-C-0476; NR PROJ. 042-267)

(AD-A158285) Avail: NTIS HC A14/MF A01 CSCL 09B

Data base management systems were discussed. Topics included data base organization for statistical analysis; machine learning; information retrieval; information management; and computer architecture.

N86-26005# Pacific Northwest Labs., Richland, Wash. MANAGING THE DATA ANALYSIS PROGRESS

W. L. NICHOLSON, P. J. COWLEY, D. B. CARR, and M. A. WHITING In Stanford Univ. Data Base Management p 141-166 31 Jul. 1985 refs

Avail: NTIS HC A14/MF A01 CSCL 09B

Advances in statistical computing allowed data analyses to handle increasingly complex problems. The complex data analyses that are required with complex problems proliferate derived data structures and create evolving analysis states. A system that helps the data analyst manage the analysis process through use of data analysis save-states was designed. The system also makes use of graphical interaction, provides organization of command logs and encourages extensive annotation. It is clear that this collaborative effort of data analysts and computer scientists is making progress toward freeing the data analyst from much mundane, but necessary, organization bookkeeping. Author

N86-26006# Computer Horizons, Inc., Cherry Hill, N. J. LINKING SCIENCE, TECHNOLOGY AND ECONOMICS DATA

F. NARIN In Stanford Univ. Data Base Management p 167-214 31 Jul. 1985 refs

Avail: NTIS HC A14/MF A01 CSCL 09B

Some of the state-of-the-art of linking science, technology and economics data are summarized. The linkage between technology and science is analyzed by analyzing the citations (references). It is concluded that: (1) funds and scientific publication are tightly linked at national and institutional levels; (2) cross-national, cross-institutional, geographic and subject-to-subject science linkages are quantifiable and mappable and reveal that the spectrum of activity from funds, to pubs, to patents, to productivity is reflected in highly correlated statistics; (3) citations from patents to papers document a close day-to-day relationship between science and technology; (4) the science used by patented technology is very recent - implying little or no lag between discovery and utilization; and (5) technology, like science, may be driven by a small number of key highly cited events. Author

N86-26007# Institute for Scientific Information, Inc., Philadelphia, Pa

THE WORLD BRAIN TODAY: SCIENTOGRAPHIC DATABASES. WHAT ARE THEY, HOW ARE THEY CREATED AND WHAT ARE THEY USED FOR?

In Stanford Univ. Data Base Management p G. VLADUTZ 215-299 31 Jul. 1985 refs Avail: NTIS HC A14/MF A01 CSCL 09B

The creation of automatized intelligent systems which could contribute to increasing the overall productivity of scientific research requires knowledge representation tools of global scale. The automatic compilation from existing databases of an intermediary type of knowledge representation is proposed in the form of a detailed concept dependency diagram of global scope. The relationships are outlined between concept dependency diagrams and detailed knowledge representations based on predicate calculus language and full formalization. The efforts aimed at the representation of the structure of scientific fields, mainly on the basis of citation data, are reviewed. The prospects for the development of related methods for the computerized compilation

of regional and global concept maps in the form of concept dependency diagrams are discussed. Author

N86-26241# National Bureau of Standards, Gaithersburg, Md. Center for Programming Science and Technology.

GUIDE ON SELECTING ADP (AUTOMATIC DATA PROCESSING)BACKUP PROCESSING ALTERNATIVES Final Report

I. E. ISAAC Nov. 1985 43 p refs

(PB86-154820; NBS/SP-500/134; LC-85-600618) Avail: NTIS HC A03/MF A01; also available SOD HC \$1.75 as SN003-003-02701-4 CSCL 05A

The publication addresses the issue of selecting ADP backup processing support in advance of events that cause the loss of data processing capability. The document emphasizes the need for managers at all levels of the organization to support the planning, funding, and testing of an alternate processing strategy. It provides a general description of the alternatives, and recommends criteria for selecting the most suitable alternate processing method. GRA

N86-27121# Naval Postgraduate School, Monterey, Calif. THE DESIGN AND ANALYSIS OF A NETWORK INTERFACE FOR THE MULTI-LINGUAL DATABASE SYSTEM M.S. Thesis C. R. WORTHERLY Dec. 1985 127 p

(AD-A164756) Avail: NTIS HC A07/MF A01 CSCL 09B

Traditionally, the design and implementation of a conventional database system begins with the choice of a data model followed by the specifications of a model-based data language. Thus, the database system is restricted to a single data model and a specific data language. An alternative to this traditional approach to database-system development is the multi-lingual database system (MLDS). This alternative approach affords the user the ability to access and manage a large collection of databases, via several data models and their corresponding data languages, without the aforementioned restriction. In this thesis, we present a methodology for supporting network (CODASYL) database management on the MLDS. Specifically, we design an interface which translates CODASYL-DML statements into ABDL requests. We describe the data structures, the control mechanisms. and the functions/procedures necessary to implement such a system.

GRA

AND

N86-28067# Mitre Corp., McLean, Va. PROCEDURES FOR CAUSE ORIENTED ANALYSIS

CONSEQUENCE ORIENTED ANALYSIS A. L. MCFARLAND, Y. S. HOH, and G. A. DORFMAN Jun.

1986 26 p (Contract DTFA01-84-C-0001)

(DOT/FAA/PM-86/21) Avail: NTIS HC A03/MF A01

Cause and consequence oriented analyses are techniques for safety analysis of software. They are particularly important for analyzing software whose inadequate performance could result in hazard to life or property. This report presents procedures for performing these analyses. Author

N86-28628*# National Aeronautics and Space Administration, Washington, D.C.

NASA SUPERCOMPUTER SYSTEM TO BECOME AVAILABLE NATIONALLY

D. J. RAHN and P. W. WALLTER (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.) Jul. 1986 2 p

(NASA-NEWS-RELEASE-86-92; P86-10152) Avail: NASA

Scientific and Technical Information Facility, P.O. Box 8752.

B.W.I. Airport, Md. 21240 CSCL 09B

The most powerful supercomputer facility in the world, the Numerical Aerodynamic Simulation (NAS) system, will go on-line to scientists and engineers throughout the country on July 21, 1986. The NAS supercomputer complex will be linked with 27 remote locations across the country through a combination of high-speed terrestrail and satellite links. The Cray-2 supercomputer was installed as the main computational engine. The NAS CRAY-2 has a 256 million word memory (largest yet available) and can perform 250 million computations a second. The next generation superfast computer currently referred to as the HSP-2 (High Speed Processor-2) is expected to perform a billion computation a second. This will bring the NAS system closer to its near-term goal of having computer with a billion word memory and computational power of 4 billion calculations a second. The NAS system will be relocated to a new computational facility in late 1986 and will be fully operational in March 1987. B.G.

N86-28694# Joint Publications Research Service, Arlington, Va. REPORT: CYBERNETICS. COMPUTERS USSR AND **AUTOMATION TECHNOLOGY**

25 Apr. 1986 62 p Transl. into ENGLISH from various Russian articles

(JPRS-UCC-86-004) Avail: NTIS HC A04/MF A01

Topics on cybernetics, computers, and automation technology include: hardware, software, applications, and education.

N86-28793# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Technical Information Panel.

THE VALUE OF INFORMATION AS AN INTEGRAL PART OF **AEROSPACE AND DEFENCE R AND D PROGRAMMES**

Loughton, England Jan. 1986 96 p Meeting held in Cheltenham, England, 4-5 Sep. 1985

(AGARD-CP-385; ISBN-92-835-0389-9; AD-A166641) Avail: NTIS HC A05/MF A01

The management and use of scientific and technical information in the R and D process is examined from the perspective of policy makers, program managers, and researchers. Aspects considered at the meeting included the need to incorporate information as an integral part of the R and D process, the value of information in reducing the cost and preventing the duplication of research, improvements in the sharing of information resources among the NATO countries, and requirements for the future.

N86-28794# British Aerospace Public Ltd. Co., Weybridge (England). Divisional Technical Directorate.

THE POLICY MAKER LOOKS AT INFORMATION

J. B. SCOTT-WILSON and J. P. HASINSKI In its The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes 9 p Jan. 1986

Avail: NTIS HC A05/MF A01

The policy making heirarchy within British Aerospace is described and the information routes to and from an intermediate level policy maker (Divisional Technical Director) are examined. The information paths for two typical research projects are considered as examples: the use of aluminum/lithium alloys as structural materials and the initiation and development of a new aircraft project. Information quality and the use of automated techniques by policy makers are also discussed. M.G.

N86-28795# NATO Integrated Communications System Management Agency, Brussels (Belgium).

A PROGRAMME MANAGER'S NEEDS FOR INFORMATION

I. MASON-SMITH In AGARD The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes 8 Jan 1986 D

Avail: NTIS HC A05/MF A01

The underlying basis for the information need of the program manager within the NATO Integrated Communications System Agency (NICSMA) is examined in some detail, in terms of the role of that agency as exemplified by its current charter. The various specific needs of the program planner working within this framework are then identified and critically reviewed. Finally, the paper notes the expanding role of the remodelled agency (NACISA) to include the development of both communications and information systems for NATO; in this context, the urgent need to re-examine the basic information requirements of the Agency is encouraged and proposals sought. Author

N86-28796# Raitt (D. I.), Den Haag (Netherlands). THE INFORMATION NEEDS OF SCIENTISTS AND ENGINEERS IN AEROSPACE

D. I. RAITT In AGARD The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes 5 p Jan. 1986

Avail: NTIS HC A05/MF A01

A brief description of a recent research project to ascertain the communication and information-seeking and use habits of scientists and engineers working in aerospace research establishments and other organizations is given. Relevant organizations studied include DFVLR, NLR, CNES and ESA. Following an overview of the basic characteristics of scientists and engineers, a review of the project's major findings as they relate to the type of information required by scientists and engineers, its availability, the sources - both oral and written from which the information is obtained and the scientists and engineers awareness of them, how they keep up-to-date, the time spent seeking information, the use made of the library and the communication patterns of scientists and engineers, is then given. Some general suggestions for improving the communication and information flow within organizations to the satisfaction of practicing scientists and engineers are made. Author

N86-28798# Engineering Sciences Data Unit, London (England).

THE COSTS OF NOT HAVING REFINED INFORMATION

A. J. BARRETT In AGARD The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes 9 Jan. 1986 р

Avail: NTIS HC A05/MF A01

The adequacy of the information resources, which are called decision points for support at in upon the research-design-production-marketing process, can in part be measured by their scope, the presence or absence of information within that scope and, increasingly, by the extent to which they offer refinement in terms of the timeliness and quality of the information which can be retrieved. Timeliness in the present context relates not so much to the response time of the information system as to the extent to which that system is tuned to the volatility of the information which it contains. Likewise, the quality of information is not to be judged only by its relevance and authenticity but also by the convenience of its form of presentation in the view of the decision maker who has need of it. The main focal points of the paper are the costs, disruption and other losses which arise from a lack of knowledge of previous work, the use of out-of-date technical information and, in particular, the extent to which the use of insufficiently refined numerical data leads to the under-, or over-, design of hardware. These are illustrated by a number of quantified examples. The transition from an industrially based to an information or service based society highlights the growing needs of the R&D decision maker and others for systems which will provide high quality numerical and factual data. However, substantiation of these needs may never be available in terms of evidence of direct future benefits as distinct from evidence of historic losses. More dynamic means of demonstrating the impact of information quality upon the interests of the decision maker must be devised and guidelines for two such projects are suggested. Author

N86-28799# King Research, Inc., Rockville, Md. VALUE OF MEASURING INFORMATION AND THE INFORMATION SYSTEMS, SERVICES AND PRODUCTS D. W. KING and J. M. GRIFFITHS In AGARD The Value of

Information as an Integral Part of Aerospace and Defence R and D Programmes 15 p Jan. 1986 Avail: NTIS HC A05/MF A01

An approach for measuring the value of information and information systems, services and products is presented. Results of four research projects that have measured value of recorded information used by professional such as scientists, engineers, managers, etc. are also discussed. Furthermore, data are given on the value of such systems and services as a bibliographic

05 COMPUTERS AND INFORMATION MANAGEMENT

database of international publications, online search systems and libraries. The approach used to measure value includes several perspectives. The first perspective is what users are willing to pay for information in terms of money (if exchanged) and the price paid by users in terms of their time and effort to get and read the information. Once information is read and assimilated, there are many purposes for which it might be used such as in one's work, to educate oneself or others, to satisfy one's curiosity, etc. The consequential value resulting from information use is partially measured by the savings that are derived from information use. Higher order values are how the consequential value affects the user's organization and, in turn, society.

N86-28803# Fachinformationszentrum fuer Energie, Physik, Mathematik G.m.b.H., Eggenstein-Leopoldshafen (West Germany). Energy and Technology Div.

INFORMATION RESOURCES MANAGEMENT IN THE R AND D ENVIRONMENT

K. BUERK *In* AGARD The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes 4 p Jan. 1986

Avail: NTIS HC A05/MF A01

Efficient management of highly specialized information is a permanent task of optimization, whereby framework conditions may constantly change on account of various influencing factors. Owing to their special significance, the following has to be considered in particular: user needs, available resources, and information techniques. The task of optimization, due to its complexity, cannot be solved model-like, but only approximately and pragmatically. Illustrated by the example of the Federal Republic of Germany and the Fachinformationszentrum Energie Physik Mathematik (FIZ) the attempt to find a practical solution is demonstrated. In this context it is shown which role a National Information Center plays within international and national cooperation including worksharing, and how information supply and dissemination of information works in the case of central information services by FIZ, and decentral dissemination of information in research centers. Illustrated by the examples of database production, online services of bibliographic, numeric and full-text databases and the concept of the International Information Network for Science and Technology (STN International), the importance of the use of the most modern information techiques is demonstrated. Author

N86-29294*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. CENTRAL ON-LINE DATA DIRECTORY

J. THIEMAN *In its* Proceedings of the Second Pilot Climate Data System Workshop 3 p 1986

Avail: NTIS HC A12/MF A01 CSCL 04B

The National Space Science Data Center (NSSDC) Central On-Line Data Directory (CODD), which allows the general scientist remote access to information about data sets available not only at NSSDC, but throughout the scientific community, is discussed. A user may search for data set information within CODD by specifying spacecraft name, experiment name, investigator name, and/or keywords. CODD will include information on atmospheric science data sets contained not only within the PCDS, but also within other data sets that are deemed important. Keywords to be used in locating these data sets are currently being formulated. The main type of keyword to be used for categorization of data sets will be discipline related. The primary discipline keyword for PCDS-type data sets would be ATMOSPHERIC SCIENCE. A good set of subdiscipline keywords is needed under this discipline to subdivide the data sets. A sheet containing a strawman set of subdiscipline keywords was distributed, and a request was made for the knowledgeable scientists to modify or replace the proposed keywords. Author

N86-29535*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PARALLEL STRUCTURES IN HUMAN AND COMPUTER MEMORY

P. KANERVA Jan. 1986 8 p Proposed for presentation at COGNITIVA 85, Paris, France Sponsored by System Development Foundation

(NASA-TM-89402; RIACS-TR-86.2; NAS 1.15:89402) Avail: NTIS HC A02/MF A01 CSCL 09B

If one thinks of our experiences as being recorded continuously on film, then human memory can be compared to a film library that is indexed by the contents of the film strips stored in it. Moreover, approximate retrieval cues suffice to retrieve information stored in this library. One recognizes a familiar person in a fuzzy photograph or a familiar tune played on a strange instrument. A computer memory that would allow a computer to recognize patterns and to recall sequences the way humans do is constructed. Such a memory is remarkably similiar in structure to a conventional computer memory and also to the neural circuits in the cortex of the cerebellum of the human brain. It is concluded that the frame problem of artificial intelligence could be solved by the use of such a memory if one were able to encode information about the world properly.

N86-29568*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ACCESS CONTROL AND PRIVACY IN LARGE DISTRIBUTED SYSTEMS

B. M. LEINER and M. BISHOP 7 Mar. 1986 18 p (Contract NCC2-387)

(NASA-TM-89397; RIACS-TR-86.6; NAS 1.15:89397) Avail: NTIS HC A02/MF A01 CSCL 09B

Large scale distributed systems consists of workstations, mainframe computers, supercomputers and other types of servers, all connected by a computer network. These systems are being used in a variety of applications including the support of collaborative scientific research. In such an environment, issues of access control and privacy arise. Access control is required for several reasons, including the protection of sensitive resources and cost control. Privacy is also required for similar reasons, including the protection of a researcher's proprietary results. A possible architecture for integrating available computer and communications security technologies into a system that meet these requirements is described. This architecture is meant as a starting point for discussion, rather that the final answer. Author

N86-29569*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

WHITE PAPER: A PLAN FOR COOPERATION BETWEEN NASA AND DARPA TO ESTABLISH A CENTER FOR ADVANCED ARCHITECTURES

P. J. DENNING, G. B. ADAMS, III, R. L. BROWN, P. KANERVA, B. M. LEINER, and M. R. RAUGH 25 Apr. 1986 14 p (Contract NCC2-387)

(NASA-TM-89388; RIACS-TR-86.10; NAS 1.15:89388) Avail: NTIS HC A02/MF A01 CSCL 09B

Large, complex computer systems require many years of development. It is recognized that large scale systems are unlikely to be delivered in useful condition unless users are intimately involved throughout the design process. A mechanism is described that will involve users in the design of advanced computing systems and will accelerate the insertion of new systems into scientific research. This mechanism is embodied in a facility called the Center for Advanced Architectures (CAA). CAA would be a division of RIACS (Research Institute for Advanced Computer Science) and would receive its technical direction from a Scientific Advisory Board established by RIACS. The CAA described here is a possible implementation of a center envisaged in a proposed cooperation between NASA and DARPA.

05 COMPUTERS AND INFORMATION MANAGEMENT

N86-29591# New York Univ., New York. Mathematics and Computing Lab.

NUMERICAL ANALYSIS AND THE SCIENTIFIC METHOD

J. GLIMM and D. H. SHARP Jan. 1986 29 p

(Contract DE-AC02-76ER03077; W-7405-ENG-36) (DE86-005404; DOE/ER-03077/270) Avail: NTIS HC A03/MF

1

A01 The computer has given rise to a new mode of scientific practice, and today computational science stands beside theory and experiment as a fundamental methodology. The impact of the computer revolution on science can be projected from current

trends. The demands to be made on computing methodologies will be reviewed. One of the demands is an ongoing need for excellence in computational methodologies. Generic difficulties encountered in meeting these challenges will be discussed. Recent work of the authors and others will be reviewed in this context. DOE

National Aeronautics and Space Administration, N86-29720* Washington, D.C.

NASA THESAURUS SUPPLEMENT: A 4-PART CUMULATIVE SUPPLEMENT TO THE 1985 EDITION OF THE NASA THESAURUS

May 1986 155 p

(NASA-SP-7053(SUPP-1); NAS 1.21:7053(SUPP-1)) Avail: NTIS HC A08 CSCL 05B

The four part cumulative NASA Thesaurus Supplement to the 1985 edition of the NASA Thesaurus includes Part 1, Hierarchical Listing, Part 2, Access Vocabulary, Part 3, NASA Thesaurus Definitions, and Part 4, Changes. The semiannual supplement gives complete hierarchies for new terms. Author

N86-29721# University of Southern California, Marina del Rey. Information Sciences Inst.

DESIGN OF A MASTER LEXICON

S. CUMMING Feb. 1986 28 p

(Contract MDA903-81-C-0335) (AD-A165999; ISI/RR-85-163) Avail: NTIS HC A03/MF A01 CSCL 05G

This document describes the design for a 'Master Lexicon' which is intended to serve all the lexical needs of the two grammars (RUS, an ATN parser, and Nigel, a systemic production grammar) of the JANUS natural language project. Each grammar had previously been using its own lexicon, and these two lexicons were significantly different, both in terms of content and in terms of design. The Master Lexicon incorporates features of each of the previous lexicons, significantly Nigel's feature hierarchy and RUS's treatment of morphology and cross-indexing; plus it includes several novel features, most notably a new lexical acquisition interface which allows the non-specialist user to add lexical items. Nigel is able to access the Master Lexicon directly, while a set of translation rules (given in the appendix) transform ML lexical entries to lexical entries of the style used by RUS. igel, Penman, RUS, Syntax, Systemic Linguistics, Text generation, Vocabulary, Word acquisition, Wordclass hierarchy, Wordclasses, GRA

N86-30360*# Reifer Consultants, Inc., Torrance, Calif. SOFTWARE MANAGEMENT TOOLS: LESSONS LEARNED FROM USE

D. J. REIFER, J. VALETT (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.), J. KNIGHT (Virginia Univ., Charlottesville), and G. WENNESON (Informatics General Corp., Palo Alto, Calif.) In NASA. Goddard Space Flight Center Proceedings of Tenth Annual Software Engineering Workshop 23 p Dec. 1985

Avail: NTIS HC A16/MF A01 CSCL 09B

Experience in inserting software project planning tools into more than 100 projects producing mission critical software are discussed. The problems the software project manager faces are listed along with methods and tools available to handle them. Experience is reported with the Project Manager's Workstation (PMW) and the SoftCost-R cost estimating package. Finally, the results of a survey, which looked at what could be done in the future to overcome the problems experienced and build a set of truly useful tools, are presented. IPB

N86-30361*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

FOR DEASEL: EXPERT SYSTEM AN SOFTWARE ENGINEERING

J. D. VALETT and A. RASKIN In its Proceedings of Tenth Annual Software Engineering Workshop 21 p Dec. 1985 Avail: NTIS HC A16/MF A01 CSCL 09B

For the past ten year, the Software Engineering Laboratory (SEL) has been collecting data on software projects carried out in the Systems Development Branch of the Flight Dynamics Division at NASA's Goddard Space Flight Center. Through a series of studies using this data, much knowledge has been gained on how software is developed within this environment. Two years ago work began on a software tool which would make this knowledge readily available to software managers. Ideally, the Dynamic Management Information Tool (DynaMITe) will aid managers in comparison across projects, prediction of a project's future, and assessment of a project's current state. This paper describes an effort to create the assessment portion of DynaMITe, called the DynaMITe Expert Advisor for the SEL (DEASEL).

Author

N86-30365*# Planning Research Corp., Washington, D. C. EXPERIENCE WITH SOFTWARE ENGINEERING ENVIRONMENT FRAMEWORK

R. BLUMBERG, A. REEDY, and E. YODIS In NASA. Goddard Space Flight Center Proceedings of Tenth Annual Software Engineering Workshop 25 p Dec. 1985 Avail: NTIS HC A16/MF A01 CSCL 09B

Experience with a software engineering environment framework tool called the Automated Product Control Environment (APCE) is described. The goals of the framework design, an overview of the major functions and features of the framework, and implementation and use of the framework are presented. Aspects of the framework discussed include automation and control; portability, distributability, and interoperability; cost/benefit analysis; and productivity. Results of using the framework are discussed and the framework approach is briefly compared to other software development environment approaches. J.P.B.

N86-30398# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.

A RELATIONAL DATABASE ENVIRONMENT FOR SOFTWARE DEVELOPMENT

A. I. WASSERMAN and M. L. KERSTEN May 1984 20 p Sponsored by Netherlands Organization for the Advancement of Pure Research

(IR-86; ETN-86-97322) Avail: NTIS HC A02/MF A01

The software tool environment for the User Software Engineering (USE) methodology is built around a compact relational database management system (Troll/USE). Within this environment, called the Unified Support Environment, tools communicate with Troll/USE through message passing. Tools include a database browser and editor, a rapid prototyping system, and interactive database design aid, a data dictionary system, a programming language, and a version control/configuration management system. The way in which these tools support the USE methodology is described. The resulting environment is highly flexible and well suited for development of software systems and additional tools. FSA

N86-31220*# Georgia Inst. of Tech., Atlanta.

A DISCRETE CONTROL MODEL OF PLANT

C. M. MITCHELL *In its* Pilot Interaction With Automated Airborne Decision Making Systems 31 p Jul. 1985

Avail: NTIS HC A03/MF A01 CSCL 05H

A model of the PLANT system using the discrete control modeling techniques developed by Miller is described. Discrete control models attempt to represent in a mathematical form how a human operator might decompose a complex system into simpler

parts and how the control actions and system configuration are coordinated so that acceptable overall system performance is achieved. Basic questions include knowledge representation, information flow, and decision making in complex systems. The structure of the model is a general hierarchical/heterarchical scheme which structurally accounts for coordination and dynamic focus of attention. Mathematically, the discrete control model is defined in terms of a network of finite state systems. Specifically, the discrete control model accounts for how specific control actions are selected from information about the controlled system, the environment, and the context of the situation. The objective is to provide a plausible and empirically testable accounting and, if possible, explanation of control behavior. B.G.

N86-31248# Los Alamos National Lab., N. Mex.

LOS ALAMOS SOFTWARE DEVELOPMENT TOOLS

G. CORT and R. O. NELSON 1985 10 p Presented at the US DECUS Symposium, Anaheim, Calif., 9 Dec. 1985

(Contract W-7405-ENG-36)

(DE86-006024; LA-UR-86-214; CONF-851264-4) Avail: NTIS HC A02/MF A01

We present the details of a strategy for acquiring a comprehensive set of software tools to support a life-cycle-based software development methodology. Specific criteria for evaluating software tools are presented with examples from the Los Alamos tool kit. The importance of an environment to support both the tools and the methodology is discussed. DOF

N86-31777# Oak Ridge National Lab., Tenn.

STANDARD GENERALIZED MARKUP LANGUAGE: A TECHNIQUE FOR DOCUMENT INTERCHANGE

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J. D. MASON 1985 6 p
(Contract DE-AC05-84OR-21400)
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(DE86-011504; DOE/OR-21400/T265) Avail: NTIS HC A02/MF A01

Technical communicators find themselves increasingly in need of communicating text electronically. Efforts were directed to providing a standardized mechanism for doing generic coding. The Standard Generalized Markup Language (SGML) has been developed for document interchange. It is a Drift International Standard and should become a full standard in 1986. SGML provides not only a basis for coding and interchange, but also a means for complete descriptions of documents to support other processes. DOE

N86-32338# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.

DATABASE CAPACITY PLANNING AND MANAGEMENT

K. LINSENMANN 1986 24 p Presented at the 15th International Software AG Users Conference, San Diego, Calif., 11 May 1986 (Contract DE-AC07-76ID-01570)

(DE86-009076; EGG-M-03286; CONF-860593-1) Avail: NTIS HC A02/MF A01

The DATABASE ADMINISTRATION (DBA) has developed a utility process that performs three functions utilizing the ADABAS general control block (GCB) and the ADABAS file control block (FCB). The three functions are file space management, automated file unload/load and physical file placement and management. ADABAS cost per command, ADABAS command durations and labor cost have been examined. DOE

N86-32340# Argonne National Lab., III. COMPUTING SERVICES SOFTWARE LIBRARY L. M. CLARK and W. H. JONES Mar. 1986 52 p (Contract W-31-109-ENG-38)

(DE86-009491; ANL/TM-436) Avail: NTIS HC A04/MF A01

This technical memorandum serves as a practical guide for managers, supervisors, programmers, analysts, and other data processing personnel who need to consult the documentation or use the software available in the Software Library. Policies and procedures necessary to preserve the software documentation and protect the Laboratory's investment in software are presented. Included are sections on responsibilities of the Software Librarian

and Software Coordinators, software change control policy, systems programming section software maintenance tools, information systems section software maintenance tools and use of the LIBRARY exec. The LIBRARY exec, which serves as the Master Index, provides on-line information about documents. DOF

N86-33048# Lawrence Livermore National Lab., Calif. USER SYSTEMS GUIDELINES FOR SOFTWARE PROJECTS L. ABRAHAMSON, ed. 1 Apr. 1986 157 p (Contract W-7405-ENG-48)

(DE86-010490; UCID-20643) Avail: NTIS HC A08/MF A01

This manual presents guidelines for software standards which were developed so that software project development teams and management involved in approving the software could have a generalized view of all phases in the software production procedure and the steps involved in completing each phase. Guidelines are presented for six phases of software development: project definition, building a user interface, designing software, writing code, testing code, and preparing software documentation. The discussions for each phase include examples illustrating the DOE recommended guidelines.

N86-33200# Texas A&M Univ., College Station. College of Business Administration.

ORGANIZATION AS INFORMATION PROCESSING SYSTEMS: TOWARD A MODEL OF THE RESEARCH FACTORS ASSOCIATED WITH SIGNIFICANT RESEARCH OUTCOMES R. L. DAFT, R. W. GRIFFIN, and V. YATES Apr. 1986 59 p

(Contract N00014-83-C-0025) (AD-A168018; TR-DG-19-ONR) Avail: NTIS HC A04/MF A01 CSCL 05B

Three models with the potential to explain significant organizational research outcomes were proposed and tested. Fifty-six organizational scholars were surveyed about one significant and one not-so-significant research project. The findings identified several reported factors that occurred prior to and during research projects that were related to research outcomes. The Ambidextrous model, which includes both organic and mechanistic research characteristics, differentiated significant from not-so-significant research better than the Davis and Antecedents models.

Author (GRA)

Department of Energy, Washington, D. C. Office N86-33206# of Computer Ser. and Telecommunications.

INFORMATION TECHNOLOGY RESOURCES LONG-RANGE PLAN, FY 1987-FY 1991

Dec. 1985 228 p

(DE86-010457; DOE/MA-0048-4) Avail: NTIS HC A11/MF A01

The objective of this plan is to describe the information technology resources and capabilities of the Department, the future requirements, and the strategies and plans to satisfy the identified requirements. The long-range planning process provides the systematic means to meet this objective and assists the Department in assuring that information technology support is provided in an efficient, effective, and timely manner so that the programmatic missions can be accomplished. Another objective of the Plan is to promote better understanding, both within and external to the of its information technology environment. Department. requirements, problems, and recommended solutions. The Plan covers the five-year period from fiscal year 1987 through 1991. It takes into consideration the information technology resource requirements of more than 52 different Departmental components and contractors. The IS section and resource identification is limited to business and project management type applications used by Departmental components. DOĖ

N86-33207# Sandia National Labs., Albuquerque, N. Mex. STATE OF THE ART OF GEOSCIENCE LIBRARIES AND INFORMATION SERVICES

N. J. PRUETT 1986 16 p Presented at the 3rd International Conference on Geoscience Information, Adelaide, Australia, 1 Jun., 1986

(Contract DE-AC04-76DP-00789)

(DE86-011188; SAND-86-1284C; CONF-8606122-1) Avail: NTIS HC A02/MF A01

Geoscience libraries and geoscience information services are closely related. Both are trying to meet the needs of the geoscientists for information and data. Both are also being affected by many trends: increased availability of personal computers; decreased costs of machine readable storage; increased availability of maps in digital format (Pallatto, 1986); progress in graphic displays and in developing Geographic Information System, (GIS) (Kelly and Phillips, 1986); development in artificial intelligence; and the availability of new formats (e.g., CD-ROM). Some additional factors are at work at changing the role of libraries: libraries are coming to recognize the impossibility of collecting everything and the validity of Bradford's Law. Unobtrustive studies of library reference services have pointed out that only 50% of the questions are answered correctly. It is clear that the number of databases is increasing although good figures for specifically geoscience databases are not available: lists of numeric database are beginning to appear; evaluative (as opposed to purely descriptive) reviews of available bibliographic databases are beginning to appear; more and more libraries are getting online catalogs. DOF

06

RESEARCH AND DEVELOPMENT

Includes Contracts and Contract Management, Project Management, Program Management, Research Projects and Research Facilities, Scientific Research, Innovations and Inventions, Technology Transfer and Utilization, R & D Resources, Agency, National and International R & D.

A86-10403

PLAN FOR THE IMPLEMENTATION OF THE WORLD CLIMATE RESEARCH PROGRAMME

P. MOREL (World Meteorological Organization, Geneva, Switzerland) (COSPAR, WMO, IAMAP, UNEP, SCOR, URSI, and S.C.A.R., Plenary Meeting, 25th, Symposium on Space Observations for Climate Studies, 4th, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol. 5, no. 6, 1985, p. 15-20.

The objectives of the World Climate Research Programme (WCRP) are expressed in terms of increasing time scales, from several weeks to several decades. The Programme calls for substantial developments in modelling the interaction of the global atmosphere with the ocean, land surface and sea-ice, as well as improved computations of radiation transfer in the presence of clouds, aerosols and absorbing gases. These developments require a large variety of space as well as surface based observations, and especially, additional efforts for systematic processing of available data to produce consistent records of significant climatological variables. The forthcoming development of a new generation of ocean observing satellites will be an essential component of the WCRP, as they will provide the data base for the large-scale oceanographic projects, the World Ocean Circulation Experiment (WOCE) and the study of the Tropical Ocean and the Global Atmosphere (TOGA). Author

A86-11602*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FUTURE DIRECTIONS IN AEROPROPULSION TECHNOLOGY N. T. SAUNDERS and A. J. GLASSMAN (NASA, Lewis Research

Center, Cleveland, OH) IN: International Symposium on Air Breathing Engines, 7th, Beijing, People's Republic of China, September 2-6, 1985, Proceedings . New York, AIAA, 1985, p. 3-22. Previously announced in STAR as N85-23685.

Future directions in aeropropulsion technology that have been identified in a series of studies recently sponsored by the U.S. Government are discussed. Advanced vehicle concepts that could become possible by the turn of the century are presented along with some of their projected capabilities. Key building-block propulsion technologies that will contribute to making these vehicle concepts a reality are discussed along with projections of their status by the year 2000. Some pertinent highlights of the NASA aeropropulsion program are included in the discussion. Author

A86-12361#

FUTURE U.S. METEOROLOGICAL SATELLITE SYSTEMS

D. B. MILLER and J. K. SPARKMAN (NOAA, National Environmental Satellite, Data, and Information Service, Washington, DC) IN: International developments in space stations and space technologies; Proceedings of the Thirty-fifth Congress, Lausanne, Switzerland, October 7-13, 1984. New York, AIAA, 1985, p. 103-110.

(IAF PAPER 84-96)

It is pointed out that the present U.S. meteorological satellite system is an array of spacecraft including both geostationary and low-orbit polar orbiting platforms. The system is designed to provide necessary minimum data for global numerical weather prediction, and to supply frequent observations in the western hemisphere of natural hazards, including tornadoes, hurricanes, flash floods, and spring-thaw flooding. The present paper provides a survey of the current array of spacecraft and sensor suites flown by the U.S., taking into account also details regarding the next series of sensing hardware. Polar imagers and sounders are examined, and geostationary sensors are discussed. Attention is given to the functions of the 'Advanced Very High Resolution Radiometer' (AVHRR/2), microwave sensors, radiation detectors, polar subsystems, polar spacecraft broadcast services, near future satellites, and future satellite systems. G.R.

A86-12935#

THE SPACE STATION POLAR PLATFORMS - INTEGRATING RESEARCH AND OPERATIONAL MISSIONS

J. H. MCELROY and S. R. SCHNEIDER (NOAA, National Environmental Satellite, Data, and Information Service, Washington, DC) AIAA, Earth Observing Systems: EOS - A Subset of Space Station Conference, Virginia Beach, VA, Oct. 8-10, 1985. 12 p. refs

(AIAA PAPER 85-3000)

The instrumentation planned for the polar-orbiting segment of the Space Station will provide both real-time and long-term archival data. It is expected that the instrumentation will include an X-ray imager, total energy and electron detectors, a proton-electron spectrometer, a plasma monitor and a gamma ray detector. Data will also be gathered on the earth radiation budget, upper atmosphere activities and constituent species, ocean spectra and atmospheric absorption lines. SAR, scatterometer, imaging and altimeter applications will be found for radar units. The multiple-instrumented polar-orbiting platforms will permit correlations to be calculated on the radiation environment and atmosphere, ocean, weather, land and biosphere phenomena.

M.S.K.

A86-13823#

ERS-1 - MISSION OBJECTIVES AND SYSTEM DESCRIPTION

G. DUCHOSSOIS (ESA, Paris, France) IN: Monitoring earth's ocean, land, and atmosphere from space - Sensors, systems, and applications . New York, AIAA, 1985, p. 536-553.

Anticipating a launch date in mid-1989, an industrial consortium of European and Canadian companies is developing and

manufacturing the first ESA remote sensing satellite, known as ERS-1. The overall ERS-1 system and the various potential applications which may benefit from the ERS-1 data are described. D.H.

A86-14095#

THE ERS-1 PROGRAM AND ITS FUTURE APPLICATIONS

H.-J. LABUDDA (Dornier System GmbH, Friedrichshafen, West Germany) IN: International Symposium on Remote Sensing of Environment, Third Thematic Conference: Remote Sensing for Exploration Geology, Colorado Springs, CO, April 16-19, 1984, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 889-898. refs

At the end of the 80's and in the early 90's the European Space Agency (ESA) will launch a series of ESA Remote Sensing Satellites (ERS). It is expected that the Synthetic Aperture Radar (SAR) in combination with the Radar Altimeter will play a significant role in the acquisition of earth surface data. ERS-1's capability to generate SAR all-weather high resolution images over land may also be used to complement optical data provided by other satellites (Landsat-D, SPOT) for a number of land applications. Users of various disciplines grouped around socalled prime centers will be provided with thematically processed images and data sets referring to oceanography, glaciology, climatology, oil platform management, ship routing, fishery and surface pollution. Extending that range of marine surface applications, a further mission will mainly contribute in sensing and analyzing terrestrial imagery with emphasis on geology, agriculture and hydrology. Author

A86-14272* National Aeronautics and Space Administration, Washington, D.C.

SPACE - THE LONG RANGE FUTURE

J. VON PUTTKAMER (NASA, Office of Space Flight, Washington, DC) Spaceflight (ISSN 0038-6340), vol. 27, Nov. 1985, p. 395-400. refs

Space exploration goals for NASA in the year 2000 time frame are examined. A lunar base would offer the opportunity for continuous earth viewing, further cosmogeochemical exploration and rudimentary steps at self-sufficiency in space. The latter two factors are also compelling reasons to plan a manned Mars base. Furthermore, competition and cooperation in a Mars mission and further interplanetary exploration is an attractive substitute for war. The hardware requirements for various configurations of Mars missions are briefly addressed, along with other, unmanned missions to the asteroid belt, Mercury, Venus, Jupiter and the moons of Jupiter and Saturn. Finally, long-range technological requirements for providing adequate living/working facilities for larger human populations in Space Station environments are summarized. M.S.K.

A86-15611*# National Aeronautics and Space Administration, Washington, D.C.

THE SPACE STATION PROGRAM DEFINITION AND PRELIMINARY SYSTEMS DESIGN - RECENT DEVELOPMENTS R. F. FREITAG (NASA, Office of Space Station, Washington, DC) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 12 p.

(IAF PAPER 85-18)

It is pointed out that space stations represent a major vehicle for accomplishing many things mankind envisions for space activities. Thus, space stations have become necessary stepping-off points for deep-space expeditions, and it is expected that they will lead eventually to the permanent occupancy of another planet. The present paper provides a report regarding planning activities in the U.S. and in other countries which have made significant progress in making a permanent Space Station a reality. The Space Station will consist of a manned base and associated platforms, as well as collateral support equipment. The purpose of the program definition and preliminary design activities (Phase B) is to arrive at the baseline configuration before initiating actual hardware development. Details of the program plan are discussed along with user considerations in design, the commercialization of space, design issues, operations, and Space Station evolution. G.R.

A86-15636*# National Aeronautics and Space Administration, Washington, D.C.

SPACE STATION UTILIZATION FOR TECHNOLOGY PURPOSES

J. L. ANDERSON and J. ROMERO (NASA, Washington, DC) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 8 p.

(IAF PAPER 85-50)

The role of the Space Station in in-space technology research and development is discussed. The categorizing of research and technology experiments, which is required in order to provide the proper facilities for the experiments, is described. The use of the Space Station, itself, as an experiment is studied; instrumented large space structure experiments, environmental interactions, human-machine interface, and evolutionary technology validation can be conducted by the Space Station. The necessary conditions for the Space Station to function as a research and technology facility are analyzed. The Space Station design and planning considerations, in order to meet research and technology objectives and support requirements, are investigated. I.F.

A86-15902#

COMMERCIALIZATION OF SPACE - A COMPREHENSIVE APPROACH

R. C. MAEHL (RCA, Astro-Electronics Div., Princeton, NJ) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 6 p.

(IAF PAPER 85-431)

The role of the government and private industries in the commercialization of space is investigated. The government needs to provide funding, stimulate research and development, and establish regulations, and industries need to develop areas which will provide profitable investments. The three phases of the evolution of space activities, which are high tech R and D, the development of infrastructure, and the establishment of the industry, are described. The relationship between NASA's policies, the joint endeavor agreement, and the stages of the evolution of space activities is analyzed; a balance between investment and profit needs to be established. Two examples of existing space commercialization, the American commercial platforms for material processing and scientific missions are presented.

A86-15914*# National Aeronautics and Space Administration, Washington, D.C.

FUNCTION, FORM, AND TECHNOLOGY - THE EVOLUTION OF SPACE STATION IN NASA

S. D. FRIES (NASA, Washington, DC) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 11 p. refs

(IAF PAPER 85-454)

The history of major Space Station designs over the last twenty-five years is reviewed. The evolution of design concepts is analyzed with respect to the changing functions of Space Stations; and available or anticipated technology capabilities. Emphasis is given to the current NASA Space Station reference configuration, the 'power tower'. Detailed schematic drawings of the different Space Station designs are provided. I.H.

A86-15949#

A DESIGN FOR FLUID MANAGEMENT IN SPACE

N. E. SEARBY IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 9 p. refs (IAF PAPER ST-85-04)

A fluid management system has been developed for space applications. The system design was based on three specific requirements of the microgravity environment in a manned space vehicle: solid-liquid-gas degassification; solid-liquid-gas separation; and algae growth and harvesting. Fluid separation is achieved using a divergent, truncated-cone separation chamber coupled with density-dependent valving. Degassification of fluids and separation of multi-level media is carried out at a high pressure level in order to move the separated media to storage areas. Operational tests of the system in a simulated low-g environment and on board Shuttle are described. A schematic diagram of the fluid management system is provided.

A86-17301* National Aeronautics and Space Administration, Washington, D.C.

SPACE STATIONS AND SPACE PLATFORMS - CONCEPTS, DESIGN, INFRASTRUCTURE, AND USES

I. BEKEY, ED. and D. HERMAN, ED. (NASA, Washington, DC) New York, American Institute of Aeronautics and Astronautics (Progress in Astronautics and Aeronautics. Volume 99), 1985, 402 p. For individual items see A86-17302 to A86-17314.

Topics discussed include space infrastructures and early Space Station and platform planning. Consideration is given to the supportive role of the Space Station and platform in future astronomy, earth observation, planetary, and communication space missions. Papers are presented on the history of the Space Station and space platform concepts, potential designs of space stations and space platforms, and long-range plans for space research.

A86-17307*# National Aeronautics and Space Administration, Washington, D.C.

INTRODUCTION - SPACE STATION AND PLATFORM ROLES IN SUPPORTING FUTURE SPACE ENDEAVORS

D. H. HERMAN (NASA, Office of Space Station, Washington, DC) IN: Space stations and space platforms - Concepts, design, infrastructure and uses . New York, American Institute of Aeronautics and Astronautics, 1985, p. 85-88.

The function of the Space Station and a platform is studied. The development of an earth observing instrument platform in a near-polar geosynchronous orbit to provide data about the earth is examined. The establishment of a permanently manned Space Station will allow development of commercial laboratories. Architectural requirements for servicing, transportation, and assembly on the Space Station are analyzed. The study of physiological and psychological effects due to weightlessness can be conducted on the Space Station. Developments in space knowledge and technology that are possible with the Space Station are discussed. I.F.

A86-17308#

ASTRONOMY AND THE SPACE STATION

H. GURSKY (U.S. Navy, E. O. Hulburt Center for Space Research, Washington, DC) IN: Space stations and space platforms -Concepts, design, infrastructure and uses . New York, American Institute of Aeronautics and Astronautics, 1985, p. 89-107.

The utilization of the Space Station for astronomical missions is studied. A review of the advances in astronomy because of the ability to observe from space and a description of previous astronomical missions are provided. The requirements for astronomical observation are improved sensitivity, angular resolution, and spectral resolution. The use of the Space Station as an observing site, a service base, and an assembly base for astronomical missions is examined. Examples of astronomical observing facilities, assembly in space, and construction in space, made possible by the Space Station are presented. I.F.

A86-17672

IDENTIFYING TECHNICAL INNOVATIONS

R. MUESER (AT&T Bell Laboratories, Short Hills, NJ) IEEE Transactions on Engineering Management (ISSN 0018-9391), vol. EM-32, Nov. 1985, p. 158-176. refs

Technical innovation is a concept proposed by economist Joseph Schumpeter almost 50 years ago. Initially ignored, it is now considered the key to improving high-tech productivity. Most writers agree on a definition which identifies the start as a novel creative step, and the end as the time of commercial availability or general use. There appear to be two basic categories of technical innovation: the first stems from research or exploration, starts with some kind of breakthrough, and requires a long period to bring to market. The second is the result of a new planned effort and usually reaches the market in a fraction of the time required for a research innovation. Author

A86-19526* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE ROLE OF SCIENTISTS IN DEVELOPING HUBBLE SPACE TELESCOPE

R. A. BROWN (NASA, Marshall Space Flight Center, Huntsville, AL) IN: The National Symposium and Workshop on Optical Platforms, Huntsville, AL, June 12-14, 1984, Proceedings. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 19-21.

The objective of the Hubble Space Telescope Program is to build and operate a high-performance, fully-instrumented and long-lived optical observatory in earth orbit. Key Program elements are (1) a logistic strategy of Shuttle launch/maintenance and TDRSS communications, (2) overall responsibility at the MSFC Project for developing both the flight and ground systems, and (3) scientific participation in ST development and responsibility after launch for conducting the observing program. The ST Project is a management structure with a budget and schedule for delivering an ST system capable of achieving its established scientific objectives. The Project distributes through contracts the responsibility for supplying particular components, but retains the responsibility for system-level integrity. Scientists have set the performance objectives and now support the Project during the development stage by providing (1) PI management of the five Science Instruments, (2) continuing translations of scientific requirements into engineering specifications, (3) oversight of designs and performance tests, and (4) specific expertise on technical concerns. Author

A86-20921

A SHARED SATELLITE SYSTEM WOULD SATISFY MANY FUTURE AVIATION NEEDS

J. D. KIESLING and R. E. ANDERSON ICAO Bulletin, vol. 40, Nov. 1985, p. 15-20.

The development of a continental mobile satellite system for aircraft communication is proposed. The system is to provide communication and surveillance for air traffic control and aeronautical operational control. The two-satellite ranging and position fixing of the satellite system are analyzed. The system architecture requires consideration of satellite earth coverage, a frequency and polarization plan, satellite and mobile power and power density, and modulation standards. The use of spot beams and frequency reuse is examined, and diagrams of coverage areas and frequency reuse are presented. Examples of aviation system and mobile satellite system frequency plans are provided. Differences in satellite characteristics, such as antenna gain, transmitter powers and receiver sensitivities, and mobile antenna gains and powers are discussed. The components and requirements for a typical satellite transponder concept, in particular an aircraft-mounted antenna, are described. IF.

A86-21519* National Aeronautics and Space Administration, Washington, D.C.

NASA DEVELOPS SPACE STATION

R. F. FREITAG (NASA, Washington, DC) Space (ISSN 0267-954X), vol. 1, June 1985, p. 18-20.

The NASA Space Station program's planning stage began in 1982, with a view to development funding in FY1987 and initial operations within a decade. An initial cost of \$8 billion is projected for the continuously habitable, Space Shuttle-dependent system, not including either operational or scientific and commercial payload-development costs. As a customer-oriented facility, the Space Station will be available to foreign countries irrespective of their participation in the development phase. O.C.

A86-21524

EUROPE GOES INDEPENDENT

S. KING Space (ISSN 0267-954X), vol. 1, June 1985, p. 56-59.

A development history, design features and performance capabilities account is presented for the Ariane unmanned spacecraft launch systems 1-4, as well as for the Ariane 5 project, which will loft the Hermes manned orbiter in 1993 and furnish enhanced payload flexibility. Over 20 configurational possibilities were studied for Ariane 5's design. Attention is presently given to the design and performance characteristics of the HM60 LH2/LOX engine used for the first booster stage of Ariane 5, whose first operation is scheduled for mid-1989. Two solid rocket boosters will also be employed. O.C.

A86-23552

SCIENCE REQUIREMENTS FOR SPACE STATION LABORATORY

B. LICHTENBERG AIAA, SAE, ASME, AIChE, and ASMA, Intersociety Conference on Environmental Systems, 15th, San Francisco, CA, July 15-17, 1985. 7 p.

(SAE PAPER 851368)

Life science research to be conducted on the Space Station is to include applied research which is needed to sustain the well being, health, and functioning of humans in space. Studies related to gaining an understanding of medical problems and basic physiological phenomena in space are also to be conducted. Other basic research is concerned with studies of gravitational and radiation biological phenomena, and investigations related to the origin and evolution of life. The facilities needed to conduct the required experiments for the considered investigations are discussed, taking into account equipment for conducting experiments with animals, a variable-g centrifuge, a high performance linear accelerator capable of delivering controlled motion to humans or animals, instrumentation for muscle studies, and equipment for cellular physiology studies. G.R.

A86-23553* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SPACE STATION LIFE SCIENCES GUIDELINES FOR NONHUMAN EXPERIMENT ACCOMMODATION

R. ARNO (NASA, Ames Research Center, Moffett Field, CA) and J. HILCHEY (NASA, Marshall Space Flight Center, Huntsville, AL) AIAA, SAE, ASME, AICHE, and ASMA, Intersociety Conference on Environmental Systems, 15th, San Francisco, CA, July 15-17, 1985. 13 p. refs

(SAE PAPER 851370)

Life scientists will utilize one of four habitable modules which constitute the initial Space Station configuration. This module will be initially employed for studies related to nonhuman and human life sciences. At a later date, a new module, devoted entirely to nonhuman life sciences will be launched. This report presents a description of the characteristics of a Space Station laboratory facility from the standpoint of nonhuman research requirements. Attention is given to the science rationale for experiments which support applied medical research and basic gravitational biology, mission profiles and typical equipment and subsystem descriptions, issues associated with the accommodation of nonhuman life sciences on the Space Station, and conceptual designs for the initial operational capability configuration and later Space Station life-sciences research facilities. G.R.

A86-24672

SATELLITE COMMUNICATIONS FOR DEVELOPING COUNTRIES - FROM CONJECTURE TO REALITY

H. E. HUDSON (Texas, University, Austin) Space Communication and Broadcasting (ISSN 0167-9368), vol. 3, Dec. 1985, p. 289-295. refs

Satellites now play an important role in developing countries where key applications are for education, health care, other social services, agriculture, rural development, and cultural enrichment. This paper traces the evolution of developing world utilization of satellites from early studies through to present-day applications, assisted by details of various case studies. An analytical framework is provided to aid prediction of the benefits and influences of satellite usage on a country's development. Author

A86-24836* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SPACE POWER SYSTEMS - 'SPACECRAFT 2000'

K. A. FAYMON (NASA, Lewis Research Center, Cleveland, OH) IN: Intersociety Energy Conversion Engineering Conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volume 1. Warrendale, PA, Society of Automotive Engineers, Inc., 1985, p. 1.422-1.424.

The program 'Spacecraft 2000' has the objective to identify critical, high-payoff, potential spacecraft technologies, taking into account the formulation, advocation, and the management of the requisite technology development programs. This program represents a joint NASA-industry program. The technology areas addressed by 'Spacecraft 2000' are related to spacecraft power/energy storage, thermal control/thermal management, power management and distribution, autonomous operation-control, on-board system integration, spacecraft environmental interactions, secondary propulsion, communications technologies, a total system response approach, and system-subsystem technology verification. The expected benefits of a development of advanced technologies include decreased spacecraft bus system weights, decreased mission costs, increased reliability/lifetimes, and increased operational flexibility. G.R.

A86-27896#

A 3M/NASA BASIC RESEARCH PROGRAM IN SPACE

C. J. PODSIADLY (3M Co., St. Paul, MN) IN: Space, our next frontier; Proceedings of the Conference, Dallas, TX, June 7, 8, 1984 . Dallas, TX, National Center for Policy Analysis, 1985, p. 318-321.

An account is given of emerging plans for a 10-year, NASA/industry joint research program to be conducted in space for the development of organic chemistry products, and their production techniques, in microgravity environments. Phase I of this research effort will encompass two experiments in organic crystal growth and one in the manufacture of proprietary organic thin films. Phase II experiments will involve the additional organic crystal growth efforts employing different techniques from those of Phase I, as well as a third thin film production experiments are more complex than those of Phase I. O.C.

A86-28055

CONCURRENT AND SEQUENTIAL NETWORKS IMPLICATIONS FOR PROJECT MANAGEMENT

L. A. SMITH and J. MILLS (Florida International University, North Miami) Engineering Management International (ISSN 0167-5419), vol. 3, Jan. 1986, p. 279-282.

Timely completion of projects is one of the essential goals of project management. The present authors have developed a probability-based explanation of the lateness phenomenon as it relates to network complexity. Concurrent activities within a network are greater determinants of the delay than are comparable sequential activities. The implications for project management are discussed. Author

A86-28593

THE SPACE INDUSTRY FOR COMMUNICATIONS AND REMOTE SENSING

P. MASARATI and G. BIANCHI (Selenia Spazio S.p.A., Rome, Italy) IN: Europe/United States space activities . San Diego, CA, Univelt, Inc., 1985, p. 287-311. (AAS 85-136)

A general outline of trends in the evolution of satellite systems for telecommunications and remote sensing applications, is given. Attention is given to several specific improvements in satellite designs which will be necessary to accommodate hypothesized traffic growths up to the year 2000. Among the improvements considered are: bandwidth compression; spot beam switching; k(a)-band transponders; and permanent space communications platforms. Trends in the development of remote sensing and meteorological satellites are also considered, with emphasis given to applications in the fields of oceanography, geology, agriculture, and resource management. I.H.

A86-28725

SPACECAB II - A LOW-COST SMALL SHUTTLE FOR BRITAIN D. M. ASHFORD (British Aerospace, PLC, Naval Weapons Div., Bristol, England) Aerospace (UK) (ISSN 0305-0831), vol. 13, Feb. 1986, p. 33-40.

The present article reports the results of a preliminary study regarding a concept which could make it possible to achieve a very substantial reduction in the cost required to place a payload into orbit. The key to such a reduction is the employment of fully reusable launch vehicles, taking into account the fact that so far all satellites and spacecraft (including the Shuttle) have involved throw-away launcher elements. A study has, therefore, been conducted concerning a small, manned, two-stage, fully reusable, aircraft-like launcher. 'Spacecab II' consists of a booster stage and an orbiter stage. The Orbiter is partially buried in the Booster. The combined vehicle takes off from a conventional airport, climbs to Mach 2 with the aid of turboiets, and is accelerated to Mach 4 by means of the Booster rocket motors. After separation, the Booster flies back to base and lands, while the Orbiter proceeds to orbit. The development costs of Spacecab II are comparatively low because existing technology is largely utilized. Thus, Concorde technology can be employed for the booster. GR

A86-28777

A MILLENNIUM PROJECT - MARS 2000

H. H. SCHMITT IN: The case for Mars II. San Diego, CA, Univelt, Inc., 1985, p. 23-31. (AAS 84-151)

A rationale is given for greatly expanded space exploration over the next decades, leading to a manned landing on and ultimate colonization of the planet Mars. The scenario calls for greater utilization of the resources of near-earth space (uninterrupted views of earth, sun and space; unlimited clean vacuum; absence of gravity), followed by establishment of a permanent lunar base, and then a manned mission to Mars to establish a settlement. Benefits and technical difficulties are addressed. D.H.

A86-28787* National Aeronautics and Space Administration, Washington, D.C.

BEYOND THE SPACE STATION

J. VON PUTTKAMER (NASA, Office of Space Flight, Washington, DC) IN: The case for Mars II . San Diego, CA, Univelt, Inc., 1985, p. 171-206. refs

(AAS 84-161)

The significance of the Space Station is examined with regard to the possibilities it will open. The Space Station, as a unique R&D facility, operation base, and transportation node, will not only enhance deeper-space ventures but also enable entirely new initiatives for man's advancement in space not possible before. One large goal enabled by the Space Station could be a manned Mars landing mission as a major national objective some time beyond the year 2000. Since its principal themes would be joint exploration and advancement of mankind in space, its scientific, technical and sociological benefits would be of unprecedented scope and magnitude. The Space Station should be regarded as having a 'beachhead' role in supporting multiple goals and multiple users. Commonalities and possible synergisms between program and mission systems, elements, and technologies of large new initiatives beyond the Space Station should be assessed. D.H

A86-28792

SCIENTIFIC PROGRAM FOR A MARS BASE

C. R. STOKER, P. J. BOSTON (National Center for Atmospheric Research, Boulder, CO), J. M. MOORE (Arizona State University, Tempe), and R. L. GROSSMAN (Cooperative Institute for Research in Environmental Sciences, Boulder, CO) IN: The case for Mars II. San Diego, CA, Univelt, Inc., 1985, p. 255-285. refs (AAS 84-166)

A program is presented for long-term Mars exploration beginning with unmanned missions and extending to the establishment of a permanent research station on Mars. Scientific objectives are identified for each phase of the program and the means of accomplishing these objectives are suggested. The science goals of unmanned missions include: selecting an optimal location for the Mars base, finding resources on Mars and facilitating their exploitation, and learning enough about the Martian environment to ensure that the base can be safely operated. The Mars exploration program proposed by the Solar System Exploration Committee (SSEC), if modified to include orbital imaging of cloud features and high resolution imaging of base candidates, will achieve these goals. After the base is established, crews occupying it will study the Mars atmosphere and surface. They will explore remote sites and collect samples for analysis at base laboratories. Climate and atmospheric dynamics and chemistry will be studied. Equipment necessary for geoscience and life science research is considered. D.H.

A86-28795

MISSION STRATEGY AND SPACECRAFT DESIGN FOR A MARS BASE PROGRAM

S. WELCH (Boulder Center for Science and Policy, CO) IN: The case for Mars II . San Diego, CA, Univelt, Inc., 1985, p. 345-375. (AAS 84-169)

Mission strategies and vehicle designs for a Mars landing are considered. The mission strategy is directed toward support of a permanently inhabited Mars base with crew rotation and resupply at every earth-to-Mars launch opportunity. The types of vehicles required for the Mars landing mission include a heavy lift launch vehicle (HLLV); aerocapture vehicles for transporting crew and cargo to the surface of Mars; interplanetary spacecraft; and a trans-Mars injection stage. The aerocapture vehicle may be converted for use as surface habitat for crews on the Martian surface. A detailed description of the three-part mission sequence is given. I.H.

A86-28796 CONCEPTS FOR THE EARLY REALIZATION OF A MANNED MISSION TO MARS

S. J. HOFFMAN and J. K. SOLDNER (Science Applications International Corp., Schaumburg, IL) IN: The case for Mars II . San Diego, CA, Univelt, Inc., 1985, p. 377-390. Research supported by the Planetary Society.

(AAS 84-170)

A concept for a first manned mission to the planet Mars, embarking in the early-2000's time frame is presented. For this analysis no new technology other than what would conservatively be expected in the next 20 years, e.g., aerocapture technology, is assumed to exist. A four person crew consisting of a three person surface exploration team, and one orbiting crewmember, is proposed. Thirty days will be spent exploring the Martian surface and near-Mars space. A dual launch mission concept is proposed, assuming all the required mass, including OTV's and their propellant, would be carried to orbit via the present Shuttle fleet. A performance summary shows that 10 OTV's are required to inject both spacecraft on their respective trajectories to Mars, and that a total of 18 Shuttle launches are necessary to deliver the mass to the near-earth orbit staging area. Author

A86-29496

HOTOL SPACEPLANE IS DESIGNED TO SLASH LAUNCH COSTS BY 80 PERCENT

D. A. BROWN Commercial Space (ISSN 8756-4831), vol. 1, Winter 1986, p. 55, 57.

'Hotol' (horizontal takeoff and landing) is a single stage to orbit aerospace vehicle, incorporating a dual airbreathing/rocket propulsion system, by means of which Britain intends to cut satellite launch costs by at least 80 percent. The hydrogen-fueled propulsion system envisioned will take its oxygen from the atmosphere at lower altitudes, as turbojets currently do, and then revert to onboard liquid oxygen during exoatmospheric operation. Hotol will, moreover, be entirely computer controlled in order to obviate crews and their life support systems. The Hotol payload bay may, nevertheless, be at some future time used to carry a passenger module seating as many as 60, thereby serving as an intercontinental transport aircraft. O.C.

A86-29581*# National Aeronautics and Space Administration, Washington, D.C.

GLOBAL INTERCONNECTIVITY IN THE NEXT TWO DECADES - A SCENARIO

R. LOVELL and C. L. CUCCIA (NASA, Communications Div., Washington, DC) IN: Communication Satellite Systems Conference, 11th, San Diego, CA, March 17-20, 1986, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1986, p. 39-49.

(AIAA PAPER 86-0605)

The present paper provides a description of a part of NASA's current long range plans, taking into account the development of hierarchal space switching centers and laser intersatellite links which can interconnect the globe. It is pointed out that a special objective involves the development of technology and satellite architecture for reducing the cost of an end-to-end voice message per minute from the present average value of around \$.40 now realized by terrestrial telephone systems to less than \$.10. The next decade of NASA communications activity (1985-1995) is discussed, giving attention to the Advanced Communications Technology Satellite ACTS (July 1984) which will test the technology of space switchboard and signal processing in space. The environment of the decade 1985-1995 is considered along with the roles of communications satellites, the hierarchies of terrestrial public switched networks, cost comparisons of terrestrial and space point-to-point links, and concomitant technology developments related to supercomputers. G.R.

A86-29750

SELECTING INTERRELATED R&D PROJECTS IN SPACE TECHNOLOGY PLANNING

A. F. CZAJKOWSKI and S. JONES (Clemson University, SC) IEEE Transactions on Engineering Management (ISSN 0018-9391), vol. EM-33, Feb. 1986, p. 17-24. refs

In this paper a decision support model and solution procedure is presented for selecting interrelated R&D projects in space technology planning. Technical and benefit interactions among projects are explicitly considered. The problem addressed is that of selecting among technologically enabling and value enhancing projects. A 0-1 integer programming model is formulated and solution technique presented that places technology project sets into two categories: (1) those the decision maker should consider, and (2) those that are dominated by sets in the first category. Use of the model and solution techniques is demonstrated in the context of a NASA case example pertaining to earth resources space programs. The efficiency of the model (with the solution technique) in reducing an unmanageably large number of possible technology project sets to a small tractable number of feasible and efficient sets is demonstrated in the example problem.

Author

A86-31218

MANAGEMENT OF OUTER SPACE FOR THE BENEFIT OF MANKIND

J. G. ROEDERER (Alaska, University, Fairbanks) CIDA, vol. 8, no. 8, 1983, p. 23-36.

Explicit form is given to recommendations implicit in the United Nations Report from the Second (1982) UN Conference on the Exploration and Peaceful Uses of Outer Space. These recommendations have as their aim the bridging of an existing gap in space research and technology benefits between the space-active developed countries and developing nations. Attention is given to such matters as space militarization, debris removal from orbit, space project environmental impacts, geostationary orbit management, and the development of means for the transfer of space-related knowledge and expertise to developing nations. The primary viewpoint in these deliberations is that of nations of Latin America and the Caribbean. O.C.

A86-32450

TOMORROW'S WEATHER - NEW ACCURACY IN FORECASTING

G. GRAFF High Technology (ISSN 0277-2981), vol. 6, April 1986, p. 27-35.

Projects designed to enhance the accuracy of routine and long-range forecasts and to guarantee early detection of such hazards as tornadoes and wind shear are presented. The Program for Regional Observing and Forecasting Services (PFOFS) aims to overcome conventional forecasting barriers by covering a limited geographical region and by processing the available data more rapidly. One component of PROFS, the advanced Doppler radar, is incorporated into a weather detection effort called Nexrad, whose purpose is to spot severe storms far earlier than is possible with conventional radar. Tornadoes can be spotted well in advance, as well as wind shear. The weather tracking system McIDAS is discussed together with projects designed to enhance air safety, such as the Airport Weather Observing System and the Airport Surface Observing System. Satellite-borne lasers will be used to monitor upper-air activity, and increased accuracy in long-range forecasting will be provided by the Tropical Oceans and Global Atmosphere project. By the turn of the century, it is predicted that two-week forecasts will have the kind of specificity now associated with two-day forecasts. K.K.

A86-32527*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

NATIONAL SPACE TRANSPORTATION SYSTEMS PLANNING

W. R. LUCAS (NASA, Marshall Space Flight Center, Huntsville, AL) IN: EASCON '85: National space strategy - A progress report; Proceedings of the Eighteenth Annual Electronics and Aerospace Systems Conference, Washington, DC, October 28-30, 1985 . New York, Institute of Electrical and Electronics Engineers, Inc., 1985, p. 3-8.

In the fall of 1984, the DOD and NASA had been asked to identify launch vehicle technologies which could be made available for use in 1995 to 2010. The results of the studies of the two groups were integrated, and a consumer report, dated December 1984, was forwarded to the President. Aspects of mission planning and analysis are discussed along with a combined mission model, future launch system requirements, a launch vehicle planning background, Shuttle derivative vehicle program options, payload modularization, launch vehicle technology implications, a new engine program for the mid-1990's. Future launch systems goals are to achieve an order of magnitude reduction in future launch cost and meet the lift requirements and launch rates. Attention is advanced cryogenic engine, advanced given to an systems, LOX/hydrocarbon engine, advanced power systems, aerodynamics/flight mechanics. reentry/recovery manufacturing techniques, avionics/software, advanced ground and mission operations, advanced autonomous structures/materials, and air breathing propulsion. G.R.

A86-32530

ADVANCED COMMUNICATIONS TECHNOLOGY SATELLITE

J. A. FROHBIETER (RCA, Astro-Electronics Div., Princeton, NJ) IN: EASCON '85: National space strategy - A progress report; Proceedings of the Eighteenth Annual Electronics and Aerospace Systems Conference, Washington, DC, October 28-30, 1985. New York, Institute of Electrical and Electronics Engineers, Inc., 1985, p. 23-27.

The Advanced Communications Technology Satellite (ACTS) scheduled for launch in 1989 is the latest in a series of NASA experimental communications satellites. Designed for Ka-Band operation, ACTS features both a high burst rate (220 mbps) trunking system incorporating IF switching, and fixed but configurable spot beams; together with a low burst rate (27.5-110 mbps) mode that provides individual 64 kbps message sorting and routing on the spacecraft, using a baseband processor. The low burst rate mode provides extended area coverage through the use of two scanning spot beams. Advanced features to be incorporated into this experimental system include: high burst rate TDMA operations, on-board baseband and IF switching automatic rain fade detection and compensation, Ka-Band transmitter, receiver and multibeam antenna technology, and Ka-Band TT&C. NASA is encouraging business, government agencies, universities and the military to participate as experimenters with the ACTS program. Author

A86-32543*# National Aeronautics and Space Administration, Washington, D.C.

SPACE STATION ADVANCED DEVELOPMENT PROGRAM

R. F. CARLISLE (NASA, Office of Space Station, Washington, DC) IN: EASCON '85: National space strategy - A progress report; Proceedings of the Eighteenth Annual Electronics and Aerospace Systems Conference, Washington, DC, October 28-30, 1985 . New York, Institute of Electrical and Electronics Engineers, Inc., 1985, p. 183-191.

The Space Station Advanced Development Program has the objective to transform promising new techniques into mature proven concepts to enable design options for the initial Space Station. It is pointed out that the options should improve system performance and reduce operational costs. Attention is given to the approach employed in the implementation of the program, the technology issues, aspects of Space Station evolution and growth, a Space Station technology overview, and subsystem technologies. The Advanced Development Power Program is considered along with the advanced development of auxiliary propulsion, the program dealing with attitude control and stabilization, and developments related to data management. Other developments are concerned with communication, system operation, manned systems technology, structures, and environmental control and life support. GR

A86-32904

MAN'S PERMANENT PRESENCE IN SPACE; PROCEEDINGS OF THE THIRD ANNUAL AEROSPACE TECHNOLOGY SYMPOSIUM, UNIVERSITY OF NEW ORLEANS, LA, NOVEMBER 7, 8, 1985

Symposium sponsored by AIAA. New Orleans, LA, American Institute of Aeronautics and Astronautics, 1985, 813 p. For individual items see A86-32905 to A86-32934.

Papers are presented on the need, and capabilities of the Space Station, managing fluids in space, propellant supply for space operations, and the effect of the space environment on spacecraft materials. Topics discussed include docking concepts, a launch system, the designs and planning of a lunar base/lunar city, space applications of composite structures, and the fabrication of composite tooling. Consideration is given to FAA air traffic control program management technology applications, the application of thermal analysis to polyurethane prepolymeric materials, surface sensitive techniques for the analysis of ET polymers, nondestructive measurements of residual stress, integrated logistics support, and mobile gantry robots for large structures.

A86-32913#

LOW COST ACCESS TO SPACE - A SECOND-GENERATION SHUTTLE CONCEPT

K. J. P. KELLEHER (Martin Marietta Corp., New Orleans, LA) IN: Man's permanent presence in space; Proceedings of the Third Annual Aerospace Technology Symposium, New Orleans, LA, November 7, 8, 1985. New Orleans, LA, American Institute of Aeronautics and Astronautics, 1985, 24 p. refs

The use of a caret wing on single-stage-to-orbit vehicles, which delivers payloads to earth orbit, is proposed. The hypersonic lift and drag for a vehicle with a caret wing and another craft with a conventional flat-delta wing are compared. The application of the thin shock theory to the calculation of lift and drag forces is examined. Flow characteristics were evaluated in a hypersonic gun tunnel at a Mach number of 9.7. It is observed that the caret wing increases the lift coefficient and lift/drag ratio.

A86-33544

SYSTEMATIC GROUND-BASED MEASUREMENTS OF MESOSPHERIC WATER VAPOR

C. L. CROSKEY, J. J. OLIVERO, L. C. HALE (Pennsylvania State University, University Park), and P. J. MOSER (Bloomsburg University, PA) IN: 1985 International Geoscience and Remote Sensing Symposium (IGARSS '85), Amherst, MA, October 7-9, 1985, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1985, p. 327-332. refs (Contract N00014-79-C-0610)

Spectral height, area, absorption, and sunspot data of atmospheric water vapor are analyzed. The measurements are obtained by observing spectral absorption against a source, such as the sun, or by studying the spectral radiation in emissions; the experimental procedures are described. The analysis reveals that there are cyclic variations in the spectral height and spectral area produced by mesospheric water vapor. I.F.

A86-34195

CAN WE DEVELOP THE 1.5 MILLION POUND AEROSPACE PLANE?

D. J. HOLT Aerospace Engineering (ISSN 0736-2536), vol. 6, April 1986, p. 26-30.

A technology readiness and economic feasibility evaluation is made of hypersonic, 'transatmospheric' aerospace vehicles; attention is given to the prospects for propulsion systems capable of attaining the Mach 25 escape velocity needed to reach low earth orbits and duplicating many of the functions currently undertaken by the Space Shuttle. Either two integrated propulsion systems or two 'staged' vehicles may be employed to yield the requisite operational capabilities. The claims of competing airbreathing and nonairbreathing (rocket) propulsion systems are evaluated. O.C.

A86-34963* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

MOTIVATIONAL CONTRACTING IN SPACE PROGRAMS -GOVERNMENT AND INDUSTRY PROSPECTIVES

D. R. CLOUGH (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Space and society - Progress and promise; Proceedings of the Twenty-second Space Congress, Cocoa Beach, FL, April 23-26, 1985 . Cape Canaveral, FL, Canaveral Council of Technical Societies, 1985, p. 3-5 to 3-20.

NASA's Marshall Space Flight Center has used incentive-free policies in contracting for Apollo's Saturn Launch vehicle hardware, as well as award-fee contracts for major development and early production programs in the case of the Space Shuttle Program. These programs have evolved to a point at which multiple incentive fees are useful in motivating cost reductions and assuring timely achievement of delivery requirements and flight mission goals. An examination is presently conducted of the relative success of these motivation-oriented techniques, drawing on the comments of both government and industry personnel. O.C.

A86-34965* Wyle Labs., Inc., Huntsville, Ala.

COMMERCE LAB - A PROGRAM OF COMMERCIAL FLIGHT OPPORTUNITIES

J. ROBERTSON (Wyle Laboratories, Huntsville, AL), H. L. ATKINS, and J. R. WILLIAMS (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Space and society - Progress and promise; Proceedings of the Twenty-second Space Congress, Cocoa Beach, FL, April 23-26, 1985. Cape Canaveral, FL, Canaveral Council of Technical Societies, 1985, p. 4-2 to 4-14.

Commerce Lab is conceived as an adjunct to the National Space Transportation System (NSTS) by providing a focal point for commercial missions which could utilize existing NSTS carrier and resource capabilities for on-orbit experimentation in the microgravity sciences. In this context, the Commerce Lab program provides mission planning for private sector involvement in the space program, in general, and the commercial exploitation of the microgravity environment for materials processing research and development. It is expected that Commerce Lab will provide a logical transition between currently planned NSTS missions and future microgravity science and commercial R&D missions centered around the Space Station. The present study identifies candidate Commerce Lab flight experiments and their development status and projects a mission traffic model that can be used in commercial Author mission planning.

A86-34967* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SPACELAB 3 MISSION - BROADENING HORIZONS IN SPACE RESEARCH

G. H. FICHTL, C. K. HILL, and O. H. VAUGHAN (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Space and society -Progress and promise; Proceedings of the Twenty-second Space Congress, Cocoa Beach, FL, April 23-26, 1985 . Cape Canaveral, FL, Canaveral Council of Technical Societies, 1985, p. 5-2 to 5-8. refs

The Spacelab 3 mission involves research in materials sciences, fluid mechanics, atmospheric science, astrophysics, and life sciences with emphasis on materials sciences. In this regard the mission will provide the best low-gravity environment possible within the hardware and operational constraints of the Shuttle/Spacelab system. This is truly a major milestone in space research. The paper describes the scientific goals of this important Spacelab mission and discusses how the mission was planned relative to the low-gravity aspects of the mission. Author

A86-34974* National Aeronautics and Space Administration, Washington, D.C.

INTERNATIONALIZATION OF THE SPACE STATION

R. V. LOTTMANN (NASA, Office of Space Station, Washington, DC) IN: Space and society - Progress and promise; Proceedings of the Twenty-second Space Congress, Cocoa Beach, FL, April 23-26, 1985. Cape Canaveral, FL, Canaveral Council of Technical Societies, 1985, p. 8-1 to 8-9.

Attention is given to the NASA Space Station system elements whose production is under consideration by potential foreign partners. The ESA's Columbus Program declaration encompasses studies of pressurized modules, unmanned payload carriers, and ground support facilities. Canada has expressed interest in construction and servicing facilities, solar arrays, and remote sensing facilities. Japanese studies concern a multipurpose experimental module concept. Each of these foreign investments would expand Space Station capabilities and lay the groundwork for long term partnerships. O.C.

A86-34991*# National Aeronautics and Space Administration, Washington, D.C.

SPACELAB HITCHHIKER, FOR RAPID, LOW COST ORBITAL RESOURCES

E. JAMES and R. L. LOHMAN (NASA, Spacelab Div., Washington, DC) Canaveral Council of Technical Societies, Space Congress, 22nd, Cocoa Beach, FL, Apr. 23-26, 1985, Paper. 8 p.

A carrier system called the Hitchhiker is being developed by NASA to bridge the gap between the limited capabilites of the

Get Away Special (GAS) and the full support capabilities of the Spacelab. The Hitchhiker offers economy class flight for experiments which need little in the way of support services. The concept behind this carrier system is to use existing hardware in two basic configurations and to provide several sets of fixed service interfaces to the payload. One version of the Hitchhiker was designed to hang on the right side of the bay and the other to span the bay. Aside from cargo bay sill-level mounting positions for experiments, both Hitchhiker configurations provide modest power, command, and data management, and no active cooling services. The Hitchhiker is a payload of opportunity system utilizing the volume and weight remaining in the cargo bay after primary-payload needs are satisfied. Pointing and other time line requirements are limited to those established by the primary payload. The paper descibes the experiments of the first two Hitchhiker flights, together with future applications. KK

A86-34992*# National Aeronautics and Space Administration, Washington, D.C.

ENABLING TECHNOLOGIES FOR TRANSITION TO UTILIZATION OF SPACE-BASED RESOURCES AND OPERATIONS

S. R. SADIN (NASA, Office of Aeronautics and Space Technology, Washington, DC) and J. D. LITTY (General Research Corp., Space Systems Div., McLean, VA) Canaveral Council of Technical Societies, Space Congress, 22nd, Cocoa Beach, FL, Apr. 23-26, 1985, Paper. 10 p.

This article explores a potential scenario for the further development of space infrastructure resources and operations management. It is a scenario that transitions from the current ground-based system to an architecture that is predominantly space-based by exploiting key mission systems in an operational support role. If this view is accurate, an examination of the range of potential infrastructure elements and how they might interact in a maximally productive space-based operations complex is needed, innovative technologies beyond the current Shuttle and Space Station legacy need to be identified, and research programs pursued. Development of technologies within the areas of telerobotics, machine autonomy, human autonomy, in-space manufacturing and construction, propulsion and energy is discussed.

A86-35526

PRESCRIPTION FOR PROFITS

T. FURNISS Space (ISSN 0267-954X), vol. 2, Mar.-May 1986, p. 56-58.

The first attempts at pharmaceutical production in microgravity are described, together with prospects for the future. It was discovered that body-produced enzymes and proteins needed to cure such diseases as hemophilia, anemia and diabetes can be produced in greater quantities and higher purities through electrophoresis in microgravity. The first space manufacturing unit (CFES), launched in 1982, was mounted in the SS lower mid-deck and consisted of a fluid systems module, a microcomputer, and a water-cooling module. The CFES achieved the separation of 700 times more material, at a purity level 4 times greater than is possible on earth. Three subsequent attempts made by McDonnell Douglas at the purification of live insulin-producing beta cells are presented in detail. Undertakings planned by other companies include urea crystal production and the study of crystals used in nylon production and electronics. K.K.

A86-37187* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

INTERACTIVE MISSION PLANNING FOR A SPACE SHUTTLE FLIGHT EXPERIMENT - A CASE HISTORY

H. M. HARRIS (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Aerospace simulation II; Proceedings of the Second Conference, San Diego, CA, January 23-25, 1986. San Diego, CA, Society for Computer Simulation, 1986, p. 143-151. NASA-supported research.

Scientific experiments which use the Space Shuttle as a platform require the development of new operations techniques for the command and control of the instrument. Principal among these is the ability to simulate the complex maneuvers of the orbiter's path realistically. Computer generated graphics provide a window into the actual and predicted performance of the instrument and allow sophisticated control of the instrument under varying conditions. In October of 1984 the Shuttle carried a synthetic aperture radar built by JPL for the purpose of recording images of the earth surface. The mission deviated from planned operation in almost every conceivable way and provided an exacting test bed for concepts of interactive mission planning. Author

A86-37428

MANAGEMENT OF HIGH-TECHNOLOGY RESEARCH AND DEVELOPMENT

J. H. DUMBLETON (Howmedica, Rutherford, NJ) Amsterdam and New York, Elsevier, 1986, 411 p. refs

R & D is discussed in terms of its position in the strategy-structure relationship of the firm. The discussion covers the following five areas: the nature of R & D, strategy and structure relationships, creativity, the R & D process, and the R & D interface. In particular, attention is given to models of the R & D process, success factors in R & D, the measurement of the R & D activity, the organizational structure of research and development, creative problem solving, project planning and control, personal factors in the R & D process, and trends in research and development.

V.L.

 $\mbox{A86-37853}^{\star}\mbox{\#}$ National Aeronautics and Space Administration, Washington, D.C.

THE U.S. SPACE STATION PROGRAM

P. E. CULBERTSON (NASA, Office of Space Station, Washington, DC) IN: International Conference on Space, 25th, Rome, Italy, March 26-28, 1985, Proceedings . Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1985, p. 11-22.

An overview is given of the U.S. Space Station program, beginning with President Reagan's directive to NASA 'to develop a permanently manned Space Station and to do it within a decade'. The international aspects of the project are emphasized, and fruitful cooperation between Italy and the U.S. in past and present space research is noted. The Station is to serve diverse functions, including that of a laboratory in space, a permanent observatory, a servicing facility, a transportation node, and assembly and manufacturing facility, a storage depot, and a staging base for future endeavors. Management-related and engineering-related guidelines are laid out. The plan is to make the Space Station a legacy from this century to the next, with the help of and to the benefit of all who share our goals. D.H.

A86-37870#

PRESENT AND FUTURE PROSPECTS OF MICROGRAVITY

L. G. NAPOLITANO (European Low Gravity Research Association, Munich, West Germany) IN: International Conference on Space, 25th, Rome, Italy, March 26-28, 1985, Proceedings . Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1985, p. 265-309.

An overview is given of the current status of microgravity research and related disciplines, with respect to the Space Station. The broad-field list of topics with microgravity relevance includes material sciences, fluid sciences, life sciences, engineering sciences, technology and processes. Areas and disciplines with the material sciences and fluid sciences are examined in some detail, and the expected requirements and evolutionary development of the sciences aboard the Space Station are considered. The report includes a position paper covering the situation in Europe with regard to microgravity research, covering ESA's microgravity experiments and the work of the organization known as ELGRA (European Low Gravity Research Association), founded in June 1979.

A86-38623

NUCLEAR POWER FOR EARTH ORBIT AND BEYOND

B. NOLLEY Space World (ISSN 0038-6332), vol. W-5-269, May 1986, p. 18-20.

The development of space-based thermoelectric nuclear power generators for such future applications as the propulsion of an Orbital Transfer Vehicle or planetary exploration is discussed. Nuclear fission reactors have a higher power/mass ratio than radioisotope or chemical generators, less atmospheric drag, and will not be dependent on attitude control. The NASA in-core thermionics SP-100 nuclear fission reactor prototype is expected in the mid-1990s. A low mass 6.4 percent efficient multimegawatt capability reactor is described with a fast spectrum reactor in the cone's apex, separate from the two silicon-germanium element thermoelectric conversion system. Liquid lithium transports heat from the 1970-C reactor to heat exchanges that convey it to the heat pipe array, and heat rejection occurs at the deployable radiator panels. R.R.

A86-38718#

ERS-1 - OUR NEW WINDOW ON THE OCEANS FOR THE 1990S

D. T. LLEWELLYN-JONES (SERC, Rutherford Appleton Laboratory, Didcot, England) British Interplanetary Society, Journal (Space Science) (ISSN 0007-084X), vol. 39, May 1986, p. 228-234.

ESA's First Remote Sensing Satellite (ERS-1) due for launch 1989 will monitor a carefully selected set of geophysical parameters in an effort to describe the state of the sea-surface. The payload instruments of ERS-1, how they make their measurements, and how the data will be dealt with, are described and discussed. The payload consists of three microwave radars: (1) a wind and wave scatterometer, (2) a synthetic aperture radar, and (3) a radar altimeter. These instruments are complemented by an Along Track Scanning Radiometer and a Precise Range and Range-Rate Experiment. The concept of fast delivery data products is an essential element of the ERS-1 system, meaning that the processed ERS-1 data will be distributed to designated points of contact within three hours of being obtained by the spacecraft. It is concluded that these measurements will lead to a better scientific understanding of ocean-atmosphere interactions; moreover, they will pave the way to the application of such data products to a large range of commercial activities. KK

A86-38959

ADVANCED PROJECT MANAGEMENT (2ND EDITION)

F. L. HARRISON Aldershost, England/New York, Gower Publishing Co. Ltd./John Wiley and Sons, 1985, 390 p. refs

A 'project' is definable as a nonroutine and nonrepetitive undertaking that is conducted on a large scale under unique time-to-completion, financial, and technical performance goals. Management, organization and information systems have to be newly established for each project, and there can therefore be only a very limited learning curve for those involved. Great emphasis must be given to planning and control activities, especially for the financial management of the large capital expenditures often entailed. Attention is given to the estimation of project costs, cash flow forecasting, network analyses and bar charts, S-curves, performance milestone charts, analysis methods, and computer-based project management systems. 00

A86-40999* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

A TECHNIQUE FOR LOWERING RISKS DURING CONTRACT NEGOTIATIONS

D. H. LEHMAN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IEEE Transactions on Engineering Management (ISSN 0018-9391), vol. EM-33, May 1986, p. 79-81. refs

In this day and age of sophisticated weapon and space system procurements, negotiations of the statement of work, technical requirements, and schedule may be as protracted as the negotiation of costs and profit. A major problem facing the program manager during contract negotiations is what affect changes in schedule, technical requirements, and contract terms have on the price. In many instances, after the statement of work has been redrafted, the contractor will be obliged to reprice the work, either on the spot or after a short recess in the negotiations. In this paper, a method for organizing the negotiation process is presented to reduce the risks incurred by the seller. The method is built upon regression analysis and two illustrative examples of its use are provided. Author

A86-41154* Alabama Univ., Huntsville. COMMERCIAL USE OF SPACE - STATUS AND PROSPECTS

C. A. LUNDQUIST (Alabama, University, Huntsville) and W. C. SNODDY (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Winter National Design Engineering Show and Conference, Anaheim, CA, December 11-13, 1985, Conference Talks . Stamford, CT, Cahners Exposition Group, 1985, p. 225-239. refs

The development of commercial enterprises in space is discussed. The convenience and cost-effectiveness of satellites for communications are examined; satellite communications is an established industry and continues to grow. Meteorological satellites and remote sensing satellite systems (Landsat and SPOT) are being utilized to collect earth resources data. The development of materials processing facilities in space is studied. Current and proposed systems for transporting payloads to space and space lab facilities are investigated. The advantages a space station will provide to communications, earth resources, and materials processing are analyzed. The role of governments in the commercialization of space is described.

A86-41981

SPACE TECHNOLOGY AND RESOURCE MANAGEMENT

P. S. THACHER Journal of International Affairs (ISSN 0022-197X), vol. 39, Summer 1985, p. 151-166. refs

The applications of space technology to the management of natural resources are examined. Meteorological and oceanographic satellite data, MSS and thematic mapper images, and Space Shuttle recorded images are useful for monitoring resources; these satellite data are utilized for determining weather conditions (droughts) and vegetation indices, especially in Africa. Long-range research on the global processes of the earth, in order to understand biogeochemical cycles and the links between geophysical and biospheric processes is described. The relationship between desertification, famine, and droughts are analyzed. The development of the Global Environmental Monitoring System which collects and analyzes meteorological data related to global resources and environmental issues is discussed. The objectives of NASA's earth science research programs and the Global Resources Information Database are considered. The need for international cooperation for resource management and the role of the UN in monitoring natural resources are studied.

A86-43229* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE EARTH OBSERVING SYSTEM

R. E. HARTLE (NASA, Goddard Space Flight Center, Greenbelt, MD) and A. TUYAHOV (NASA, Washington, DC) IN: Astrodynamics 1985; Proceedings of the Conference, Vail, CO, August 12-15, 1985. Part 1 . San Diego, CA, Univelt, Inc., 1986, p. 529-550.

(AAS PAPER 85-397)

This paper summarizes concepts for an Earth Observing System (EOS) for the 1990s that will provide the observational capabilities and an information system needed to understand how the earth works as a system. The concept diverges somewhat from past practices in that it considers EOS as an information system, where mission operation, EOS data bases and information about other relevant data sets are tied together by an information network. Three EOS instrument packages were chosen on the basis of synergistic groupings of instruments to make simultaneous observations of selected phenomena over a variety of wavelengths.

A86-43341

CONTRACTS OF AND WITH PRIVATE ENTERPRISES CONCERNING THE DEVELOPMENT, THE CONSTRUCTION, AND THE ASSEMBLY OF SPACE VEHICLES [VERTRAEGE VON UND MIT PRIVATUNTERNEHMEN BETR. DIE ENTWICKLUNG, DEN BAU UND DIE MONTAGE VON RAUMFLUGKOERPERN]

E. WOLFF (Dornier System GmbH, Friedrichshafen, West Germany) IN: Space stations: Legal aspects of scientific and commercial use in a framework of transatlantic cooperation; Proceedings of the International Colloquium, Hamburg, West Germany, October 3, 4, 1984 . Cologne, West Germany, Carl Heymanns Verlag, 1985, p. 89-99. In German. refs

This paper provides a representation of some special features which characterize development contracts that governmental agencies award to industrial enterprises. Particular attention is given to conditions in West Germany. However, approaches used in connection with contracts involving ESA and NASA are also considered. The origin of the development contract is discussed along with the objective of the development contract, questions regarding the legal qualification of the development contract, regulations regarding compensation in development contracts, assurances concerning the quality of the performed work, and the rights of the party awarding the contract with respect to information, participation, and control. G.R.

A86-44404

THE DECISION TO DEVELOP THE SPACE SHUTTLE

J. M. LOGSDON (George Washington University, Washington, DC) Space Policy (ISSN 0265-9646), vol. 2, May 1986, p. 103-119. refs

In connection with the tragic destruction of the Challenger, questions regarding the origin of the Shuttle itself are considered, taking into account the decision, announced on 5 January 1972, to develop a particular Shuttle design on a limited budget. It is felt that the situation surrounding this decision has had a great deal of influence on the inability of that design to deliver routine and inexpensive space transportation. According to NASA plans in 1969, the Space Shuttle was to consist of two reusable components. After launch, the 'booster stage' would be flown by its crew to a landing near its launch site, while the 'Orbiter' would rendezvous with a Space Station. As a result of budgetary restrictions, these plans had to be abandoned. The final result, after very extended evaluations and negotiations, was the Space Shuttle design in its current form, which is characterized by much smaller development costs, but substantially larger operating costs. G.R.

A86-44526

SPACE - TECHNOLOGY AND OPPORTUNITY; PROCEEDINGS OF THE CONFERENCE, GENEVA, SWITZERLAND, MAY 28-30, 1985

Pinner, England, Online Publications, 1985, 356 p. For individual items see A86-44527 to A86-44551.

The technologies, organizations, hardware and plans for the commercialization of space activities in the near future are detailed. Financing schemes for manufacturing, leasing, sharing, or owning all or part of a spacecraft or a potential space-based industrial process are delineated, along with the problems facing the space insurance business. Although emphasis is placed on ESA and other European programs, the NASA Manned Space Station plays a pivotal role in the space development plans of most western nations, experimenters, and corporations. Attention is also devoted to unmanned platforms, their potential commercial applications, and to the necessary hardware infrastructure to support their operations. The capabilities of the Ariane 5 launch vehicle, the Hermes space plane, and a series of Chinese launch vehicles are described. Comparisons are made of the economics of various types of partially and fully reusable launch vehicles with diverse payload capabilities, of which the STS has the largest capacity.

58

06 RESEARCH AND DEVELOPMENT

A86-44530

STATUS OF ESA'S PLANNING FOR THE SPACE STATION

G. ALTMANN (ESA, Manned and Retrievable Systems Dept., Noordwijk, Netherlands) IN: Space - Technology and opportunity; Proceedings of the Conference, Geneva, Switzerland, May 28-30, 1985 . Pinner, England, Online Publications, 1985, p. 17-33.

The present status of preparation for the European Space Station Programme (COLUMBUS) is reviewed. A description of the COLUMBUS Programme concept placed in the context of ESA's long term space plane is presented and all facets of the COLUMBUS Preparatory Programme are outlined to provide an overview of ESA's planning for the Space Station Programme.

Author

A86-44543

A FULLY REUSABLE LAUNCH VEHICLE FOR EUROPE?

A. BOND (Commercial Space Technologies, Ltd.; U.K. Atomic Energy Authority, Culham Laboratory, England) IN: Space -Technology and opportunity; Proceedings of the Conference, Geneva, Switzerland, May 28-30, 1985 . Pinner, England, Online Publications, 1985, p. 221-229.

It is argued in this paper that Europe should make a serious attempt to lead the commercial launcher field by building a fully reusable space transporter based on advanced propulsion concepts and structures. By analogy with the history of commercial aircraft it is postulated that such a development would not only enable traffic growth to be forced but also guarantee a major fraction of the 21st century world market for Europe, initially in spacecraft launches and later in launch vehicle sales. Author

A86-44548

ELECTROPHORESIS OPERATIONS IN SPACE - A PROMISING NEW COMMERCIAL VENTURE

J. T. ROSE (McDonnell Douglas Astronautics Co., Saint Louis, MO) IN: Space - Technology and opportunity; Proceedings of the Conference, Geneva, Switzerland, May 28-30, 1985 . Pinner, England, Online Publications, 1985, p. 281-284.

Space-based electrophoresis biological materials processing (EBMP) is being developed on Shuttle flights. EBMP takes advantage of the incipient electrical charge possessed by every biological and chemical substance. When the substances pass through an electrical field, they separate into distinct streams which can be collected. The efficiency of the process is hundreds of times more efficient in space than on the ground because of the microgravity in space. Biological substances such as enzymes and hormones, if produced in quantity, could have significant medical applications in the treatment of diseases such as diabetes, emphysema, dwarfism, thrombosis, etc. Mass production is thus far only a possibility in space, not on the ground. The technology is being developed as a Joint Endeavor between NASA and a orbiting platforms for the industrial-scale operations to follow.

M.S.K.

A86-45643 HORIZON 2000 AND ITS RELATION TO THE COLUMBUS PROGRAMME

V. MANNO (ESA, Directorate of the Scientific Programme, Paris, France) (Columbus Workshop, 1st, Capri, Italy, June 17-21, 1985) Earth-Oriented Applications of Space Technology (ISSN 0277-4488), vol. 6, no. 1, 1986, p. 101-104.

The ministers representing the different nation members of ESA agreed to an initial 5 percent/yr increase in the ESA science budget for the period 1985-90 as a show of support for the Horizon 200 plan. Projects started during the plan period have the flexibility for optimum utilization of all available launch facilities, including interfacing with the Columbus segment of the Manned Space Station (MSS). This interface would permit maintenance of a planned space-based submillimeter radiotelescope and the retrieval and storage of cometary samples gathered by a unmanned spacecraft. Other experiments, considered minor, could be carried on the Eureca free-flying platform, which will be launched, serviced and retrieved from the MSS base. M.S.K.

A86-45709#

TECHNOLOGY BASE FOR THE FUTURE OF SPACE

R. A. DAVIS Aerospace America (ISSN 0740-722X), vol. 24, July 1986, p. 44-47.

A summary is given of the detailed report of the AIAA's Ad Hoc Technical Committee on Space Systems, presented in November 1985 to the National Commission on Space. Among the key technologies detailed in the AIAA report that were highlighted by the Commission are high-performance electric propulsion systems, processing of lunar and other nonterrestrial materials, autonomous fault-tolerant machinery, aerospaceplane propulsion, advanced rocketry, aerobraking, long-duration closed ecosystems, nuclear-electric power plants, space tethers, and high-performance materials. Themes for civil space agendas are considered: cooperative international ventures, space commercialization, manned space stations leading to the protocolony, a Moon base, a Mars base during the third decade of the next century, and development and refinement of all the necessary support technologies. Author

A86-46763* National Aeronautics and Space Administration, Washington, D.C.

NASA PLANS FOR SPACEBORNE LIDAR - THE EARTH OBSERVING SYSTEM

R. J. CURRAN (NASA, Washington, DC) IN: Tunable solid state lasers for remote sensing; Proceedings of the Conference, Stanford, CA, October 1-3, 1984. Berlin and New York, Springer-Verlag, 1985, p. 4-12. refs

The use of laser techniques to observe the earth's atmosphere and surface from space is examined. An Earth Observing System is proposed as the platform for performing lidar observations. The objectives and capabilities of the Lidar Atmospheric Sounder and Altimeter (LASA) are described. The measurement techniques for collecting temperature, pressure, and water vapor profiles, the vertical distribution of ozone in the stratosphere and troposphere, and atmospheric particulates profiles are discussed. The LASA requirements for altimetry and retroranging are considered. The Doppler Lidar Wind Sensor which provides data on wind velocity is analyzed. These laser systems with increased spatial resolution and accuracy form an efficient information system for studying earth science developments.

A86-46938#

AN UPDATED MODEL FOR A SPACE STATION HEALTH MAINTENANCE FACILITY

W. T. HARVEY, S. M. FARRELL, A. J. HOWARD, and F. C. PEARLMAN (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) AIAA, Space Station in the Twenty-first Century, Meeting, Reno, NV, Sept. 3-5, 1986. 7 p.

(AIAA PAPER 86-2303)

The Space Station Health Maintenance Facility (HMF) is required to provide 'critical care' capability for one crew-nember for 28 days. The HMF must also provide routine monitoring and care for the Space Station crew for the duration of the mission. The equipment necessary to meet these requirements has been defined and an estimate of the physical characteristics of each piece of equipment has been completed. The equipment has been integrated into two Space Station standard outfitting packages, one which contains the laboratory and data management equipment and one which holds the critical care equipment and X-ray reader. The front panel configuration has been designed for optimum crew interface. The total system weight, volume and power requirements have been estimated at 1500 lbs, 140 cubic feet, and 0.5/2 kilowatts (routine/ critical care). The HMF Medical Data Management System hardware and architecture has been designed to complement the Space Station Data Management System.

Author

06 RESEARCH AND DEVELOPMENT

A86-46960#

SPACE STATION - LIFE SCIENCES

R. S. YOUNG (Management and Technical Services Co., Washington, DC) AIAA, Space Station in the Twenty-first Century, Meeting, Reno, NV, Sept. 3-5, 1986. 4 p. (AIAA PAPER 86-2346)

The use of the Space Station for biomedical research and the study of biological cellular and subcellular processes is described. The research will require: (1) a health maintenance facility, (2) a life science research facility, and (3) instruments and platforms for automatic experiments. Experiments analyzing physiological changes induced by microgravity and the relationship between gravity, cellular and organismal physiology, and biochemistry are to be performed on the Station. The development of closed ecological life support systems is to be studied on the Space Station. The Station's facilities are also to be utilized to examine the interaction of the earth's biota with the planet environment, and the origin, evolution, and distribution of life throughout the universe. 1 F

A86-47052* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

SPACE TECHNOLOGY TODAY

A. COHEN (NASA, Johnson Space Center, Houston, TX) Journal of Vacuum Science and Technology A (ISSN 0734-2101), vol. 4, May-June 1986, pt. I, p. 263-267.

The current status of major NASA programs and planning efforts is surveyed. Consideration is given to space-sciences programs (IRAS, SIRTF, Space Telescope, and planetary probes), applications programs (terrestrial remote sensing, communication, and meteorology), manned spacecraft, the STS, the Space Station, space commercialization efforts (materials processing and bioprocessing), and the feasibility of permanent lunar bases and manned Mars expeditions. Photographs and drawings are included. T.K.

A86-47648#

THE U.S. CIVIL SPACE PROGRAM: A REVIEW OF THE MAJOR **ISSUES REPORT OF AN AIAA WORKSHOP, ALEXANDRIA, VA.** JULY 22, 23, 1986

New York, American Institute of Aeronautics and Astronautics, 1986, 85 p. refs

Urgent and long-term issues affecting the U.S. civil space program are defined and recommendations are made. These issues include: (1) access to space (i.e., Shuttle redesign and requalification, launch and spacecraft insurance, and new launcher development); (2) space program management (ie., budget rationale and implementation, NASA's relation to other agencies, and military-civil interaction); (3) international involvement (ie., interactional civil space leadership, international cooperation and competition and international space year 1992); and (4) human motivations, resources and perceptions. It is noted that U.S. leadership in space can be restored only by vigorous action backed by firm commitments. The first requirement is a unified national policy which sets along terms objectives, and the second is a civil space budget which is approximately double what it is at the present time. K.K.

A86-47960*# RCA Astro-Electronics Div., Princeton, N. J. SPACE STATION POLAR ORBITING PLATFORM - MISSION ANALYSIS AND PLANNING

P. A. MILLER (RCA, Astro-Electronics Div., Princeton, NJ) AIAA and AAS, Astrodynamics Conference, Williamsburg, VA, Aug. 18-20, 1986. 8 p. refs

(Contract NAS5-29400)

(AIAA PAPER 86-2178)

The Space Station Polar Orbiting Platform will be a serviceable spacecraft supporting a range of missions. The planning and analysis of these missions is investigated. The subjects of STS compatibility, rendezvous strategy, and requisite launch windows are addressed. General, as well as, two specific cases are detailed with respect to their incremental velocity requirements. Author

A86-48100 **MISSIONS TO MARS**

A. WILSON Flight International (ISSN 0015-3710), vol. 130, July 12, 1986, p. 35-37.

The two Mars missions which have been planned include NASA's Mars Observer and the Soviet Phobos project. Phobos, which is to use the new-generation Venera spacecraft, is scheduled to be launched on July 15, 1988. It is expected to arrive in Mars orbit during January 1989. NASA's Mars Observer is the first of the Planetary Observer series. The series will employ modified existing earth-orbiting satellites for inner solar system missions. Mars Observer will not be launched until August/September 1990. This mission will possibly be followed by the launch of the Mars Aeronomy Orbiter (MAO) in 1993/4. It is pointed out that, unless the Soviets undertake a manned Mars expedition before the turn of the century, the next logical step would be an unmanned sample return mission. The results of studies of such a mission are discussed, taking into account the conduction of such an enterprise in the time period from 1996 to 2005. G.R.

A86-48373

SPACE STATION EVOLUTION - THE UNCERTAINTY PRINCIPLE PREVAILS

C. BULLOCH Interavia (ISSN 0020-5168), July 1986, p. 779-782.

NASA planners have repeatedly reduced the scope of initial Space Station design concepts in order to realistically respond to financial stringencies. The number of U.S.-operated pressurized modules has been reduced to two, not counting the Space Station's logistics module. A decision has been made to rely on a solar dynamic electrical generation system based on a closed thermodynamic is powered cycle that by а solar concentrator-reflector. Attention is given to Canadian, European and Japanese plans for participation, and the ownership/legal status consequences that various collaborative arrangements can have. O.C.

A86-48451#

PROJECTIONS OF SPACE SYSTEMS OPPORTUNITIES AND TECHNOLOGIES FOR THE 2000 TO 2030 TIME PERIOD

New York, American Institute of Aeronautics and Astronautics, 1985, 101 p. refs

The present work is a report compiled by an Ad Hoc Committee of AIAA and subsequently presented to AIAA for submittal to the National Commission on Space. Particular emphasis is placed on the establishment of a technology base which would be crucial to civil space endeavors in the 2000-2030 time period. It considers the impact of technologically relevant events of the last five years, discusses future space system missions and opportunities. highlights critical technology developments, and outlines the steps necessary to the enhancement of the technology base over the next few decades. Space system technologies for the following areas are discussed in detail: information processing; guidance navigation and control; autonomy and automation; sensors; communications; materials; propulsion, power and energy; atmospheric flight; thermal management; environment; human support manufacturing; test and evaluation; and economics. K.K.

A86-49453

THE FLOWERING OF JAPAN'S SPACE PROGRAM

R. YARED Space World (ISSN 0038-6332), vol. W-7-271, July 1986, p. 15, 16.

Recent accomplishments and upcoming planned missions in Japan's space program are described. The Japanese space program is now one of the largest in the world. There have been 31 launchings to date of made-in-Japan satellites, including two spacecraft used recently for the international study of Halley's Comet, and there is talk, and drawing board designs, of a Japanese manned shuttle for early in the next century. Japan has space centers at Kagoshima on Kyushu island and also on Tanegashima island. The government budget is relatively modest: 0.02 percent of the national budget or about \$600 million. The National Space Development Agency (NASDA) gets more than three quarters of

this amount. NASDA is scheduling a launch into sun-synchronous orbit in early 1987 of Japan's first remote sensing spacecraft, a marine observation satellite; it will aid in determining weather conditions and forecasts as well as monitor fishing grounds. currents, red tides and other pollution; three sensors will be used: a multi-spectral electronic radiometer, a mechanical scanning radiometer with one visible and three IR channels, and a microwave scanning radiometer to pick up data transmitted from a collection platform on the sea surface. The Institute of Space and Astronautical Science (ISAS) is planning for a reflight of a Spacelab package on a January 1988 Shuttle flight. X-ray astronomy, microgravity, NASA Space Station participation (along with the U.S., ESA, and Canada), and the training of three Japanese astronauts are other areas being actively pursued. DH

N86-11657*# National Academy of Sciences - National Research Council, Washington, D. C.

GEODESY: A LOOK TO THE FUTURE

1985 193 p refs Sponsored in part by NASA, Defense Mapping Agency, NOAA and Geological Survey

(NASA-CR-176283; NAS 1.26:176283; PB85-199578) Avail:

NTIS HC A09/MF A01 CSCL 08E The report deals with the current and future uses of contemporary geodetic data and poses some questions and possibilities for the future. It is anticipated that the document will generate interest in present and future geodetic data for the solution of problems in Earth, ocean, and atmospheric sciences. GRA

N86-12158*# National Academy of Sciences - National Research Council, Washington, D. C.

NASA-UNIVERSITIES RELATIONSHIPS IN AERO/SPACE ENGINEERING: A REVIEW OF NASA'S PROGRAM 1985 33 p refs

(NASA-CR-176307; NAS 1.26:176307) Avail: NTIS HC A03/MF A01 CSCL 051

NASA is concerned about the health of aerospace engineering departments at U.S. universities. The number of advanced degrees in aerospace engineering has declined. There is concern that universities' facilities, research equipment, and instrumentation may be aging or outmoded and therefore affect the quality of research and education. NASA requested that the National Research Council's Aeronautics and Space Engineering Board (ASEB) review NASA's support of universities and make recommendations to improve the program's effectiveness. G.L.C.

N86-12976# Oak Ridge National Lab., Tenn. FUTURE DIRECTIONS IN MOBILE TELEOPERATION

22 p Presented at the Workshop on W. R. HAMEL 1985 Requirements of Mobile Teleoperators for Radiol. Emergency Response and Recovery, Dallas, 23 Jun. 1985

(Contract DE-AC05-84OR-21400) (DE85-014308; CONF-8506148-3) Avail: NTIS HC A02/MF A01 Mobile teleoperator systems are the subject of an increasing amount of research and development. This work is motivated by general problems of remote operations in hazardous environments, some of which are very similar to the challenges of radiological emergency response and recovery. Current work appears to fall into two broad economic classes, one in the \$100 K range and the other in the \$1000 K range. Both are believed to be important for technology development and deployment. Recent developments confirm that we are at the technical doorstep of next-generation mobile systems which integrate dexterous manipulation, high mobility, and telerobotic operation.

DOF

N86-13221*# ECON. Inc., Princeton, N.J. **R AND D LIMITED PARTNERSHIPS (POSSIBLE APPLICATIONS** IN ADVANCED COMMUNICATIONS SATELLITE TECHNOLOGY EXPERIMENT PROGRAM) 22 Jun. 1985 75 p refs

(Contract NASW-3339)

(NASA-CR-176333; NAS 1.26:176333; ECON-80-111) Avail: NTIS HC A04/MF A01 CSCL 05A

Typical R&D limited partnership arrangements, advantages and disadvantages of R&D limited partnership (RDLPs) and antitrust and tax implications are described. A number of typical forms of RDLPs are described that may be applicable for use in stimulating R&D and experimental programs using the advanced communications technology satellite. The ultimate goal is to increase the rate of market penetration of goods and/or services based upon advanced satellite communications technology. The conditions necessary for these RDLP forms to be advantageous are outlined. Ê.A.K.

N86-13343*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

REPORT ON ACTIVE AND PLANNED SPACECRAFT AND EXPERIMENTS

N. J. SCHOFIELD, JR., R. G. LITTLEFIELD, and M. F. ELSEN Feb. 1985 337 p

(NASA-TM-87499; NSSDC/WDC-A-R/S-85-01; NAS 1.15:87499) Avail: NTIS HC A15/MF A01 CSCL 22A

This report provides the professional community with information on current and planned spacecraft activity (including both free-flying spacecraft and Shuttle-attached payloads) for a broad range of scientific disciplines. By providing a brief description of each spacecraft and experiment as well as its current status, it is hoped that this document will be useful to many people interested in the scientific, applied, and operational uses of the data collected. Furthermore, for those investigators who are planning or coordinating future observational programs employing a number of different techniques such as rockets, balloons, aircraft, ships, and buoys, this document can provide some insight into the contributions that may be provided by orbiting instruments. The document includes information concerning active and planned spacecraft and experiments. The information covers a wide range of scientific disciplines: astronomy, earth sciences, meteorology, planetary sciences, aeronomy, particles and fields, solar physics, life sciences, and material sciences. These spacecraft projects represent the efforts and funding of individual countries, as well as cooperative arrangements among different countries. Author

N86-15157*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

R AND D PRODUCTIVITY: NEW CHALLENGES FOR THE US SPACE PROGRAM

O. W. BASKIN, ed. (Houston Univ., Clear Lake) and L. J. SULLIVAN, 596 p refs Conference held in Houston, Tex., ed. 1985 10-11 Sep. 1985; sponsored in cooperation with NASA. Johnson Space Center, Houston Univ., AIAA, and the American Productivity Center

(NASA-TM-87520; NAS 1.15:87520) Avail: NTIS HC A25/MF A01 CSCL 05A

Various topics related to research and development activities applicable to their U.S. space program are discussed. Project management, automatic control technology, human resources, management information systems, computer aided design, systems engineering, and personnel management were among the topics covered.

N86-15165*# Harvard Univ., Cambridge, Mass. Business School.

MANAGING COOPERATIVE RESEARCH AND DEVELOPMENT VENTURES

W. J. MURPHY *In* NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 75-87 1985 refs

Avail: NTIS HC A25/MF A01 CSCL 05A

As cooperative ventures to conduct research and development become increasingly attractive, management of these collective undertakings poses new challenges to executives. In selecting the most appropriate organizational structure and strategy the author suggests that the collective enterprise executive must strike the best balance among three distinct but related elements: contribution of the participants; creation of benefits; and transfer of benefits to contributors. Eight types of cooperative R&D ventures are proposed with discussion of the unique management tasks associated with each type. R.J.F.

N86-15168*# Purdue Univ., West Lafayette, Ind. EFFICIENCY AND INNOVATION: STEPS TOWARD COLLABORATIVE INTERACTIONS

C. A. LENGNICK-HALL and D. C. KING *In* NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 121-131 1985 refs Avail: NTIS HC A25/MF A01 CSCL 05A

Research and development units are faced with the challenging objective of being cost effective while developing high quality, innovative products. Advanced technology is only part of the solution. It is increasingly clear that organization structures and managerial processes must also be designed and structured to meet the dual objectives of quality and efficiency. The results of an empirical case analysis of a large R & D division which is attempting to meet this challenge is presented. Author

N86-17225*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

RESEARCH AND TECHNOLOGY FISCAL YEAR 1985 REPORT Annual Report

F. SPEER Nov. 1985 136 p

(NASA-TM-86532; NAS 1.15:86532) Avail: NTIS HC A07/MF A01 CSCL 05A

A quarter of a century is but a moment on the cosmic calendar. Now that Marshall Space Flight Center has reached its 25th Anniversity, it seems just moments ago that President Dwight D. Eisenhower stood on these grounds and formally dedicated the George C. Marshall Space Flight Center in Huntsville, Alabama. The Fiscal Year 1985 Research and Technology Report reflects the wide spectrum of activities closely linked with the Center's mainstream spaceflight developments. Past accomplishments testify to the success of getting deeply involved in the science and technology of its projects - 32 Saturn launches, Pegasus, the Skylab missions, three High Energy Astronomy Observatory missions, the Apollo - Soyuz mission, and an accelerating schedule of successful Shuttle, Spacelab, and Shuttle payload missions. The Center continues to be involved in engineering development, scientific research, and technology. At the beginning of the second quarter century, the experience and dedication of the engineers and scientists, and the success of the collaboration with industry and academia will now be aimed at the next great endeavor, the Space Station. Author

N86-17230# Pacific Northwest Labs., Richland, Wash. TECHNOLOGY TRANSFER IS OPPORTUNITY TRANSFER

T. M. LEVINSON, L. C. SCHMID, and R. L. WATTS Jun. 1985 11 p Presented at the 10th Annual Meeting of the Technology Transfer Society, San Francisco, Calif., 24 Jun. 1985 (Contract DE-AC06-76RL-01830)

(DE85-016622; PNL-SA-12976; CONF-8506175-1) Avail: NTIS HC A02/MF A01

The management of intellectual property and the decision process of selecting federal technologies for transfer is approached from the perspective of how they can be packaged as business opportunities. The package is usually provided by a technologist who is the technology provider and the opportunity must be perceived as such by the business person. Thoughts are provided on the different perspectives of the technology provider and the technology seeker and the environment in which the transfer process occurs. The different perspectives and the environment can cause a disconnect between the research result and its uses. By using selection criteria based on the business person's perspective and by presenting the technology in terms of what it can become helps to mitigate this disconnect. DOE

N86-17265*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

RESEARCH AND TECHNOLOGY Annual Report, 1985 Nov. 1985 62 p

(NASA-TM-83099; NAS 1.15:83099) Avail: NTIS HC A04/MF A01 CSCL 05A

As the NASA Center responsible for assembly, checkout, servicing, launch, recovery, and operational support of Space Transportation System elements and payloads, Kennedy Space Center is placing increasing emphasis on the Center's research and technology program. In addition to strengthening those areas of engineering and operations technology that contribute to safe, more efficient, and more economical execution of our current mission, we are developing the technological tools needed to execute the Center's mission relative to Space Station and other future programs. The Engineering Development Directorate encompasses most of the laboratories and other Center resources that are key elements of research and technology program implementation and is responsible for implementation of the majority of the projects in this Kennedy Space Center 1985 Annual Report. The report contains brief descriptions of research and technology projects in major areas of Kennedy Space Center's disciplinary expertise. Author

N86-17595*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TECHNOLOGY ACHIEVEMENTS AND PROJECTIONS FOR COMMUNICATION SATELLITES OF THE FUTURE

J. W. BAGWELL 1986 13 p refs Proposed for presentation at the 11th Communications Satellite Systems Conference, San Diego, Calif., 16-20 Mar. 1986; sponsored by AIAA

(NASA-TM-67201; E-2856; NAS 1.15:87201) Avail: NTIS HC A02/MF A01 CSCL 17B

Multibeam systems of the future using monolithic microwave integrated circuits to provide phase control and power gain are contrasted with discrete microwave power amplifiers from 10 to 75 W and their associated waveguide feeds, phase shifters and power splitters. Challenging new enabling technology areas include advanced electrooptical control and signal feeds. Large scale MMIC's will be used incorporating on chip control interfaces, latching, and phase and amplitude control with power levels of a few watts each. Beam forming algorithms for 80 to 90 deg. wide angle scanning and precise beam forming under wide ranging environments will be required. Satelllite systems using these dynamically reconfigured multibeam antenna systems will demand greater degrees of beam interconnectivity. Multiband and multiservice users will be interconnected through the same space platform. Monolithic switching arrays operating over a wide range of RF and IF frequencies are contrasted with current IF switch technology implemented discretely. Size, weight, and performance improvements by an order of magnitude are projected. Author

N86-18379# European Space Agency, Paris (France). SPACE STATION: ESA VIEWS ON REQUIREMENTS FOR EXPERIMENTAL AND OPERATIONAL EARTH OBSERVATION MISSIONS

G. DUCHOSSOIS *In its* Proceedings of EARSeL/ESA Symposium on European Remote Sensing Opportunities: Systems, Sensors, and Applications p 189-199 Jun. 1985 refs Avail: NTIS HC A12/MF A01

The requirements of spaceborne experimental and operational Earth observations are reviewed, and an unmanned polar platform element, composed preferably of two platforms in adequately phased orbits is recommended as part of the European contribution to the US Space Station. Possible configuration and resources capabilities for such platforms are provided, together with candidate payloads. Author (ESA)

N86-19943*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DEVELOPMENT OF SPACE TECHNOLOGY FOR ECOLOGICAL HABITATS

N. V. MARTELLO *In* NASA. Ames Research Center Controlled Ecological Life Support Systems p 613-625 Jan. 1986 refs Avail: NTIS HC A99/MF A01 CSCL 06K

The development of closed ecological systems for space stations is discussed. Growth chambers, control systems, microgravity, ecosystem stability, lighting equipment, and waste processing systems are among the topics discussed. R.J.F.

N86-21420*# National Aeronautics and Space Administration, Washington, D.C.

NASA: 1986 LONG-RANGE PROGRAM PLAN

Aug. 1985 269 p

(NASA-TM-87560; NAS 1.15:87560) Avail: NTIS HC A12/MF A01 CSCL 05A

For the years beyond FY 1986, the plan consists of activities that are technologically possible and considered to be in the national interest. Its implementation will ensure logical and continued progress in reaching the Nation's goals in aeronautics and space, consistent with the responsibilities assigned NASA by the National Aeronautics and Space Act of 1958, as amended. The major features of the programs are described in detail and the nature of the aeronautics and space programs beyond the year 2000 are projected. The abbreviations and acronyms that appear in this report are listed. The status of NASA's plans are summarized at the time of its preparation.

N86-23184# World Meteorological Organization, Geneva (Switzerland).

METEOROLOGICAL SERVICES OF THE WORLD 1985 367 p refs

(WMO-2; ISBN-92-63-03002-2) Avail: NTIS MF A01; print copy available at WMO, Geneva

For World Meteorological Organization members, details of the state meteorological service; other state meteorological organizations dependent on the service; other state meteorological organizations independent of the service; meteorological institutes forming part of the service; meteorological institutes not forming part of the service; publications; and responsible authority for aeronautical meteorological services are listed. Author (ESA)

N86-24712*# Essex Corp., Huntsville, Ala. THE GRAT OBSERVATORIES FOR SPACE ASTROPHYSICS

M. HARWIT (Cornell Univ., Ithaca, N.Y.) and V. NEAL 9 Jan. 1986 51 p Original contains color illustrations

(Contract NASA ORDER H-78175-B)

(NASA-CR-176754; NAS 1.26:176754) Avail: NTIS HC A04/MF A01 CSCL 22A

Motivated by the ancient urge to observe, measure, compute, and understand the nature of the Universe, the available advanced technology is used to place entire observatories into space for investigations across the spectrum. Stellar evolution, development and nature of the Universe, planetary exploration, technology, NASA's role, and careers in asronomy are displayed. B.G.

06 RESEARCH AND DEVELOPMENT

N86-25290# National Planning Association, Washington, D. C. TRENDS IN INDUSTRIAL R AND D ACTIVITIES IN THE UNITED STATES, EUROPE AND JAPAN, 1963-83

D. M. LÉVY and N. E. TERLECKYJ 26 Sep. 1985 53 p refs Presented at the Conference on Productivity Growth in Japan and The United States, Cambridge, Mass., 26-28 Aug. 1985

(Contract NSF SRS-83-07769)

(PB86-141371) Avail: NTIS HC A04/MF A01 Prepared in cooperation with George Mason Univ., Fairfax, Va. CSCL 05A

The growth in industrial R and D activity in the United States in relation to R and D expenditures in Western Europe and Japan is examined. The effects of foreign industrial R and D expenditures on private R and D expenditures in the United States are considered, with R and D expenditures performed under contract for the United States Government taken into account. A clear and positive relationship is shown between private R and D expenditures and R and D expenditures performed under government contract. In addition, the influence of foreign industriat R and D expenditures on U.S. expenditures is explored econometrically. GRA

N86-26249# Massachusetts Inst. of Tech., Cambridge. Sea Grant Program.

MARINE-RELATED RESEARCH AT MIT (MASSACHUSETTS INSTITUTE OF TECHNOLOGY): A DIRECTORY OF RESEARCH PROJECTS, 1985-1986

S. D. STOLZ Sep. 1985 104 p Sponsored by NOAA (PB86-158102; MITSG-85-31) Avail: NTIS HC A06/MF A01 CSCL 05B

A report on marine-related research at MIT contains items in the following areas: fisheries and food and drugs from the sea; marine biology; marine mineral resources; alternative energy sources; pollution; oceanography; ocean engineering; ship design and operations; shipping and transportation systems; and marine education. GRA

N86-26355*# National Aeronautics and Space Administration, Washington, D.C.

ENVIROSAT-2000 REPORT: FEDERAL AGENCY SATELLITE REQUIREMENTS

D. COTTER, ed., I. WOLZER, ed., N. BLAKE, J. JARMAN, D. LICHY, T. PANGBURN, R. MCARDLE, C. PAUL, L. SHAFFER, G. THORLEY et al. NOAA Jul. 1985 156 p refs (NASA-TM-88752; NAS 1.15:88752) Avail: NTIS HC A08/MF

(NASA-TM-88752; NAS 1.15:88752) Avail: NTIS HC A08/MF A01 CSCL 22B

The requirement of Federal agencies, other than NOAA, for the data and services of civil operational environmental satellites (both polar orbiting and geostationary) are summarized. Agency plans for taking advantage of proposed future Earth sensing space systems, domestic and foreign, are cited also. Current data uses and future requirements are addressed as identified by each agency. B.G.

N86-27109# Los Alamos National Lab., N. Mex. CREATIVITY IN SCIENCE - A SYMPOSIUM

M. R. RAJU, ed., J. A. PHILLIPS, ed., and F. HARLOW, ed. Aug. 1985 143 p Presented at the Creativity in Science Symposium, Los Alamos, N. Mex., 13-14 Aug. 1984

(Contract W-7405-ENG-36)

(DE86-003289; LA-10490-C; CONF-8408177) Avail: NTIS HC A07/MF A01

This conference proceeding is a collection of the talks and panel discussions for the symposium, Creativity in Science, held at Los Alamos National Laboratory August 13 and 14, 1984. Also included is a related colloquium and dialogue by J. Krishnamurti, which took place at Los Alamos National Laboratory on March 20 and 21, 1984. The symposium addressed issues concerning individual creativity and management for creativity. DOE

San Jose State Univ., Calif. Space Research N86-27306*# and Development Organization.

THE DEVELOPMENT OF A PROJECT PLAN FOR THE GET AWAY SPECIAL PROGRAM

S. J. BUTOW In NASA. Goddard Space Flight Center The 1985 Get Away Special Experimenter's Symposium p 65-72 Mav 1986

Avail: NTIS HC A13/MF A01 CSCL 22A

Trying to get a project started? Well, since the introduction of the Get Away Special Program, there have been 451 reservations placed by people who, just like yourself, are eager to send a small payload into space; and yet only 33 of them have actually succeeded. Even more staggering, many of those who have flown have done so more than once; meaning that less than 10% of all GAS users have actually sent something into space. Some of the problems that face GAS users are approached and it is hoped that they will be helpful, especially to those new to the program. Some of the subject areas include selecting a project, and payload management. Author

National Aeronautics and Space Administration, N86-27409*# Washington, D.C.

THE SUITABILITY OF VARIOUS SPACECRAFT FOR FUTURE SPACE APPLICATIONS MISSIONS

C. W. MATHEWS, R. BERNSTEIN (International Business Machines Corp., Palo Alto, Calif.), and D. C. MACLELLAN (Massachusetts Inst. of Tech., Cambridge.) Jul. 1986 18 p

(NASA-TM-88986; NAS 1.15:88986) Avail: NTIS HC A02/MF A01 CSCL 22B

The Space Applications Advisory Committee (SAAC) of NASA's Advisory Council was asked by the Associate Administrator for Space Science and Applications to consider the most suitable future means for accomplishing space application missions. To comply with this request, SAAC formed a Task Force whose report is contained in this document. In their considerations, the Task Force looked into the suitability of likely future spacecraft options for supporting various types of application mission payloads. These options encompass a permanent manned space station, the Space Shuttle operating in a sortie mode, unmanned platforms that integrate a wide variety of instruments or other devices, and smaller free fliers that accommodate at most a few functions. The Task Force also recognized that the various elements could be combined to form a larger space infrastructure. This report summarizes the results obtained by the Task Force. It describes the approach utilized, the findings and their analysis, and the conclusions

Author

N86-28805# General Accounting Office, Washington, D. C. Resources Community and Economic Development Div.

A PROFILE OF SELECTED FIRMS AWARDED SMALL **BUSINESS INNOVATION RESEARCH FUNDS**

Mar. 1986 15 p

(AD-A165664; GAO/RCED-86-113FS) Avail: NTIS HC A02/MF À01 CSCL 05C

The General Accounting Office conducted interviews and developed a profile of the 19 firms, obtained a description of their research work and experiences with the SBIR (Small Business Innovative Research) program, and identified efforts these firms were making to commercialize products or services developed with SBIR funding. The information collected was from firms receiving awards in fiscal years 1983 and 1984. To obtain additional information about commercialization of products developed with SBIR funding, we interviewed officials at eight venture capital firms and three experts on small business innovation. GRA

N86-28907# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

ACTIVITIES REPORT IN AEROSPACE RESEARCH Annual Report, 1984

24 Apr. 1985 195 p

(ETN-86-97190) Avail: NTIS HC A09/MF A01

Research in aerodynamics; test facilities; spacecraft and aircraft construction materials; spacecraft and aircraft structures; computer science; fluid mechanics; energetics; physics; and aerospace systems is summarized. ESA

N86-29463# Delaware Univ., Lewes.

THE OVERALL PLAN: A SCIENTIFIC STRATEGY

F. WEBSTER In WMO International Conference on the TOGA Scientific Program 5 p Sep. 1985

Avail: NTIS MF A01; print copy available at WMO, Geneva

The aims of the Tropical Ocean Global Atmosphere project are to assess knowledge of the interannual variability of the tropical ocean and the global atmosphere. Program objectives are: to determine to what extent the time-dependent behavior of the tropical ocean and global atmosphere system is predictable on time scales of months to years and to understand the mechanism of this behavior; to study the feasibility of modeling the coupled ocean-atmosphere system for predicting its variations on time scales of months to years; and to provide the scientific background for designing an observing and data transmission system for operational prediction if this capability is demonstrated by coupled ocean-atmosphere models. ESA

N86-29477# World Meteorological Organization, Geneva (Switzerland).

FIRST IMPLEMENTATION PLAN FOR THE WORLD CLIMATE **RESEARCH PROGRAM**

Nov. 1985 151 p

(WCRP-5: ETN-86-97076) Avail: NTIS MF A01; HC at WMO, Geneva, Switzerland

The World Climate Research Program activities are organized according to six subprograms whose objectives are to establish the physical basis of long range weather forecasting; understand the predictable aspects of global climate variations over periods of several months to several years, and assess the response of climate to natural or man-made influences over periods of several decades. The subprograms are: Atmospheric Climate Prediction; Coupled Atmosphere-Ocean Boundary Layer; Tropical Ocean and Global Atmosphere project; World Ocean Circulation Experiment; Cryosphere; and Climatic Sensitivity Assessment. ESA

National Aeronautics and Space Administration. N86-29888*# John F. Kennedy Space Center, Cocoa Beach, Fla.

PROCEEDINGS OF THE 2ND ANNUAL CONFERENCE ON NASA/UNIVERSITY ADVANCED SPACE DESIGN PROGRAM

31 p Conference held at Cocoa Beach, Fla., 18-20 Jun. 1986 Jun. 1986

(Contract NGT21-002-080)

(NASA-TM-89399; NAS 1.15:89399) Avail: NTIS HC A03/MF A01 CSCL 22B

Topics discussed include: lunar transportation system, Mars rover, lunar fiberglass production, geosynchronous space stations, regenerative system for growing plants, lunar mining devices, lunar oxygen transporation system, mobile remote manipulator system, Mars exploration, launch/landing facility for a lunar base, and multi-megawatt nuclear power system. B.G.

N86-30302*# National Aeronautics and Space Administration, Washington, D.C.

LIFE SCIENCES SPACE STATION PLANNING DOCUMENT: A REFERENCE PAYLOAD FOR THE LIFE SCIENCES RESEARCH FACILITY

Aug. 1986 132 p (NASA-TM-89188; NAS 1.15:89188) Avail: NTIS HC A07/MF A01 CSCL 06B

The Space Station, projected for construction in the early 1990s, will be an orbiting, low-gravity, permanently manned facility providing unprecedented opportunities for scientific research. Facilities for Life Sciences research will include a pressurized research laboratory, attached payloads, and platforms which will allow investigators to perform experiments in the crucial areas of Space Medicine, Space Biology, Exobiology, Biospherics and Controlled Ecological Life Support System (CELSS). These studies are designed to determine the consequences of long-term exposure to space conditions, with particular emphasis on assuring the

permanent presence of humans in space. The applied and basic research to be performed, using humans, animals, and plants, will increase our understanding of the effects of the space environment on basic life processes. Facilities being planned for remote observations from platforms and attached payloads of biologically important elements and compounds in space and on other planets (Exobiology) will permit exploration of the relationship between the evolution of life and the universe. Space-based, global scale observations of terrestrial biology (Biospherics) will provide data critical for understanding and ultimately managing changes in the Earth's ecosystem. The life sciences community is encouraged to participate in the research potential the Space Station facilities will make possible. This document provides the range and scope of typical life sciences experiments which could be performed within a pressurized laboratory module on Space Station. Author

N86-30470*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SONIC-BOOM RESEARCH: SELECTED BIBLIOGRAPHY WITH ANNOTATION

H. H. HUBBARD (Bionetics Corp., Hampton, Va.), D. J. MAGLIERI, and D. G. STEPHENS Sep. 1986 44 p

(NASA-TM-87685; L-16127; NAS 1.15:87685) Avail: NTIS HC A03/MF A01 CSCL 20A

Citations of selected documents are included which represent the state of the art of technology in each of the following subject areas: prediction, measurement, and minimization of steady-flight sonic booms; prediction and measurement of accelerating-flight sonic booms; sonic-boom propagation; the effects of sonic booms on people, communities, structures, animals, birds, and terrain; and sonic-boom simulator technology. Documents are listed in chronological order in each section of the paper, with key documents and associated annotation listed first. The sources are given along with acquisition numbers, when available, to expedite the acquisition of copies of the documents. Author

N86-30583# Los Alamos National Lab., N. Mex. INSTITUTIONAL SUPPORTING RESEARCH AND DEVELOPMENT, 1985

H. MOTZ, comp. Feb. 1986 83 p (Contract W-7405-ENG-36)

(DE86-008580; LA-10600) Avail: NTIS HC A05/MF A01

This report presents 25 articles on projects currently supported by the Institutional Supporting Research and Development Program at Los Alamos National Laboratory. Articles are grouped into several categories: chemistry and materials sciences, life sciences, geosciences and space physics, techniques/instrumentation/devices, and physics. Much of the work reported here relies on multidisciplinary approaches; it encompasses not only basic research but also important, technically challenging applied research relevant to the Laboratory's mission. DOE

N86-30602*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

SPACE STATION

D. R. THOMPSON *In* Lunar and Planetary Inst. IN Trajectory Determination and Collection of Micrometeoroids on the Space Station p 83-84 1986

Avail: NTIS HC A06/MF A01 CSCL 03B

The Space Station is being defined as a multi-purpose facility with emphasis in the following areas: scientific and technology research laboratory; permanent observatory; spacecraft servicing facility; construction and assembly facility; manufacturing facility; transportation node; and staging base for future space endeavors. The Station complex, in its initial operating capability configuration, includes a continuously habitable manned element, a polar orbiting unmanned platform, and a second unmanned platform co-orbiting with the manned element. All elements are dependent on the Space Transportation System (STS) for initial placement on-orbit and for subsequent logistical services. The manned element will be designed for long duration operations with systems maintainable on-orbit and operationally autonomous from ground control. A major feature of the Station will be its adaptability to evolutionary technology upgrades; and the Space Station, as a system, is to be designed for maximum ease of use by its users. Author

N86-31340*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. ACOUSTICS DIVISION RECENT ACCOMPLISHMENTS AND

ACOUSTICS DIVISION RECENT ACCOMPLISHMENTS AND RESEARCH PLANS

L. R. CLARK and H. G. MORGAN Jul. 1986 144 p (NASA-TM-89012; NAS 1.15:89012) Avail: NTIS HC A07/MF A01 CSCL 20A

The research program currently being implemented by the Acoustics Division of NASA Langley Research Center is described. The scope, focus, and thrusts of the research are discussed and illustrated for each technical area by examples of recent technical accomplishments. Included is a list of publications for the last two calendar years. The organization, staff, and facilities are also briefly described. Author

 $\textbf{N86-31451}^{*}\#$ National Aeronautics and Space Administration, Washington, D.C.

SPINOFF 1985

J. J. HAGGERTY 1986 131 p

(NASA-TM-89240; NAS 1.15:89240) Avail: NTIS HC A07/MF A01 CSCL 05A

Mainline NASA programs, whose challenging objectives necessitate advances across a diverse scientific/technological spectrum are summarized. A representative selection of spinoff products and processes are presented and the NASA technology from which these transfers are derived, are described. The mechanisms NASA employs to foster technology utilization and stimulate interest among prospective users of the technology are detailed.

N86-31461# Amsterdam Univ. (Netherlands). Dept. of Science Dynamics.

EVALUATION OF RESEARCH: EXPERIENCES AND PERSPECTIVES IN THE NETHERLANDS

S. BLUME, H. DITS, P. GROENEWEGEN, L. LEYDESDORFF, A. PRINS, J. W. SMEENK, J. SPAAPEN, and S. ZELDENRUST Dec. 1984 47 p

(ESA-86-96709) Avail: NTIS HC A03/MF A01

Dutch research is evaluated in relation to government science and technology policy. Universities and special research institutes are covered. ESA

N86-31489*# California Univ., San Diego. Center for Astrophysics and Space Sciences.

EXTRAGALACTIC ASTRONOMY

E. M. BURBIDGE *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 6 p Feb. 1986

Avail: NTIS HC as boxed set only \$200/MF A01 per volume or E99 per entire set CSCL 03B

Components of the active extragalactic universe are examined to discover what extragalactic objects exhibit physical processes of the same kind as those thought to be important within the galaxy. Radio galaxies; quasars; bulk ejection from galactic objects such as novae supernovae, and other galactic nuclei; the red shifts of quasars; and the possibility of non-cosmological red shifts are among the topics discussed. It is concluded that the highest energy cosmic rays may have an extragalactic or extragalactic origin. R.J.F. N86-32849# European Space Agency. European Space ESTEC. Noordwijk Technology Center. Research and (Netherlands).

ESA AND ITS EARTH OBSERVATION PROGRAMS

J. N. DEVILLIERS In its Remote Sensing Applications in Civil Engineering p 19-28 Mar. 1985 Avail: NTIS HC A06/MF A01

The ESA Earth Observation Programs in meteorology (Meteosat) precise time transfer (LASSO), remote sensing of the oceans (ERS-1), and cartographic mapping from Spacelab are described. Reception, processing and distribution of satellite remote sensing data are outlined. The requirements for advanced satellite missions in land observation and solid Earth physics, and studies undertaken to define and determine the feasibility of such missions FSA are summarized.

N86-32950*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NASA WORKSHOP ON ANIMAL GRAVITY-SENSING SYSTEMS M. L. CORCORAN, ed. Aug. 1986 52 p Held at Pacific Grove, Calif., Feb. 1985

(NASA-TM-88249; A-86233; NAS 1.15:88249) Avail: NTIS HC A04/MF A01 CSCL 06C

The opportunity for space flight has brought about the need for well-planned research programs that recognize the significance of space flight as a scientific research tool for advancing knowledge of life on Earth, and that utilize each flight opportunity to its fullest. For the first time in history, gravity can be almost completely eliminated. Thus, studies can be undertaken that will help to elucidate the importance of gravity to the normal functioning of living organisms, and to determine the effects microgravity may have on an organism. This workshop was convened to organize a plan for space research on animal gravity-sensing systems and the role that gravity plays in the development and normal functioning of these systems. Scientists working in the field of animal gravity-sensing systems use a wide variety of organisms in their research. The workshop presentations dealt with topics which ranged from the indirect gravity receptor of the water flea, Daphnia (whose antennal setae apparently act as current-sensing receptors as the animal moves up and down in water), through specialized statocyst structures found in jellyfish and gastropods, to the more complex vestibular systems that are characteristic of amphibians, avians, and mammals. Author

N86-33212# General Accounting Office, Washington, D. C. Resources Community and Economic Development Div. UNIVERSITY FUNDING: FEDERAL FUNDING MECHANISMS IN SUPPORT OF UNIVERSITY RESEARCH

Feb. 1986 187 p

(AD-A168023; GAO/RCED-86-53) Avail: NTIS HC A09/MF A01 CSCL 05A

The nation's universities play a vital role in advancing U.S. economic health by performing nearly half of its basic research that provides the foundation for technological progress. Federal funds support approximately two-thirds of this university-based basic research. As reported by the National Science Foundation, the federal government, in fiscal year 1984, expended approximately \$5.5 billion at universities for research and development, of which approximately \$4 billion was for basic research. The federal government transfer funds to universities and colleges through various funding mechanisms support both research and the infrastructure of research (major equipment and facilities, special training needs, and institutional support). A funding mechanism is a category of federal financial support or scientific research performed at and by U.S. universities. With the last decade concern has grown that the current array of funding mechanisms may not adequately provide for the continuity and stability of research, the modernized equipment, and the human resourcs needed to maintain the vital role the universities play in the nation's research effort. This report provides information on federal funding of university research by presenting the array of funding mechanisms used by Federal agencies in funding such research.

ECONOMICS, COSTS AND MARKETS

Includes Costs and Cost Analysis, Cost Control and Cost Effectiveness, Productivity and Efficiency, Economics and Trade, Financial Management and Finance, Investments, Value and Risk (Monetary), Budgets and Budgeting, Marketing and Market Research, Consumerism, Purchasing, Sales, Commercialization, Competition, Accounting,

A86-10568

TURBOPROP AIRLINERS GET BIGGER - WILL THEY HAVE A MARKET?

B. REK Interavia (ISSN 0020-5168), vol. 40, Sept. 1985, p. 995-998.

New turboprop aircraft seating over 40 passengers are being built by European manufacturers to satisfy the demands of feeder, regional and commuter traffic. The new aircraft include the ATR42-200 44-seater, the F26 50-seater, the ATP 64-seater and the Dash 8 Series 300 50-seater. Variants of all the aircraft are also being planned, some in stretch versions and some with pressurized cabins. Much of the manufacturing activity is spurred by the growth of U.S. regional markets since deregulation. The size of the stretch turboprop aircraft is inherently limited by the overlap with small jet aircraft and their speed advantages.

M.S.K.

A86-15857#

THE CANADIAN MOBILE SATELLITE SERVICE AND ITS SOCIO-ECONOMIC ASSESSMENT

P. M. BOUDREAU and J. H. C. BRADEN (Department of Communications, Ottawa, Canada) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 11 p. (IAF PAPER 85-364)

The Mobile Satellite (MSAT) program of Canada, established for the purpose of developing mobile-satellite services by 1990, and its associated services are discussed, together with the program's definition studies for evaluating the financial and socioeconomic impact. The economic concept and the methodology used to perform the socioeconomic assessment are described in detail. The results of the analysis indicate that the total socioeconomic benefits of the MSAT are very large for both the baseline (\$1159 millions) and pessimistic (\$513 millions) market scenarios, with most of the benefits accrued by the net users (in land, maritime, aeronautical, communications, and space services and the manufacturing industries), and high returns to private investors and the government, including sizable indirect social benefits. LS.

A86-15893# THE ECONOMICS OF SPACE LAUNCHERS - OUTLOOK FOR THE FUTURE

D. MUGNIER (CNES, Evry, France) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 6 p. (IAF PAPER 85-420)

It is noted that, at present, the fees charged by both NASA for Space Shuttle launchings and ESA for Ariane launches do not reflect the actual cost of such operations; they are instead defined by the need of the U.S. and Western Europe to establish and expand markets for future commercial exploitation. The recovery of launch system development costs cannot, however, be indefinitely postponed, especially in view of the coming development of the reusable upper stage, Hermes. Projections are made in the present economic study which indicate that the Ariane 5 launch vehicle or a derivative will continue to profitably launch commercial satellites until the year 2010. O.C

A86-15895*# National Aeronautics and Space Administration, Washington, D.C.

THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA) TRACKING AND DATA RELAY SATELLITE SYSTEM (TDRSS) PROGRAM ECONOMIC AND PROGRAMMATIC, CONSIDERATIONS

R. O. ALLER (NASA, Washington, DC) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 10 p.

(IAF PAPER 85-422)

The Tracking and Data Relay Satellite System (TDRSS) represents the principal element of a new space-based tracking and communication network which will support NASA spaceflight missions in low earth orbit. In its complete configuration, the TDRSS network will include a space segment consisting of three highly specialized communication satellites in geosynchronous orbit, a ground segment consisting of an earth terminal, and associated data handling and control facilities. The TDRSS network has the objective to provide communication and data relay services between the earth-orbiting spacecraft and their ground-based mission control and data handling centers. The first TDRSS spacecraft has been now in service for two years. The present paper is concerned with the TDRSS experience from the perspective of the various programmatic and economic considerations which relate to the program. GB

A86-17673

ESTIMATING - THE INPUT INTO GOOD PROJECT PLANNING

L. A. SMITH and T. MANDAKOVIC (Florida International University, North Miami) IEEE Transactions on Engineering Management (ISSN 0018-9391), vol. EM-32, Nov. 1985, p. 181-185. refs

The application of project management systems has grown rapidly in all economic sectors and industries. The growth is expected to continue with the implementation of new and more complex computerized planning and control systems. However, these systems are only as good as the input or estimates of time, cost, and resources. In this paper, the literature on the procedures and techniques used to develop good estimates are reviewed. These techniques are generically summarized to be applicable to any project. Some considerations are broken down which should be understood prior to estimating. It is concluded that not all estimates should be evaluated with the same level of effort and concern. Finally, an estimate is defined, rules for developing better estimates are summarized, and a checklist of constraints and considerations is developed.

A86-18385

COMMERCIALIZATION OF SPACE - THE INVESTMENT OPPORTUNITIES

R. A. WILLIAMSON (Office of Technology Assessment, Washington, DC) Space Policy (ISSN 0265-9646), vol. 1, May 1985, p. 210-214. refs

The prospects for space commercialization into the 21st century are discussed, with emphasis given to the benefits of private investment. The major factors encouraging and inhibiting the growth of private investments in space activities are considered, including technological uncertainties; insurance costs; government support; and tax benefits. A model agreement between government and industry to share in the development of a space venture, the NASA Joint Endeavor Agreement (JEA) is described in detail.

L.H.

A86-18539

FINANCE OF INTERNATIONAL CARRIERS

C. TILLINGHAST, JR. Northrop University Law Journal of Aerospace, Energy, and the Environment (ISSN 0196-1489), vol. 5, Winter 1984, p. 25-30.

An assessment is made of the economic basis for the operation of international air carriers, with attention to the differences that inhere in private and government ownership status. Emphasis is put on the danger that privately owned carriers lacking the credit, earnings, or government support required to keep fleets at a high level of competitive efficiency will be crowded out of markets by foreign airlines having government support. Nevertheless, capital markets have historically demonstrated an exceptional ability to adapt to changes in the economic environment. O.C.

A86-21886

ECONOMIC CONSIDERATIONS OF SPACE MANUFACTURING

W. A. JOHNSTON, JR. and B. G. MONTGOMERY (Fairchild Space Co., Germantown, MD) IN: EASCON '84; Proceedings of the Seventeenth Annual Electronics and Aerospace Conference, Washington, DC, September 10-12, 1984. New York, Institute of Electrical and Electronics Engineers, 1984, p. 181-185.

Materials processing in space (MPS) offers an opportunity to produce dramatic new products in pharmaceuticals, electronics, and metals. But the cost of access to space forces prospective manufacturers to select products whose market value is exceptionally high. This paper addresses the factors influencing the costs of transporting and operating factories in space and offers approaches for minimizing the effect of these costs on the finished product. In particular, the trade-off between operating entirely on the shuttle versus setting up on a free-flying platform is explored, with examples given for hypothetical pharmaceutical and crystal manufacturing processes. Author

A86-24102

WASHINGTON BROADENS ITS EFFORTS TO AID SMALL BUSINESS

P. MANN Commercial Space (ISSN 8756-4831), vol. 1, Summer 1985, p. 21, 24, 25.

Efforts by NASA to develop interest in the small business community for commercial space ventures are discussed. Activities undertaken by NASA's Office of Commercial Programs to facilitate Joint Endeavor Agreements (JEAs) between small business and NASA are described in detail. Emphasis is given to the need for a broad array of potential investors in capital-intensive space R&D programs, including: electronic materials research; pharmaceuticals processing; remote sensing; and satellite communications. A list of U.S. government centers for space business information is provided.

A86-24104

SHUTTLE LAUNCHES OF SATELLITES ARE MAKING SPACE A BOTTOMLINE BUSINESS

G. MIGLICCO (Peat, Marwick, Mitchell and Co., Houston, TX) Commercial Space (ISSN 8756-4831), vol. 1, Summer 1985, p. 36-39.

Factors affecting the levels of private investment in commercial projects in space are considered. Attention is given to tax uncertainties; the long lag time between investment and payoff; and government regulation costs. Some of the attributes of an attractive space venture are discussed including: high investment/return ratio; investment-to-payoff lag time of 1-5 years; and relaxed tax requirements. The opportunities for limited partnerships in R&D for space projects are briefly outlined. I.H.

A86-24110

SPACE STATION MANAGER'S NEXT BIG JOB IS TO DRUM UP BUSINESS

E. H. KOLCUM Commercial Space (ISSN 8756-4831), vol. 1, Summer 1985, p. 81, 83-85.

A progress report on the development of Space Station is given. The Phase B design definition study now under way is described in detail. Phase B consists of four separate mission design studies involving the selection of designs for the command modules structural framework, power sources and free-flying servicing vehicles. Contracts will be awarded for the development of Space Station hardware during Phase C, and Phase D will be the assembly of the Station in orbit. A photograph of a full scale mock-up of a Space Station command module is provided. I.H.

07 ECONOMICS, COSTS AND MARKETS

A86-24123

COMMERCIAL MARKETING OF LANDSAT DATA BEGINS

B. M. GREELEY, JR. Commercial Space (ISSN 8756-4831), vol. 1, Fall 1985, p. 66-69.

The marketing of the data made available from Landsat 4 and 5 is examined. The proposed design and functions of Landsat 6 and 7 are described. Agreements with data users concerning the prices, ordering, reproduction, and dissemination of data are discussed. The policies on remarketing of enhanced and unenhanced digital and photographic data are analyzed. The educational use of Landsat data is studied. A price schedule for Landsat data, effective November 1, 1985, is provided.

A86-26451

SPACE: THE COMMERCIAL OPPORTUNITIES; PROCEEDINGS OF THE INTERNATIONAL BUSINESS STRATEGY CONFERENCE, LONDON, ENGLAND, OCTOBER 31, NOVEMBER 1, 1984

Pinner, England, Online Publications, 1984, 191 p. For individual items see A86-26452 to A86-26465.

Among the topics discussed are: insurance in space risk management; legal issues in planning commercial space activities; and the potential market for commercial launch vehicles. Consideration is also given to: the position of Ariane in the world launch vehicle market; the economic advantages of reusable systems like Shuttle; and the growth of the satellite communications market; and European perspectives on the U.S. Space Station proposal. Additional topics include spin-off investments in space for small and medium-size investors; the market potential of remote sensing imagery; a general overview of risks and rewards in space investments.

A86-26453

INSURANCE IN SPACE RISK MANAGEMENT

D. S. THOMPSON (Stewart Wrightson International Group, Ltd., Space and Satellite Div., England) IN: Space: The commercial opportunities; Proceedings of the International Business Strategy Conference, London, England, October 31, November 1, 1984. Pinner, England, Online Publications, 1984, p. 15-27.

Risk management concepts are presently applied to parties intimately involved with the commercialization of space activities, encompassing financiers, system manufacturers, spacecraft owners, spacecraft component transporters and shippers, spacecraft users, and consultants to all the aforementioned. Attention is given to the ways in which risks can be transferred to international insurance markets, on the basis of assessments of financing, assets, personnel, and general market conditions. Actions typical in risk financing are discussed, with emphasis on satellite-related practices. O.C.

A86-26464

SATELLITE COMMUNICATIONS - A RAPIDLY EXPANDING MARKET?

R. FILEP (Communications 21 Corp., Redondo Beach, CA) IN: Space: The commercial opportunities; Proceedings of the International Business Strategy Conference, London, England, October 31, November 1, 1984 . Pinner, England, Online Publications, 1984, p. 153-163.

The worldwide commercial communication satellite market has experienced phenomenal growth during the past five years and is expected to grow at an irregular rate through 2000. This paper discusses current and planned expenditures, procurements, and launches, as well as key factors affecting the market. Author

A86-26465

EARTH OBSERVATION SATELLITES - FROM TECHNOLOGY PUSH TO MARKET PULL

G. BRACHET (SPOT Image, Toulouse, France) IN: Space: The commercial opportunities; Proceedings of the International Business Strategy Conference, London, England, October 31, November 1, 1984 . Pinner, England, Online Publications, 1984, p. 165-183.

The present trend towards commercial operation of high resolution observation satellites of the earth's surface will have a profound effect on the market for remote sensing data as well as on the industry for data enhancement and interpretation. The present situation is described, including satellites programs planned for the medium term, and the role of hardware, software and service industry is stressed. Author

A86-27885#

COST IN SPACE - THE PRICE OF GOVERNMENT CONTROL

R. W. POOLE, JR. (Reason Foundation, Santa Barbara, CA) IN: Space, our next frontier; Proceedings of the Conference, Dallas, TX, June 7, 8, 1984 . Dallas, TX, National Center for Policy Analysis, 1985, p. 151-165. refs

This paper advances the thesis that government space projects are inherently more costly that privately conceived and financed space projects. Both the Shuttle and the proposed Space Station are cases in point. Government space projects end up being costly for a number of reasons: (1) NASA has built-in incentives to prefer large budget projects, and so do NASA contractors; (2) political pressures lead to more costly multipurpose designs to satisfy different constituencies; (3) government lacks a marketing orientation, and therefore prices things incorrectly; (4) government spends excessively to minmize risk, rather than taking prudent gambles on potential breakthroughs; and (5) NASA also presumes that central planning is the best way to manage R&D, failing to understand how venture capital markets and entrepreneurship foster real innovation. Thus, government space programs have created a highly misleading impression that space development is more costly than it needs to be. If venture capital is to be attracted to space, it is important that government's central role be drastically reduced. Author

A86-27886#

FOUR IMPORTANT ISSUES IN THE CIVIL SPACE AREA

T. F. ROGERS (Office of Technology Assessment, Washington, DC) IN: Space, our next frontier; Proceedings of the Conference, Dallas, TX, June 7, 8, 1984 . Dallas, TX, National Center for Policy Analysis, 1985, p. 242-245.

A discussion is presented concerning the U.S. civilian space program's policy concern with such problems as the future reduction of currently high unit costs of space infrastructure and activities, and the determination of those ways in which the resources available to government institutions can be made available to private sector commercial and industrial interests. It is strongly recommended that NASA redouble its efforts to enlist, in order to disseminate enthusiasm for space exploration and exploitation. O.C.

A86-28418

PRODUCTIVITY IMPACTS OF SOFTWARE AUTOMATION

T. G. BINDER (Boeing Aerospace Co., Seattle, WA) IN: NAECON 1985; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1985. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1985, p. 750-754.

Software automation activities are being initiated throughout industry on the basis of expected payoffs in terms of productivity. This paper discusses the productivity improvement impacts that can be expected when software automation is introduced into a software development organization. A software cost modeling approach is used to attempt to quantify productivity improvement impacts in terms of reduced labor expenditures to develop and maintain embedded software systems. The impacts of individual tools as well as increased availability of the computing resources are considered. The sources of software costs are described and related to a life cycle model and to the cost model. The key features of the Boeing Automated Software Engineering (BASE) project are related to the sources of software cost. A description is presented that estimates the productivity impact of the BASE project through the use of a simple cost model and conclusions and recommendations for future work are made. Author

07 ECONOMICS, COSTS AND MARKETS

A86-29494 PRIVATE FUNDS WILL BOLSTER TAX DOLLARS IN THE JOB OF FINANCING THE STATION

D. C. WALKLET (Terra-Mar, Mountain View, CA) Commercial Space (ISSN 8756-4831), vol. 1, Winter 1986, p. 41-43, 46-48.

The NASA Space Station, although originally intended solely as a research facility, is now committed to commercial activity as well and thereby invites consideration as a substantially privately funded industrial park in space. Investors must assess risks posed by technical, financial, and political uncertainties. Possible financing methods include venture capital, limited partnership, and project financing; each of these is appropriate under different circumstances, as detailed in the present discussion. Assuming that commercial applications become a significant factor in the planning process, a strategy must be implemented that will accomodate differing user requirements for orbiting facilities. Space Station design and financing should accordingly be structured around its individual components, rather than the facility as a whole. O.C.

A86-29607#

IMPROVED SYSTEM COST AND PERFORMANCE ACTS USING MULTI-BEAM PROCESSING SATELLITES

H. S. BRAHAM (TRW, Inc., Redondo Beach, CA) IN: Communication Satellite Systems Conference, 11th, San Diego, CA, March 17-20, 1986, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1986, p. 259-265. refs (AIAA PAPER 86-0645)

ACTS, a NASA flight program featuring an experimental, multibeam, processing spacecraft, is discussed. ACTS represents the first space use of several advanced technologies, and will permit major system advantages in follow-on operational systems, including: (1) multiple T-1 capacity in low-cost Customer Premise Service (CPS) stations that can affordably be proliferated in thousands throughout the U.S.; (2) full network interconnectivity among CPS stations of all customers, where single-string hardware can be used in each station to maintain its low cost; (3) single hop through the satellite, permitting toll-grade voice in a mesh network of low-cost CPS stations; (4) optimum echo cancelation, because each station is collocated with the end user; and (5) low-cost interconnectivity to each local telco switch. In this paper, the ACTS architecture and its routing and interconnectivity are described, and the benefits of the ACTS multibeam processing satellite are discussed. CD

A86-29699* Princeton Synergetics, Inc., N.J.

COMMUNICATIONS SATELLITE BUSINESS VENTURES -MEASURING THE IMPACT OF TECHNOLOGY PROGRAMMES AND RELATED POLICIES

J. S. GREENBERG (Princeton Synergetics, Inc., NJ) Space Policy (ISSN 0265-9646), vol. 2, Feb. 1986, p. 37-51. NASA-supported research.

An economic evaluation and planning procedure which assesses the effects of various policies on fixed satellite business ventures is described. The procedure is based on a stochastic financial simulation model, the Domsat II, which evaluates spacecraft reliability, market performance, and cost uncertainties. The application of the Domsat II model to the assessment of NASA's ion thrusters for on-orbit propulsion and GaAs solar cell technology is discussed. The effects of insurance rates and the self-insurance option on the financial performance of communication satellite business ventures are investigated. The selection of a transportation system for placing the satellites into GEO is analyzed. I.F.

A86-41037#

WHICH TRANSPORT TECHNOLOGIES WILL FLY?

J. M. SWIHART (Boeing Co., Seattle, WA) Aerospace America (ISSN 0740-722X), vol. 24, May 1986, p. 56-58.

The cost of ownership of commercial aircraft is seen as a factor that will limit which new technologies will be adopted. Today, for a 10 percent fuel saving, an airline can bear a premium of only 2.5 percent. Thus, some technologies that look promising

technically will not pay off big enough to fly. Technologies that can be expected to pay off include: using computers to design improved wings; lighter materials such as aluminum-lithium alloys and composites (if labor and material costs for composite structures are not too great); computer-aided design/computer-aided manufacturing; microprocessor technology; fiber optics (to potentially reduce the heavy electromagnetic shielding required for electronics); and improved engines such as the counterrotating pusher turboprop. Fly-by-wire and fly-by-light systems, which might replace mechanical cable controlled flight systems, need to be studied further. Various of these technologies in combination may within a decade make possible a transport delivering over 150 seat-miles per gallon. Such an airliner would make most of today's aircraft obsolete - if the cost of ownership can be kept down.

D.H.

A86-41681

NEW JOB FOR NASA IS MARKETING MANAGEMENT

M. MACMILLIAN Commercial Space (ISSN 8756-4831), vol. 2, Spring 1986, p. 66-68.

The growing internationalization of the space business has resulted in NASA's need to develop new commercial markets, while at the same time advancing space technological evolution and being responsive to the congressional funding process. The NASA Office of Commercial programs will develop future markets in space, and NASA Centers for Commercial Development are being created to encourage industrial participation in space R&D. Privatization of the space transportation system is considered. The possibility of the establishment of a separate government agency to market the Shuttle's capabilities, and the idea of space-based industry in general, are also discussed. It is suggested that easing the process of applying for a Joint Endeavor Agreement with NASA will enhance the relationship with the private sector.

A86-44537

COUNTERTRADE - A NECESSARY PART OF MARKETING, OR AN EXPENSIVE DIVERSION?

M. W. BRACKENREED JOHNSTON (Jardine Glanvill (Interplanetary), Ltd., England) IN: Space - Technology and opportunity; Proceedings of the Conference, Geneva, Switzerland, May 28-30, 1985 . Pinner, England, Online Publications, 1985, p. 133-144.

Satellite sales throughout the developing world are constrained by the lack of hard currency. Countertrade can assist by providing exporters with payments, but this in turn can lead to new and unfamiliar risks. In this paper the role of trading houses and the insurance market in this rediscovered aspect of world trade is discussed. Author

A86-44538

FINANCIAL STRUCTURE FOR PARTICIPATION IN INDUSTRIAL SPACE PROJECTS

R. S. SOWTER (Airlease International Management, Ltd., London, England) IN: Space - Technology and opportunity; Proceedings of the Conference, Geneva, Switzerland, May 28-30, 1985 . Pinner, England, Online Publications, 1985, p. 145-154.

Financial techniques for engaging profitably in a space industrial project are discussed. Investment in a space project can be done through equity or by installments. The former is normally arranged with consideration of the tax benefits, and can be done through a subsidiary which will find further partners if the expenses become too burdensome. Loans are an option, subject to lending institution views of the value of space hardware, the terms, the payment schedule. The types of international, credit, domestic, export, World Bank, and European Investment Bank loan arrangements which can be made are discussed briefly. Attention is given to the benefits of leasing hardware from the manufacturer, and to time and finance leases for amortising the hardware cost. Factors which may affect any lease, i.e., tax credits, corporate tax rates, rental payments, charges against taxes, and equipment obsolescence are M.S.K. reviewed.

A86-44549

MORE PRECIOUS THAN GOLD - THE ECONOMICS OF MATERIALS PROCESSING IN SPACE

J. J. EGAN (Coopers and Lybrand, Space Consulting Div., Washington, DC) IN: Space - Technology and opportunity; Proceedings of the Conference, Geneva, Switzerland, May 28-30, 1985 - Pinner, England, Online Publications, 1985, p. 285-295.

This paper examines the fundamental economic factors affecting emerging space processing ventures. It assesses how thay apply in the context of current activities in the areas of semiconductor materials, pharmaceuticals, protein crystals and biotechnology, metals and glasses, and polymer and organic chemistry. Finally, it addresses the economic impact of developments in space transportation and workplaces on the future of these ventures. Author

A86-45636

ECONOMIC ASPECTS OF SPACE INDUSTRIALIZATION

G. VIRIGLIO (Aeritalia S.p.A., Gruppo Sistemi Spaziali, Turin, Italy) (Columbus Workshop, 1st, Capri, Italy, June 17-21, 1985) Earth-Oriented Applications of Space Technology (ISSN 0277-4488), vol. 6, no. 1, 1986, p. 61-63.

The prospects for commercialization of space in the near-term are discussed. It is estimated that \$65 billion in space ventures could be realized by the year 2000 AD, which would include \$27 billion for pharmaceuticals, \$15 billion for advanced space communications, and \$11.5 billion for space-processed glasses. Initiatives are underway to develop semiconductor processor facilities for space to obtain, e.g., high-purity GaAs chips at a cost 25 percent lower than possible on earth. Private companies are engaging in joint projects with NASA to develop commercial space manufacturing techniques and to educate non-aerospace industries in the potential benefits of space manufacturing. Several measures can further the process, e.g., tax credits for space investments, the treatment of profits as long-term capital gains, and continual follow-ups on companies which profess interest in space manufacturing. M.S.K.

A86-46961#

AN ECONOMICS PERSPECTIVE OF THE 21ST CENTURY SPACE STATION

M. K. MACAULEY (Resources for the Future, Washington, DC) AIAA, Space Station in the Twenty-first Century, Meeting, Reno, NV, Sept. 3-5, 1986. 5 p. refs

(AIAA PAPER 86-2348)

This paper offers an admonition for effective Space Station growth in the next century. Short of ability either to forecast or influence levels of economic activity, there nonetheless remains one aspect of near-term station use that can be implemented by station planners and that has direct consequences for the longer term. This aspect is the role of pricing policy for station access and use. Pricing can be crucial in determining where technical change and new developments in station design and operation will be needed. Furthermore, if past experience with technical change in the use of nonpriced resources is a guide to the future (as with the geostationary orbit and electromagnetic spectrum), the absence of prices can invite the presence of stringent, costly technical rules to accommodate scarcity, as well as emotive debate. Given the large amount of international collaboration envisioned for the Space Station, efficient pricing established early on in the program may perpetuate the most objective long-run allocation of scarce station resources. Author

N86-12243*# ECON, Inc., Alexandria, Va. MARKETING THE USE OF THE SPACE ENVIRONMENT FOR THE PROCESSING OF BIOLOGICAL AND PHARMACEUTICAL MATERIALS Final Report 13 Apr. 1984 162 p refs

(Contract NASW-3339)

(NASA-CR-176334; NAS 1.26:176334; ECON-81-110) Avail: NTIS HC A08/MF A01 CSCL 22A

The perceptions of U.S. biotechnology and pharmaceutical companies concerning the potential use of the space environment

for the processing of biological substances was examined. Physical phenomena that may be important in space-base processing of biological materials are identified and discussed in the context of past and current experiment programs. The capabilities of NASA to support future research and development, and to engage in cooperative risk sharing programs with industry are discussed. Meetings were held with several biotechnology and pharmaceutical companies to provide data for an analysis of the attitudes and perceptions of these industries toward the use of the space environment. Recommendations are made for actions that might be taken by NASA to facilitate the marketing of the use of the space environment, and in particular the Space Shuttle, to the biotechnology and pharmaceutical industries.

N86-12390# Rockwell International Corp., Golden, Colo. OPTIONS FOR OPERATIONAL RISK ASSESSMENTS

S. A. DOVER 1985 12 p Presented at the 7th Intern. System Safety Conf., San Jose, Calif., 25 Jul. 1985 (Contract DE-AC04-76DP-03533)

(DE85-014904; RFP-3855; CONF-850723-4) Avail: NTIS HC A02/MF A01

Risk assessment is a set of analytical tools that can be used to clarify possible outcomes of decisions where the two different courses of action are indicated or different values are in conflict. These conflicts often arise in the management of any production or support facility. This paper outlines the options for performing risk assessments of any scope and the parameters that determine their effectiveness. It highlights the relative costs of each option, useful information developed, and limitations of the information. The paper concludes with the types of decisions that are routinely made in an operating facility and could benefit from the information generated in a risk assessment.

N86-16451*# Princeton Synergetics, Inc., N.J.

EVALUATION OF SPACECRAFT TECHNOLOGY PROGRAMS (EFFECTS ON COMMUNICATION SATELLITE BUSINESS VENTURES), VOLUME 1 Final Report

J. S. GREENBURG, C. GAELICK, M. KAPLAN (Spacetech, Inc.), J. FISHMAN, and C. HOPKINS (Econ, Inc., San Jose, Calif.) Sep. 1985 186 p refs 2 Vol.

(Contract NAS3-23886)

(NASA-CR-174978; NÁS 1.26:174978) Avail: NTIS HC A09/MF A01 CSCL 17B

Commercial organizations as well as government agencies invest in spacecraft (S/C) technology programs that are aimed at increasing the performance of communications satellites. The value of these programs must be measured in terms of their impacts on the financial performane of the business ventures that may ultimately utilize the communications satellites. An economic evaluation and planning capability was developed and used to assess the impact of NASA on-orbit propulsion and space power programs on typical fixed satellite service (FSS) and direct broadcast service (DBS) communications satellite business ventures. Typical FSS and DBS spin and three-axis stabilized spacecraft were configured in the absence of NASA technology programs. These spacecraft were reconfigured taking into account the anticipated results of NASA specified on-orbit propulsion and space power programs. In general, the NASA technology programs resulted in spacecraft with increased capability. The developed methodology for assessing the value of spacecraft technology programs in terms of their impact on the financial performance of communication satellite business ventures is described. Results of the assessment of NASA specified on-orbit propulsion and space power technology programs are presented for typical FSS and R.J.F. DBS business ventures.

N86-23630# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.

A COST ANALYST'S GUIDE TO SATELLITE AUTONOMY AND FAULT-TOLERANT COMPUTING

P. S. KILLINGSWORTH 1985 22 p Presented at the 19th Annual Department of Defense Cost Analysis Symposium, Leesburg, Va., 17-20 Sep. 1985

(AD-A161853) Avail: NTIS HC A02/MF A01 CSCL 12A

The trend in satellite design is toward greater autonomy in satellite functions, particularly in attitude determination and navigation. Fault-tolerant computing is a necessary condition for autonomy, and incurs costs in terms of computer memory, throughput, power and weight. Fault-tolerance and reliability issues need to be looked at and estimated early in the system development. This could prevent cost overruns due to lengthened test programs and unexpected redesigns. Finally, space logistics is becoming an area of increasing interest and study. The costs of space transportation and modular designs for on-orbit replacement of components need to be weighed against the cost of building increasingly intelligent and autonomous satellites.

GRA

N86-24574# Defense Systems Management School, Fort Belvoir, Va.

B. H. RUDWICK 1985 20 p Presented at the 19th Annual Department of Defense Cost Analysis Symposium, Leesburg, Va., 17-20 Sep. 1985

(AD-A161871) Avail: NTIS HC A02/MF A01 CSCL 05A One method that a government reviewer can use in validating a contractor's cost estimate is to motivate the contractor to generate the cost estimate properly, and to forward the entire analysis, including all of the data used, to the government for review. If the analysis has been done properly, the government's effort is reduced to one of checking, rather than independent cost estimating. Furthermore, if several contractors are providing estimates, the government review team can check corresponding parts of the analysis against one another, draw their own conclusions of what the CER input values should be (including the range of uncertainty of each input characteristic), and obtain a good bounded range of the estimated cost. This paper describes and illustrates the type of instructions which can be given to the contractors to provide such motivations, and how the government can use the contractor's data to obtain its own estimate. GRA

N86-24575# Clemson Univ., S.C.

COST UNCERTAINTY ASSESSMENT METHODOLOGY: A **CRITICAL OVERVIEW**

K. T. WALLENIUS Sep. 1985 19 p Presented at the 19th Annual Department of Defense Cost Analysis Symposium, Leesburg, Va., 17-20 Sep. 1985

(AD-A161920) Avail: NTIS HC A02/MF A01 CSCL 14A

An appraisal of the quality of methodology and software for performing cost uncertainty analysis will be given. It will be argued that the standard practice of developing a most likely cost and then generating an uncertainty distribution associated with that figure is a consequence of historical precedent and places the cart before the horse. It will also be argued that methodology for encoding subjective probability distributions are out of date, being, for the most part, modifications of the PERT techniques of the sixties. Additionally, methodology for processing elemental uncertainty assessments into uncertainty distributions over higher order structures (e.g., subsystem CER's or total system cost) often ignores important sources of variability, and extent computer software designed to implement cost uncertainty analysis methodology is often poorly written and, in some cases, may lead to conclusions which are inconsistent with the inputs. This is a paper presented at a cost analysis symposium. GRA N86-24588# Space Command, Peterson AFB, Colo. Cost and Economic Analysis Div.

PRIMER ON OPERATING AND SUPPORT (O AND S) COSTS FOR SPACE SYSTEMS

R. H. LAMONTAGNE Sep. 1985 16 p Presented at the 19th Annual Department of Defense Cost Analysis Symposium, Leesburg, Va., 17-20 Sep. 1985

(AD-A162381) Avail: NTIS HC A02/MF A01 CSCL 14A

Currently, the most common space system is the satellite with its associated ground-based support facilities. However, other systems are currently being developed such as the Strategic Defense Initiative (SDI), Space Station, space based radar. anti-satellite weapon, and others. Our difficulty in the cost community is in developing O&S cost estimates for all these systems. As a result HQ Space Command/ACM is in the process of developing a primer on O&S costs for Space Systems. It is intended to provide some guidelines and fundamentals for estimating the O&S cost for space systems; to address the O&S costs associated with space systems; and to present methodologies and factors to estimate the O&S costs. An O&S cost element structure will be developed for space systems. The primer will result in providing cost visibility for space systems for developing budget and life cycle cost estimates and analyses. ĠRĂ

N86-27115# Naval Postgraduate School, Monterey, Calif. AN APPLICATION OF COST RISK IN INCENTIVE CONTRACTS M.S. Thesis

C. M. MCGRATH Dec. 1985 96 p

(AD-A165177) Avail: NTIS HC A05/MF A01 CSCL 14A

This thesis begins with an examination of the literature concerning incentive contract effectiveness and contractor motivation. Citing the most frequently supported conclusions, the researcher integrates these with a cost risk analysis methodology based upon the Beta distribution. The result is a share curve that automatically adjusts the share ratio based upon estimated cost variance. The researcher suggests that this approach is better at reflecting cost risk than the standard linear design. The share curve provides more risk sharing, especially at higher levels of cost variance, and provides both significant rewards and penalties only for significant deviations from target cost. The final conclusion is that the share curve mitigates the defense contractors' risk averse nature, thus allowing the profit motive to become operative in incentivizing the contractor to control or reduce costs. GRA

N86-28783# Mohawk Research Corp., Lake Forest, III. FINANCING APPLIED R AND D IN SMALLER COMPANIES

M. L. RORKE, H. C. LIVESAY, H. KIERULFF, and A. RAMSEUR Oct. 1985 14 p

(PB86-196987) Avail: NTIS HC \$11.50/MF A01 CSCL 05A

The authors have been interested in the issues surrounding financing for small firms since 1977. This series of research projects conducted in the U.S. and abroad included a series of workshops held in the period 1982 to 84. These workshops involved a broad spectrum of financiers ranging from passive investors of small amounts of money to professional venture capital firms investing millions of dollars in syndication with other venture capital firms.

GRA

N86-31758# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Industrial Engineering and Management Sciences.

SEMIMANUFACTURED PRODUCTS MADE OF COPPER AND COPPER ALLOYS: AN ANALYSIS OF PRODUCTION AND SALE IN A WORLD PERSPECTIVE [HALFFABRIKATEN VAN KOPER EN KOPERLEGERINGEN: EEN ANALYSE VAN PRODUKTIE EN AFZET IN MONDIAAL PERSPEKTIEF]

A. SANNEN 1984 69 p In DUTCH (EUT/BDK/15; ISBN-90-6757-015-X; ETN-86-97687) Avail: NTIS HC A04/MF A01

Semimanufactured products based on copper or copper alloys were investigated with a view to an economical and technically justified production in copper-exporting developing countries. The structure of the world copper industry is presented. The recycling of copper for industrial applications is discussed. The market for semimanufactured products and the copper market in developing countries is presented.

08

LOGISTICS AND OPERATIONS MANAGEMENT

Includes Inventory Management and Spare Parts, Materials Management and Handling, Resources Management, Resource Allocation, Procurement Management, Leasing, Contracting and Subcontracting, Maintenance and Repair, Transportation, Air Traffic Control, Fuel Conservation, Operations, Operational Programs.

A86-10928#

LOGISTICS SUPPORTABILITY CONSIDERATIONS DURING CONCEPTUAL AND PRELIMINARY DESIGN

D. P. SCHRAGE and S. A. MEYER (Georgia Institute of Technology, Atlanta) AIAA, AHS, and ASEE, Aircraft Design Systems and Operations Meeting, Colorado Springs, CO, Oct. 14-16, 1985. 9 p. (AIAA PAPER 85-3052)

Big payoffs in aircraft life cycle costs and mission effectiveness can be achieved if logistic supportability considerations are adequately addressed during conceptual and preliminary design. Logistic supportability considerations must be sensitized and traded off like other quantifiable design parameters. With current aircraft design practices this has been difficult. This paper discusses methods to address logistic supportability trade-offs. The concept formulation effort for the U.S. Army's Light Helicopter Experimental (LHX) program is used to illustrate these methods. Author

A86-15632*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

SPACE STATION OPERATIONS

R. H. GRAY (NASA, Kennedy Space Center, Cocoa Beach, FL) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 10 p.

(IAF PAPER 85-45)

An evaluation of the success of the Space Station will be based on the service provided to the customers by the Station crew, the productivity of the crew, and the costs of operation. Attention is given to details regarding Space Station operations, a summary of operational philosophies and requirements, logistics and resupply operations, prelaunch processing and launch operations, on-orbit operations, aspects of maintainability and maintenance, habitability, and questions of medical care. A logistics module concept is considered along with a logistics module processing timeline, a habitability module concept, and a Space Station rescue mission. G.R.

A86-17318* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

SPACE STATION PROGRAM OPERATIONS - MAKING IT WORK

G. R. PARKER (NASA, Kennedy Space Center, Cocoa Beach, FL) IN: Permanent presence - Making it work; Proceedings of the Twenty-second Goddard Memorial Symposium, Greenbelt, MD, March 15, 16, 1984 . San Diego, CA, Univelt, Inc., 1985, p. 31-35.

(AAS PAPER 84-112)

The Space Station Program (SSP) will consist, in part, of a permanently orbiting facility composed of a mix of manned and unmanned elements. To insure that such a facility will be an operationally viable and productive one, capable of performing a myriad of assigned missions, special attention must be given to the following operational disciplines during the design and development of the SSP systems and subsystems: (1) Automation/Autonomy, (2) Customer Interfaces/Operations, (3) Habitability/Crew Productivity, (4) Maintainability, and (5) Logistics. In order to properly address these disciplines, from an operations point of view, the Director of the Space Station Task Force (SSTF)

formed the Operations Working Group (OWG) in July 1982, and chartered this group to develop the top level operational technical and management-approach philosophies and requirements for the SSP. This paper attempts to summarize the results and conclusions reached by the OWG after an 18 month intensive study effort.

Author

A86-19524* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

SCIENCE OPERATIONS MANAGEMENT

G. F. SQUIBB (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: The National Symposium and Workshop on Optical Platforms, Huntsville, AL, June 12-14, 1984, Proceedings . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 4-9. NASA-supported research. refs

The operation teams engaged in the IR Astronomical Satellite (IRAS) project included scientists from the IRAS International Science Team. The detailed involvement of these scientists in the design, testing, validation, and operations phases of the IRAS mission contributed to the success of this project. The Project Management Group spent a substantial amount of time discussing science-related issues, because science team coleaders were members from the outset. A single scientific point-of-contact for the Management Group enhanced the depth and continuity of agreement reached in decision-making. O.C.

A86-19685*# National Aeronautics and Space Administration, Washington, D.C.

FUTURE OPERATIONAL PLANS FOR THE NATIONAL SPACE TRANSPORTATION SYSTEM

C. H. NEUBAUER, JR. (NASA, Washington, DC) AIAA, Aerospace Sciences Meeting, 24th, Reno, NV, Jan. 6-9, 1986. 4 p. (AIAA PAPER 86-0090)

In March 1985, the NASA/DOD Space Transportation System Master Plan was published. This document establishes objectives and plans for operating the Space Transportation System (STS) for the next decade. In the present paper, some key points are discussed, and the significance of the weather forecasting capability is indicated. The STS is to become fully operational by the later 1980's and is to support fully the national needs into the mid-1990's. Attention is given to NASA/DOD STS coordination, NASA/DOD STS Master Plan Traffic Models, the Orbiter Launch-Rate Capability, Launch-Rate Capabilities for Shuttle Processing Facilities at Kennedy Space Center, and Launch-Rate Capabilities for Shuttle Processing Facilities at Vandenberg Air Force Base. G.R.

A86-21055

AVIATION MAINTENANCE MANAGEMENT

E. H. KING (Southern Illinois University, Carbondale, IL) Carbondale, IL, Southern Illinois University Press, 1986. 221 p. refs

The maintenance management concerns that confront the various levels of aviation supervision are discussed. The topics addressed include: the FAA's organizational structure, FAA publications pertaining to maintenance, aviation maintenance procedures, the application of aviation maintenance considered are: training and professional development in aviation maintenance, safety and maintenance, electronic data processing, and aviation maintenance management problem areas. C.D.

A86-22267

SATELLITE LEASING - CHEAP ACCESS TO SPACE

R. MAEHL (RCA, Astro-Electronics Div., Princeton, NJ) Space (ISSN 0267-954X), vol. 1, Dec. 1985-Feb. 1986, p. 10, 11, 17.

The role of satellite leasing arrangements in marketing commercial ventures in space is considered. The most recent examples of leased space platforms are described, including Leasat: ESA's EURECA; Omnistar; and Leasecraft. It is shown that because of NASA Shuttle pricing policies, leasing room for commercial payloads on board space platforms will become an increasingly attractive way of financing space ventures in which capital investments are often at risk. The development of the first large-scale commercial space platform for the Electrophoresis in Space (EOS) program is also discussed.

A86-22379

NEW MAINTAINABILITY PREDICTION TECHNIQUE

R. L. VANNATTER (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: Annual Reliability and Maintainability Symposium, Philadelphia, PA, January 22-24, 1985, Proceedings . New York, Institute of Electrical and Electronics Engineers, 1985, p. 39-43.

This paper describes a unique computerized (including graphics) modeling technique for performing maintainability predictions. The model features simplicity, broad application, and visibility of equipment diagnostic characteristics. It also provides visibility of assumptions used in creating the model. It can be used directly or in support of many logistics support functions. This technique is applicable to all phases of equipment development and for all maintenance levels. It can be expanded to include multiple maintenance levels, as well as logistics flow, using the same basic data elements. Author

A86-24128

NASA CENTERS WILL STIMULATE INDUSTRY R & D

D. DOOLING (Essex Corp., Huntsville, AL) Commercial Space (ISSN 8756-4831), vol. 1, Fall 1985, p. 95-98.

Four prototype centers supported by NASA in order to stimulate research and development, and encourage individual investment in space are described. The crystallography program of the Center for Macromolecular Crystallization is examined; the center will grow the crystals in space and analyze the usefulness of the products. The benefits and problems of these protein experiments are investigated. The Consortium for Materials Development is to study the applications of physical chemistry and material transport through fluids in space. The processes by which metals, alloys, ceramics, and glasses are formed will be analyzed by the Center for Space Processing of Engineering Materials in order to improve production on earth. The interpretation and commercialization of Landsat data is conducted at the Space Remote Sensing Center. The production of materials which will be easily commercialized. such as piezoelectric transducers and glass microspheres, is the objective of the Multi-Phase Materials Center. I.F.

A86-26525

SPACE REMOTE SENSING SYSTEMS: AN INTRODUCTION

H. S. CHEN (Rockwell International Corp., Downey, CA; California, University, Los Angeles) Orlando, FL, Academic Press, Inc., 1985, 269 p. refs

An introductory primer on space remote sensing technologies and their applications is presented. Among the specific technologies discussed are: spaceborne radiation collector systems; space detectors; and passive space radiometers. Consideration is also given to: passive space spectrometer systems; passive space microwave radiometers; active space lidar systems; and active synthetic aperture radar and scatterometer systems. Some of the atmospheric phenomena which influence the reliability of remote sensing data are also discussed.

A86-27897#

SPACE MATERIALS RESOURCES AND PROCESSING OPTIONS - THEIR INFLUENCE ON FUTURE SPACE OPERATIONS

R. WALDRON (Rockwell International Corp., Space Div., Downey, CA) IN: Space, our next frontier; Proceedings of the Conference, Dallas, TX, June 7, 8, 1984. Dallas, TX, National Center for Policy Analysis, 1985, p. 325-328.

The feasibility and consequentiality for future space operations of four distinct routes toward space materials resources processing are evaluated. The first of these options involves the orbital processing of high-tech, high specific value products, and the third is predicated on the development of lower access-cost materials in space itself. The second and fourth options, proposed as alternatives to the first and third, encompass methods of

08 LOGISTICS AND OPERATIONS MANAGEMENT

transporting hardware to space for orbital use. Energy as well as materials requirements are considered for the four options. O.C.

A36-28581[•] National Aeronautics and Space Administration, Washington, D.C.

SPACE STATION PLANNING

R. F. FREITAG (NASA, Office of Space Station, Washington, DC) IN: Europe/United States space activities . San Diego, CA, Univelt, Inc., 1985, p. 85-96.

(AAS 85-111)

An overview of NASA Space Station planning activities is given. Among the specific topics addressed are: the role of private contractors in the construction and operation of Space Station; international cooperation in planning Space Station configurations; and optimum management strategies for Space Station planning activities. The division of work packages for the preliminary design definition phase of the Space Station program is described. I.H.

A86-30549

HELICOPTER MAINTENANCE IN THE REAL WORLD

G. R. VANSLYKE (Okanagan Helicopters, Ltd., Richmond, Canada) Vertiflite (ISSN 0042-4455), vol. 32, Mar.-Apr. 1986, p. 24-28.

The need to minimize helicopter operating and maintenance costs and improve reliability and durability is examined. It is estimated that large current generation helicopters cost \$1,000/flying hour; the largest cost is engine repair followed by accessory repair. The improvements required in field maintenance, repair shop maintenance, and helicopter and engine design and developments are described. The use of in-house repair services and overhaul capabilities has reduced maintenance costs. The elimination of helicopter design problems such as vibrations, corrosion, water leaking, and the removal of finite-lifted components, by the manufacturer is studied. I.F.

A86-32095*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

MAINTAINABILITY PLANNING FOR THE SPACE STATION

G. R. EGAN (NASA, Johnson Space Center, Houston, TX) AIAA, AHS, CASI, DGLR, IES, ISA, ITEA, SETP, and SFTE, Flight Testing Conference, 3rd, Las Vegas, NV, Apr. 2-4, 1986. 5 p.

(AIAA PAPER 86-9754)

The planned NASA Space Station, which is expected to have many years of on-orbit operation, for the first time confronts spacecraft designers with major questions of maintainability in design. A Maintainability Guidelines Document has been distributed to all Space Station Definition and Preliminary Design personnel of the Space Station Program Office. Trade studies are being performed to determine the most economical balance between initial (reliability) cost and life cycle cost (crew time and replacement hardware) costs. O.C.

A86-32930#

INTEGRATED LOGISTICS SUPPORT - FIVE KEY AREAS OF ENGINEERING TECHNOLOGY IN SPACE

J. M. DRAKE (Martin Marietta Corp., Michoud Div., New Orleans, LA) IN: Man's permanent presence in space; Proceedings of the Third Annual Aerospace Technology Symposium, New Orleans, LA, November 7, 8, 1985 . New Orleans, LA, American Institute of Aeronautics and Astronautics, 1985, 19 p. refs

The purpose of this paper is to discuss the concept and elements of integrated logistics support as it applies to the manned space program. Five key areas of technology which are critical in making needed improvements in the support and development of the space transportation systems are identified and discussed in detail. These five areas are: materials, infrastructure, life support systems, operations, and human factors. Each of these areas is presented in relation to how improvements in terrestrial applications and methodology will lead to advances in extraterrestrial systems. Author **A86-34956*** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

LOGISTICS SUPPORT ECONOMY AND EFFICIENCY THROUGH CONSOLIDATION AND AUTOMATION

G. R. SAVAGE, C. J. FONTANA, and J. D. CUSTER (NASA, Kennedy Space Center; Lockheed Space Operations Co., Cocoa Beach, FL) IN: Space and society - Progress and promise; Proceedings of the Twenty-second Space Congress, Cocoa Beach, FL, April 23-26, 1985 . Cape Canaveral, FL, Canaveral Council of Technical Societies, 1985, p. 1-57 to 1-59.

An integrated logistics support system, which would provide routine access to space and be cost-competitive as an operational space transportation system, was planned and implemented to support the NSTS program launch-on-time goal of 95 percent. A decision was made to centralize the Shuttle logistics functions in a modern facility that would provide office and training space and an efficient warehouse area. In this warehouse, the emphasis is on automation of the storage and retrieval function, while utilizing state-of-the-art warehousing and inventory management technology. This consolidation, together with the automation capabilities being provided, will allow for more effective utilization of personnel and improved responsiveness. In addition, this facility will be the prime support for the fully integrated logistics support of the operations era NSTS and reduce the program's management, procurement, transportation, and supply costs in the operations KK era.

A86-35646

COMPUTER SIMULATION AND MODELING - A TOOL FOR INVENTORY MANAGEMENT

J. G. WILLIAMS (Bell Helicopter Textron, Fort Worth, TX) IN: American Helicopter Society, Annual Forum, 41st, Fort Worth, TX, May 15-17, 1985, Proceedings . Alexandria, VA, American Helicopter Society, 1985, p. 629-634. refs

The use of computer simulation and modeling to aid decision-making in inventory management is illustrated by means of four actual cases: raw materials/capital investment tradeoffs, buffering against uncertainty concerning a material, demand-forecasting technique evaluation, and inventory and service level simulation. It is noted that such simulation methods involve few limiting assumptions, by comparison with optimization techniques; in addition, the incorporation of uncertainties is straightforward, and complex situations can be easily modeled.

O.C.

A86-35647

SPARE PARTS PRICING - IMPACT ON LOGISTICS SUPPORT

J. K. HANCOCK (Boeing Vertol Co., Ridley Park, PA) IN: American Helicopter Society, Annual Forum, 41st, Fort Worth, TX, May 15-17, 1985, Proceedings . Alexandria, VA, American Helicopter Society, 1985, p. 635-637.

A task force composed of management-level representatives from all major organizations of a military helicopter manufacturer was formed in response to a 10-point program, promulgated in July 1983 by the Secretary of Defense, in order to reform spare parts procurement practices. A corporate spares policy was duly formulated by October 1983. Attention is given to the effects of this policy on price lists, recommended minimum quantities, combined buy practices, low intrinsic value spares, ground support equipment, spare parts data tracking, and cost avoidance. O.C.

A86-43333#

DEVELOPING A MAINTENANCE CONCEPT FOR FUTURE ELECTRONIC SYSTEMS

R. O. BLEAU (USAF, Electronic Systems Div., Bedford, MA) AIAA and SOLE, Aerospace Maintenance Conference, 2nd, San Antonio, TX, May 21-23, 1986. 6 p.

(AIAA PAPER 86-1145)

A team composed of U.S. Air Force acquisitions logisticians and prime contractor logistics and design engineers has used several analytical approaches to identify improvements in maintenance support, design, and logistics contracting strategies. The combination of design and support concepts thus achieved increased system supportability at reduced life cycle cost, and yielded a more combat-capable system. Major focuses of the analytic method used were life cycle costs, capabilities, and flexibility. O.C.

A86-43881

SYSTEMS MODELING AND DBMS APPLICATION IN TEST ASSETS MANAGEMENT

D. D. RHODES, S. HSU, and N. W. FRUSH (Sperry Corp., Microwave and Support Systems Div., Clearwater, FL) IN: AUTOTESTCON '85; Proceedings of the International Automatic Testing Conference, Uniondale, NY, October 22-24, 1985. New York, Institute of Electrical and Electronics Engineers, 1985, p. 37-42. refs

This paper addresses 'management of test assets' over the full range of maintenance support system management phases from inception through operation to system evolution. The paper discusses the versatile utilities of some innovative system models and the supporting DBMS as test assets management tools. These models are used to augment both development and operations management capabilities. The paper mentions the successful applications to on-going large scale programs of CSS (USN) and IFTE (USA).

A86-44935

THE SELECTION AND ACQUISITION OF COMMERCIAL AIRCRAFT FLEETS

W. PETERS (South African Airways, Johannesburg, Republic of South Africa) Aeronautica Meridiana (ISSN 0257-8573), vol. 6, no. 1, 1985, p. 43-50.

Fleet planning, aircraft selection and aircraft acquisition processes must be constantly undertaken by airlines irrespective of their size, and will have as their primary concern the matching of aircraft performance characteristics with market route networks, on the one hand, and on the other the large amounts and high cost of capital for fleet refurbishment. Other considerations encompass market analyses, the purchase of new or used aircraft, aircraft performance suitability for certain route sectors, and the guarantee of engine and airframe manufacturers' performance specifications. O.C.

A86-46951#

SPACE STATION OPERATIONS IN THE TWENTY-FIRST CENTURY

G. R. BENNETT (McDonnell Douglas Astronautics Co., Houston, TX) AIAA, Space Station in the Twenty-first Century, Meeting, Reno, NY, Sept. 3-5, 1986. 10 p. refs

(AIAA PAPER 86-2328)

A model outlining the requirements for achieving manned space operations is presented. Several Space Stations, each serving specific functions are proposed for effective use of space. The components of the Stations are to be designed for modularity and flexibility. The advantages of a multi-Space-Station system are discussed. The transportation system necessary for accomplishing the proposed space operations is described. The implementations of robotics to assist in operations, due to a limit on crew size, and of a computer system to schedule the use of limited resources are examined. The effect of the National Aerospace Plane on Space Station operations is investigated. The participation of industry in Space Station operations is considered. I.F.

A86-46954#

SPACE STATION ON-ORBIT OPERATIONS FOR THE TWENTY FIRST CENTURY

R. H. SCHAEFER and A. C. BEARDSLEY (Grumman Corp., Bethpage, NY) AIAA, Space Station in the Twenty-first Century, Meeting, Reno, NV, Sept. 3-5, 1986. 8 p.

(AIAA PAPER 86-2331)

The three areas of Space Station operations, mission, maintenance, and coordination, are considered. The operational activities of the Space Station consist of assembling the equipment necessary for specific missions and conducting the experiments.

The maintenance operations which involve monitoring system operations and supplying resources are described. The proximity operations and ground-based support (coordination activities) are examined. The Space Station is to have a crew of 18-20 station specialists, a mobile work station, satellite servicing bays, and maneuvering vehicles for conducting orbit operations; the functions of each component are studied. IF.

A86-46963#

GROWTH OF ELECTRONIC MATERIALS IN MICROGRAVITY

B. L. HOEKSTRA (USAF, Materials Laboratory, Wright-Patterson AFB, OH) and W. R. WILCOX (Clarkson University, Potsdam, NY) AIAA, Space Station in the Twenty-first Century, Meeting, Reno, NV, Sept. 3-5, 1986. 6 p.

(AIAA PAPER 86-2356)

This paper reviews the advantages of processing electronic materials in the microgravity environment. Emphasis is placed on commercially viable processes for high value-added crystals and the development of scientific knowledge for improving crystals growth on earth. This will be done by reviewing past flight experiments as well as ground-based experiments and theory. This will all be discussed in the context of future electronic materials research needs as well as the potential for commercial production on the Space Station in the 21st century. Author

A86-47139#

THE ROLE OF LASER TECHNOLOGY IN MATERIALS **PROCESSING AND NONDESTRUCTIVE TESTING IN THE 21ST** CENTURY

B. M. SHEINBERG (BMS Consultants, Houston, TX) IN: Symposium on Nondestructive Evaluation, 15th, San Antonio, TX, April 23-25, 1985, Proceedings . San Antonio, TX, Nondestructive Testing Information Analysis Center, 1986, p. 147-157. refs

Some of the potential applications of laser technology in the 21st century are explored, and the proposed role of this technology in relation to materials processing, nondestructive testing, and quality control are discussed. Examples illustrating the implementation of this techology include the proposed construction of vehicles and platforms in near and deep space, and construction of underwater platforms. The direction in which today's technology should evolve to pursue the achievement of such goals is indicated. Included in the discussion is an evaluation of laser, robotics, and fiber optics technologies with respect to their ability to achieve a synergistic level of operation. Author

A86-47616

PLANNING FOR MINIMUM OVERHAUL TIME

E. MUELLER (Swissair-Schweizerischer Luftverkehr AG, Zurich, IN: AIRMEC '85 - Aviation equipment servicing: Switzerland) Aircraft and helicopter maintenance; International Exhibition and Conference, 4th, Duesseldorf, West Germany, February 26-March 3, 1985, Conference Reports . Duesseldorf, West Germany, Duesseldorfer Messegesellschaft mbH, 1985, 15 p.

The experiences of planning and managing an aircraft overhaul program, aimed at achieving maximal aircraft utilization with minimal maintenance, are presented. Maintenance concepts, work in planning advance preparations, job schedules, steps documentation, workshop organization, and deployment of personnel resources are discussed. Advance preparations include drawing up a detailed program of all jobs involved for each heavy maintenance visit and a flow chart comprising about 500 individual activities subdivided into ten aircraft areas and skill categories, which plots the performance of the various individual assignments over two-week periods. The operation of a computerized maintenance control system for planning and implementing the maintenance activities is described. LS

08 LOGISTICS AND OPERATIONS MANAGEMENT

N86-22065# National Weather Service, Silver Spring, Md. Engineering Div. MAINTENANCE PLANNING FOR THE 1990'S (INITIAL

PLANNING)

W. J. VANFELDT, R. R. KNIBB, D. M. ENTRIKIN, A. KERNER, and R. I. RACER Jul. 1985 51 p refs (PB86-106010; NOAA-TM-NWS-ENG-11) Avail: NTIS HC

A04/MF A01 CSCL 04B

New equipment programs, changing technologies, staffing constraints, and restrictive budgets are but a few of the reasons why the National Weather Service (NWS) must strive for greater efficiency and productivity in its maintenance and logistics programs. Comprehensive maintenance and logistics planning is necessary to allow smooth transition and integration of new systems into the NWS meteorological and hydrological operations. To initiate this planning, a Maintenance and Logistics Steering Group (MLSG) was formed to study and recommend action necessary to ensure appropriate NWS maintenance and logistics programs in the 1990's. NOAA technical memorandum NWS ENG-11 describes the MLSG analyses and contains the resulting recommendations. GRĂ

N86-23556# RAND Corp., Santa Monica, Calif. DEPOT MAINTENANCE OF AVIATION **COMPONENTS:** CONTRACTOR VERSUS ORGANIC REPAIR

L. B. EMBRY, N. Y. MOORE, J. CAVE, and F. LABRUNE Mar. 1985 116 p (Contract N00014-83-C-0100) (AD-A162071; RAND/N-2225-NAVY) Avail: NTIS HC A06/MF

A01 CSCL 01C

Aviation and engine component repair requirements make up over half of the projected wartime depot-level maintenance workload. Organic (service-owned) ability to support this workload is particularly limited; at present, nearly half of the Navy's depot-level component repair is performed in contractor or other service facilities. Before major investments are made in the facilities and equipment needed to accomplish these repairs, it will be necessary to determine the appropriate mix of organic and contractor repair sources. This note addresses the economic and operational implications of alternative source-of-repair decisions. Based on analyses of the distribution of projected wartime demands, technical data limitations, the structure of the repair industry, the operational payoff of facilities characterized by broad scope of repair, and airline industry practices, it postulates a strategy for providing depot-level component support that can be used to specify the appropriate source of repair at different points in the weapon system and subsystem life cycle. GRA

N86-24005# DMEA Ltd., Scottsdale, Ariz. **EXPLORATION FOR STRATEGIC MATERIALS**

B. F. DICKERSON and C. A. OBRIEN 1985 210 p refs Sponsored by the Office of Technology Assessment (PB86-126463) Avail: NTIS HC A10/MF A01 CSCL 081

The report by the Office of Technology Assessment discusses technologies, methodologies, and the effects of technical and nontechnical factors on exploration for on-shore deposits of strategic materials. Author

N86-24586# Defense General Supply Center, Richmond, Va. LOGMARS (LOGISTICS APPLICATIONS OF AUTOMATED MARKING AND READING SYMBOLS) CLEARINGHOUSE, **APPLICATIONS DIRECTORY**

Sep. 1985 134 p

(AD-A162327) Avail: NTIS HC A07/MF A01 CSCL 15E

The DOD challenge is to improve material readiness, while also seeking ways to lower overall costs. The Logistics Applications of Automated Marking and Reading Symbols (LOGMARS) Program, using bar code technology in automated logistics systems, is ideally suited to achieve these objectives. Implementation of LOGMARS will increase productivity, reduce error rates, and improve the responsiveness of automated systems. This directory lists applications initiated by the various DOD components and the status of each. It is intended to eliminate duplicative development efforts within the components where application efforts are GRA similiar.

National Aeronautics and Space Administration. N86-25321*# Lewis Research Center, Cleveland, Ohio.

RESEARCH AND COMPETITION: BEST PARTNERS

Presented at the 90th Casting J. M. SHAW 1986 12 p Congress, Minneapolis, Minnesota, 11-15 May 1986; sponsored by the American Foundrymen's Society

(NASA-TM-87313; E-3044; NAS 1.15:87313) Avail: NTIS HC A02/MF A01 CSCL 05A

NASA's Microgravity Science and Applications Program is directed toward research in the science and technology of processing materials under conditions of low gravity. The objective is to make a detailed examination of the constraints imposed by gravitational forces on Earth. The program is expected to lead ultimately to the development of new materials and processes in Earth-based commercial applications, adding to this nation's technological base. An important resource that U.S. researchers have readily available to them is the new Microgravity Materials Science Laboratory (MMSL) at NASA Lewis Research Center in Cleveland. A typical scenario for a microgravity materials experiment at Lewis would begin by establishing 1-g baseline data in the MMSL and then proceeding, if it is indicated, to a drop tower or to simulated microgravity conditions in a research aircraft to qualify the project for space flight. A major component of Lewis microgravity materials research work involves the study of metal and alloy solidification fundamentals. Author

N86-28012# Department of Energy, Washington, D. C. Office of Civilian Radioactive Waste Management. PROGRAM MANAGEMENT SYSTEM MANUAL

Jan. 1986 95 p

(DE86-005396; DOE/RW-0043) Avail: NTIS HC A05/MF A01

The Program Management System (PMS), as detailed in this manual, consists of all the plans, policies, procedure, systems, and processes that, taken together, serve as a mechanism for managing the various subprograms and program elements in a cohesive, cost effective manner. The PMS is consistent with the requirements of the Nuclear Waste Policy Act of 1982 and the Mission Plan for the Civilian Radioactive Waste Management Program (DOE/RW-0005). It is based on, but goes beyond, the DOE management policies and procedures applicable to all DOE programs by adapting these directives to the specific needs of the Civilian Radioactive Waste Management program. This PMS Manual describes the hierarchy of plans required to develop and maintain the cost, schedule, and technical baselines at the various organizational levels of the Civilian Radioactive Management Program. It also established the management policies and procedures used in the implementation of the program. These include requirements for internal reports, data, and other information; systems engineering management; regulatory compliance; safety; quality assurance; and institutional affairs. Although expanded versions of many of these plans, policies, and procedures are found in separate documents, they are an integral part of this manual. The PMS provides the basis for the effective management that is needed to ensure that the Civilian Radioactive Waste Management Program fulfills the mandate of the Nuclear Waste Policy Act of 1982. DOE

N86-28418*# Martin Marietta Aerospace, Denver, Colo. TETHER APPLICATIONS FOR SPACE STATION

W. NOBLES In NASA, Washington Applications of Tethers in Space: Workshop Proceedings, Volume 1 p 239-267 .lun 1986

Avail: NTIS HC A25/MF A01 CSCL 13I

A wide variety of space station applications for tethers were reviewed. Many will affect the operation of the station itself while others are in the category of research or scientific platforms. One of the most expensive aspects of operating the space station will be the continuing shuttle traffic to transport logistic supplies and payloads to the space station. If a means can be found to use tethers to improve the efficiency of that transportation operation,

it will increase the operating efficiency of the system and reduce the overall cost of the space station. The concept studied consists of using a tether to lower the shuttle from the space station. This results in a transfer of angular momentum and energy from the orbiter to the space station. The consequences of this transfer is studied and how beneficial use can be made of it. FR

N86-28972*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala. SPACE PROCESSING APPLICATIONS ROCKET (SPAR)

PROJECT: SPAR 10

R. POORMAN, comp. Jun. 1986 92 p

(NASA-TM-86548; NAS 1.15:86548) Avail: NTIS HC A05/MF A01 CSCL 20H

The Space Processing Applications Rocket Project (SPAR) X Final Report contains the compilation of the post-flight reports from each of the Principal Investigators (PIs) on the four selected science payloads, in addition to the engineering report as documented by the Marshall Space Flight Center (MSFC). This combined effort also describes pertinent portions of ground-based research leading to the ultimate selection of the flight sample composition, including design, fabrication and testing, all of which are expected to contribute to an improved comprehension of materials processing in space. The SPAR project was coordinated and managed by MSFC as part of the Microgravity Science and Applications (MSA) program of the Office of Space Science and Applications (OSSA) of NASA Headquarters. This technical memorandum is directed entirely to the payload manifest flown in the tenth of a series of SPAR flights conducted at the White Sands Missile Range (WSMR) and includes the experiments entitled, Containerless Processing Technology, SPAR Experiment 76-20/3; Directional Solidification of Magnetic Composites, SPAR Experiment 76-22/3; Comparative Alloy Solidification, SPAR Experiment 76-36/3; and Foam Copper, SPAR Experiment 77-9/1B Author

N86-30568*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

SCIENTIFIC AND TECHNICAL PAPERS PRESENTED OR PUBLISHED BY JSC AUTHORS IN 1985 Aug. 1986 111 p

(NASA-TM-58273; S-553; NAS 1.15:58273) Avail: NTIS HC A06/MF A01 CSCL 05B

The Lyndon B. Johnson Space Center contributions to the scientific and technical literature in aerospace and life sciences made during calendar year 1985 are described. Citations include NASA formal series reports, journal articles, conference and symposium presentations, papers published in proceedings or other collective works, and seminar and workshop results. Author

N86-30759# Fulmer Research Inst. Ltd., Stoke Poges (England).

THE APPLICATION OF COMPOSITES TO SPACE STRUCTURES: **GUIDELINES ON IMPORTANT ASPECTS FOR THE DESIGNER** D. P. BASHFORD In ESA Proceedings of a Workshop on Composites Design for Space Applications p 9-16 Feb. 1986 Avail: NTIS HC A16/MF A01

Guidelines and surveys on the state of composites as structural aerospace materials were produced. The guidelines give a detailed background on composites for spacecraft and are intended for designers and engineers unfamiliar with composites. Topics covered include: selection of composite materials; aramid composites; prepreg and resin procurement specifications; nondestructive tests polymeric matrices; mechanical test methods techniques; for composites; joining and moisture absorption/thermal cycling response. ESA

N86-30898# Selenia Industrie Associate S.p.A., Rome (Italy). Engineering Support Dept.

AN EXAMPLE OF INTEGRATED LOGISTIC SUPPORT APPLIED ALSO TO PRODUCTION TESTING

V. BUONTEMPO In its Rivista Tecnica Selenia, v. 9, no. 4, p 1985 26-45

Avail: NTIS HC A03/MF A01

The basic concepts of an aerospace industry integrated logistic support plan are presented. An example shows that as well as achieving overall economy on system life cycle support cost, it reduces production costs by designing support means and production test in harmony with the logistic support means. A life cycle computation model related to the logistic support is provided. The model is also applicable to on board avionic systems such as Tornado and AMX aircraft and EH 101 helicopter. ESA

N86-32328# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Industrial Engineering and Management Sci.

PRODUCTION AND INVENTORY CONTROL WITH THE BASE STOCK SYSTEM

J. P. J. TIMMER, W. MONHEMIUS, and J. W. M. BERTRAND May 1984 39 p

(EUT/BDK/12; ISBN-90-6757-012-5; ETN-86-97686) Avail: NTIS HC A03/MF A01

Base stock control (BSC), of safety stocks in a multiproduct multiphase production system is compared with techniques such as master product scheduling. It is shown that BSC results in good control with a low level of safety stocks and reduced control effort. ESA

N86-32329# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Industrial Engineering and Management Sci.

BALANCING PRODUCTION LEVEL VARIATIONS AND VARIATIONS IN COMPLEX PRODUCTION INVENTORY SYSTEMS

J. W. M. BERTRAND Apr. 1984 18 p

(THE/BDK/84; ETN-86-97688) Avail: NTIS HC A02/MF A01

The behavior of production levels and stocks in an integrally controlled multiproduct multiphase production system is analyzed. It is shown that certain types of variations in the master production schedule (MPS) may lead to large short term variations in production. To reduce the costs of these variations production smoothing is introduced; a modification of well-known integral production decision rules is derived to realize smoothed production behavior. The quantitative effects of the production smoothing rule on the variations in stocks and production levels are demonstrated. A cost model to determine appropriate values for the smoothing parameters, given a specific production structure, a given capacity structure, and a given variability of the MPS is outlined. FSA

N86-32471*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

HISTORICAL DATA AND ANALYSIS FOR THE FIRST FIVE YEARS OF KSC STS PAYLOAD PROCESSING

J. M. RAGUSA Sep. 1986 124 p

(NASA-TM-83105; NAS 1.15:83105) Avail: NTIS HC A06/MF A01 CSCL 22A

General and specific quantitative and gualitative results were identified from a study of actual operational experience while processing 186 science, applications, and commercial payloads for the first 5 years of Space Transportation System (STS) operations at the National Aeronautics and Space Administration's (NASA) John F. Kennedy Space Center (KSC). All non-Department of Defense payloads from STS-2 through STS-33 were part of the study. Historical data and cumulative program experiences from key personnel were used extensively. Emphasis was placed on various program planning and events that affected KSC processing, payload experiences and improvements, payload hardware condition after arrival, services to customers, and the impact of STS operations and delays. From these initial considerations, operational drivers were identified, data for selected processing parameters collected and analyzed, processing criteria and options determined, and STS payload results and conclusions

reached. The study showed a significant reduction in time and effort needed by STS customers and KSC to process a wide variety of payload configurations. Also of significance is the fact that even the simplest payloads required more processing resources than were initially assumed. The success to date of payload integration, testing, and mission operations, however, indicates the soundness of the approach taken and the methods used. Author

N86-32584# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Product Assurance Div.

DATA FOR SELECTION OF SPACE MATERIALS

Nov. 1985 211 p

(ESA-PSS-01-701-ISSUE-1; ISSN-0379-4059; ETN-86-97796) Avail: NTIS HC A10/MF A01

Data on adhesives, adhesive tapes, coatings and varnishes, glasses, lubricants, metals, paints, plastic films, potting compounds, reinforced and thermosetting resins, rubbers, and thermoplastics for space applications are presented. The materials were used by FSA ESA

09

RELIABILITY AND QUALITY CONTROL

Includes Fault Tolerance, Failure and Error Analysis, Reliability Engineering, Quality Assurance, Wear, Safety Management and Safety, Standards and Measurement, Tests and Testing Inspections, Specifications, Performance Tests, Certification.

A86-15833*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

EARTH BASED APPROACHES TO ENHANCING THE HEALTH AND SAFETY OF SPACE OPERATIONS

A. M. KOLLER, JR. (NASA, Kennedy Space Center, Cocoa Beach, IAF, International Astronautical Congress, 36th, Stockholm, FL) Sweden, Oct. 7-12, 1985. 7 p. refs (IAF PAPER 85-330)

This paper provides an overview of the current state of our earth based knowledge of space safety hazards; identification of several key areas of concern for space operations; and proposed approaches to providing technology enhancement and information needed to improve the health and safety to those conducting space operations. Included are a review of the identified hazards for space opprations by hazard classification; a summarization of the information currently available on space experiences and an assessment of potential hazards for long duration spaceflight; a discussion of potential failure modes and their significance for Space Station work: and an assessment of current work which indicates additional research and experimentation which can only be accomplished in actual space missions. Author

A86-15839#

DEVELOPMENT AND IMPLEMENTATION OF THE FUTURE GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM (FGMDSS)

V. BOGDANOV (International Maritime Organization, London, England) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 15 p.

(IAF PAPER 85-338)

The present maritime distress and safety system is briefly reviewed, and plans for the Future Global Maritime Distress and Safety System (FGMDSS), which is expected to be introduced by the International Maritime Organization in 1990, are outlined. In particular, attention is given to SAR coordinating communications, on-scene communications, preventive actions, and carriage requirements for the future system. The satellite systems that are to be used in the FGMDSS are discussed. V.L.

A86-15840#

INMARSAT ROLE IN THE FUTURE GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM

J. L. FEAR IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 10 p.

(IAF PAPER 85-339)

The Future Global Maritime Distress and Safety System (FGMDSS) is discussed. The FGMDSS through the Inmarsat system is to provide ship-to-shore alerting of distress. The procedures and functions of the Inmarsat distress and safety service are described. The function of the devices used to provide FGMDSS communications, which include the enhanced group call receiver, distress message generator, L-band emergency position indicating radio beacon, and standard-C ship earth station, are examined. The response of the FGMDSS to the gradual buildup of distress incident, and to sudden distress signals from unforeseen disasters is explained.

A86-17472

QUALITY CONTROL, RELIABILITY, AND ENGINEERING DESIGN

B. S. DHILLON (Ottawa, University, Canada) New York, Marcel Dekker, Inc. (Industrial Engineering. Volume 10), 1985, 308 p. refs

An introductory test on quality control, reliability, and engineering design is presented. The topics discussed include: basic mathematical concepts, economic considerations, introduction to quality control, management for quality control, quality costs and procurement quality control, statistical quality control, applied quality control, introduction to reliability, design for reliability, time-dependent reliability models, and reliability estimation. Also addressed are: introduction to engineering design, the design process, engineering design reviews, reliability and maintainability in systems design, human factors in engineering design, and design optimization methods.

A86-17602#

ENVIRONMENTAL MANAGEMENT OF PAYLOAD PROCESSING FACILITIES

F. B. WENKSTERN (McDonnell Douglas Astronautics Co., Cocoa Beach, FL) AIAA, Shuttle Environment and Operations Conference, 2nd, Houston, TX, Nov. 13-15, 1985. 7 p. refs (AIAA PAPER 85-6067)

Space Transportation System (STS) Orbiters and Payloads require environmentally controlled facilities for prelaunch testing and integration activities. John F. Kennedy Space Center (KSC) Cargo processing facilities are controlled by a KSC Cargo Facility Contamination Control Plan. This plan addresses the four mandatory elements for environmentally controlled facilities: environmental monitoring, visual inspection, work rules, and operational controls. The KSC environmental program implements the plan and seeks to define and quantify the various levels of the four elements necessary to achieve required levels of cleanliness. Details of the program are presented to provide an understanding of contamination control at KSC in terms of processing facility capability.

A86-21878

ENCRYPTION PROTECTION FOR COMMUNICATION SATELLITES

D. R. SOOD and O. W. HOERNIG, J.R. (American Satellite Co., Rockville, MD) IN: EASCON '84; Proceedings of the Seventeenth Annual Electronics and Aerospace Conference, Washington, DC, September 10-12, 1984. New York, Institute of Electrical and Electronics Engineers, 1984, p. 83-88.

In connection with the growing importance of the commercial communication satellite systems and the introduction of new technological developments, users and operators of these systems become increasingly concerned with aspects of security. The user community is concerned with maintaining confidentiality and integrity of the information being transmitted over the satellite links, while the satellite operators are concerned about the safety of their assets in space. In response to these concerns, the commercial satellite operators are now taking steps to protect the communication information and the satellites. Thus, communication information is being protected by end-to-end encryption of the customer communication traffic. Attention is given to the selection of the NBS DES algorithm, the command protection systems, and the communication protection systems. G.R.

A86-22178

IMPLICATIONS OF NEW AIRCRAFT AVIONICS RELIABILITY PERFORMANCE

M. E. MOORHEAD (Rockwell International Corp., Collins Div., Melbourne, FL) IN: Environmental integration technology today for a quality tomorrow; Proceedings of the Thirtieth Annual Technical Meeting, Orlando, FL, May 1-3, 1984. Mount Prospect, IL, Institute of Environmental Sciences, 1984, p. 232-235.

An evaluation is made of MTBF values projected for avionics operating under environmental conditions typical of state-of-the-art 'digital' aircraft. Equipment reliability levels obtained during the fist year of operational experience with the B 767 and B 757 airliners are presented and compared with levels characteristic of previous avionic failure rates. Theoretical reliability levels based on existing MIL-HDBK-217 failure rate curves and acceleration factors are related to demonstrated performance levels, in order to identify points of correlation as well as discrepancies. O.C.

A86-22185

INNOVATIVE STIMULUS TESTING AT THE LOWEST LEVEL OF ASSEMBLY TO REDUCE COSTS AND INDUCE RELIABILITY

J. L. CAPITANO (Gould, Inc., Nav Com Systems Div., El Monte, CA) IN: Environmental integration technology today for a quality tomorrow; Proceedings of the Thirtieth Annual Technical Meeting, Orlando, Fl, May 1-3, 1984 . Mount Prospect, IL, Institute of Environmental Sciences, 1984, p. 303-305.

Stimulus Testing is the application of stimuli to electronic systems, assemblies, or parts to precipitate failures before the product reaches the customer. This can be in the form of Repetitive changes to temperature, random vibration spectrums, or other applicable conditions as necessary to force-fail infant and latent defects at an appropriate point in the evolution of the product. The end product reliability then shall be improved beyond that normally achieved with standard methods of manufacturing and quality control.

A86-22377

RELIABILITY REQUIREMENTS AND CONTRACTUAL PROVISIONS

B. S. LIEBESMAN (Bell Communications Research, Inc., Holmdel, NJ) IN: Annual Reliability and Maintainability Symposium, Philadelphia, PA, January 22-24, 1985, Proceedings . New York, Institute of Electrical and Electronics Engineers, 1985, p. 1-5. refs

The specification of reliability requirements for complex commercial systems is a formidable process which should include consideration of the total quality and reliability assurance program during the entire product life cycle. Specifying the management of this program is as important as specifying the values of the reliability parameters. This paper deals with the total reliability specification problem and concludes with a summary of contractual quality and reliability provisions which are important to an effective reliability assurance program. Author

A86-22394

DECISION MAKING IN PRODUCT ASSURANCE

R. NEOGY (INTELSAT, Palo Alto, CA) IN: Annual Reliability and Maintainability Symposium, Philadelphia, PA, January 22-24, 1985, Proceedings . New York, Institute of Electrical and Electronics Engineers, 1985, p. 203-207. refs

A decision-making method based on quantifying the risk assessment and cost of various options to assure product quality is discussed. The utilization of a failure data base and a cost-to-fail data base in the decision-making process is examined. A model scenario describing the analysis of a failure, cost assessment, and evaluation of alternatives, and revealing the applicability of the process is presented. $$\rm I.F.$$

A86-22402

IS THERE LIFE AFTER 10,000 FLIGHT HOURS?

T. M. EVANS and D. L. MERKORD (LTV Aerospace and Defense Co., Dallas, TX) IN: Annual Reliability and Maintainability Symposium, Philadelphia, PA, January 22-24, 1985, Proceedings . New York, Institute of Electrical and Electronics Engineers, 1985, p. 396-401.

(Contract N00019-80-G-0033; NAVY ORDER 0002)

The possibility of keeping an aircraft in service beyond the predetermined fatigue life limits of its structures is considered, with particular reference to the fleet of A-3 aircraft, which exceeded their wing design fatigue life of 10,000 flight hours. Fatigue test/analysis on an A-3 trainer model is described, including discussions of test requirements, development of the fatigue test loading spectrum, the test setup, and testing procedure. It was found that service life of A-3 fleet aircraft can be extended to 18,000 flight hours and 2000 catapults. The test data verified that theoretical analyses for service life extension are reliable when fatigue-test-derived maintainability items are applied.

A86-23009

PLANNING AND MONITORING RELIABILITY GROWTH IN ACCORDANCE WITH MIL-STDS AND HANDBOOKS

J. M. FINKELSTEIN (Hughes Aircraft Co., Fullerton, CA) IN: Institute of Environmental Sciences, Annual Technical Meeting, 31st, Las Vegas, NV, April 30-May 2, 1985, Proceedings . Mount Prospect, IL, Institute of Environmental Sciences, 1985, p. 283-287. refs

Reliability growth has become a regulated process for military systems developments. MIL-STD-785B and the proposed D revision to MIL-STD-781C place requirements on the planning, monitoring, and allocation of resources of reliability development growth tests (RDGT). Guidance for planning and monitoring of the RDGT is given in the proposed MIL-HDBK-781 and in MIL-HDBK-189. The most important requirements to be met by the plan for RDGT, are to integrate the RDGT into the overall system test plan and to achieve the specified reliability value in a specific calendar period. The handbooks provide guidance on using the AMSAA model for reliability growth to design the RDGT and analyze the data that results from the conduct of the RDGT. Additional methodology for incorporating a limiting reliability into the AMSAA model and planning and monitoring discrete trail RDGT programs are discussed. Author

A86-25866

HOW NASA PREPARED TO COPE WITH DISASTER

K. ESCH IEEE Spectrum (ISSN 0018-9235), vol. 23, March 1986, p. 32-36.

The present paper provides excerpts from an interview, conducted in March of 1982, taking into account two of the worst-case disaster scenarios which had been projected by NASA and Air Force planners for the Space Shuttle since the beginning of the program. Some insight is provided regarding the magnitude of the risks, giving attention to NASA's plans for coping with them. It was considered that the worst case would involve the event in which the Shuttle lifts off, and then at some higher altitude for some reason one of the solid rocket motors fails, and the vehicle pitches over toward the ground.

A86-32947#

THREAT-STRATEGY TECHNIQUE - A SYSTEM SAFETY TOOL FOR ADVANCED DESIGN

R. L. PEERCY, JR. and R. F. RAASCH (Rockwell International Corp., Space Transortation Systems Div., Downey, CA) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 23, Mar.-Apr. 1986, p. 200-206. Previously cited in issue 07, p. 868, Accession no. A85-19723. **A86-37479*** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

NAŠA STORM HAZARDS RESEARCH IN LIGHTNING STRIKES TO AIRCRAFT

B. D. FISHER, P. W. BROWN (NASA, Langley Research Center, Hampton, VA), and J. A. PLUMER (Lightning Technologies, Inc., Pittsfield, MA) IN: International Conference on the Aviation Weather System, 2nd, Montreal, Canada, June 19-21, 1985, Preprints . Boston, MA, American Meteorological Society, 1985, p. 152-160. refs

The lightning strike condition data gathered in the 1980-1984 period are presented, together with the lightning attachment point analysis for the NASA F-106B research aircraft are presented. The analysis of the experienced 637 direct lightning strikes shows that the highest strike rates (2.1 strikes/min and 13 strikes/penetration) occurred at altitudes between 38,000 and 40,000 ft. The regions of highest risk for an aircraft to experience a direct lightning strike were the areas of thunderstorms where the ambient temperature was colder than -40 C and where the relative turbulence and precipitation intensities were characterized as negligible to light. The presence and location of lightning, therefore, did not necessarily indicate the presence and location of hazardous precipitation and turbulence. The total onboard data show that the lightning attachment patterns on this aircraft fall into four general categories, although the 1984 data suggest that the entire surface of the F-106B may be susceptible to lightning attachment. LS.

A86-38317

AIRCRAFT GROUND SUPPORT EQUIPMENT STANDARDIZA-TION - THE PROS AND CONS OF 'FUNCTIONAL' VS 'TECH-NICAL' STANDARDIZATION

J. J. MACHON (Air France, Paris) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 14-17, 1985. 14 p.

(SAE PAPER 851794)

The main international bodies currently active in the fields of aircraft Ground Support Equipment (GSE) standardization are discussed, and an attempt is made to define what standardization should or should not be in this field. The activities of the ISO, SAE, and IATA are described, and their interlinks are shown. The classes of 'technical' standardization, which concerns design type specifications and purchasing type specifications, are addressed. The meaning of 'functional' specification, and how in practice it leads to a fairly effective worldwide GSE standardization, is considered. The way in which the market may respond to technical and functional standardization is discussed. C.D.

A86-38324* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

RETROFITTING AVIONICS - CLOSING THE PERFORMANCE 'GENERATION GAP'

C. R. SPITZER (NASA, Langley Research Center, Hampton, VA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 14-17, 1985. 7 p. refs

(SAE PAPER 851813)

The retrofitting of advanced avionics to in-service aircraft in order to increase operational safety and flexibility, and reduce operating costs is analyzed. Research in flight management planning and airborne guidance for full-and cost-effective flight is examined. The use of CRTs and thin film electroluminescent displays in aircraft is described. The development of more accurate and reliable fuel gauges using nuclear-based techniques or volumetric measurements to evaluate fluid levels is studied. Advances in airspace systems, such as the Microwave Landing System, and Air Traffic Control Beacon System/Select Mode, the Traffic Advisory and Collision Advance System, and satellite-based communications, navigation, and surveillance are discussed. I.F.

A86-43901#

TESTABILITY MANAGEMENT THROUGH MIL-STD-2165

W. L. KEINER (U.S. Navy, Naval Surface Weapons Center, Dahlgren, VA) IN: AUTOTESTCON '85; Proceedings of the International Automatic Testing Conference, Uniondale, NY, October 22-24, 1985. New York, Institute of Electrical and Electronics Engineers, 1985, p. 383-388.

MIL-STD-2165, 'Testability Program for Electronic Systems and Equipments', was issued on January 26, 1985. This new standard may be applied to all electronics developments within the Department of Defense. This paper discusses the role of the new military standard as a management tool for the development of testable electronic systems and equipments. A framework is presented for managing testability requirements tradeoffs, design tradeoffs, and testability evaluations. Author

A86-48371

AIRPORTS BUILD FOR FUTURE TRAFFIC AMID NEW SECURITY CONCERN

D. WOOLLEY Interavia (ISSN 0020-5168), July 1986, p. 763, 764, 767-770.

An evaluation is made of the financial, technical, commercial, and security-related factors currently influencing major international airport construction, renovation and expansion programs. Attention is given to such new technologies as mobile X-ray equipment for baggage inspection by the side of aircraft, automated handling of containerized baggage and freight, ground-movement radars, and large departures/arrivals display technology. Progress toward the detection of explosives and fire-arms by pencil-beam and two-beam X-ray machines is assessed. O.C.

A86-49084#

THE AIRLINE ENGINEERING ROLE IN THE MANAGEMENT OF SAFETY

D. K. CRAIG (British Airways, London, England) IN: ICAS, Congress, 15th, London, England, September 7-12, 1986, Proceedings. Volume 2 . New York, American Institute of Aeronautics and Astronautics, Inc., 1986, p. 1010-1016.

The paper outlines the contribution the Engineering Department of a major International Airline makes in the maintenance and enhancement of Safety Standards. The areas to be covered are: the innovaitive approaches to the identification of maintenance requirements; the progressive maintenance programmes for the future; the introduction of enhanced safety standards through the airlines; development of techniques such as Engine Health Monitoring, NDT and AIDS; and the improvements in quality standards of staff.

A86-49478

LONG ENDURANCE AIRCRAFT PERFORMANCE

P. MACCREADY (AeroVironment, Inc., Monrovia, CA) Unmanned Systems, vol. 4, Summer 1985, p. 31-33.

A comprehensive evaluation is made of the factors governing the design and achievable performance of ultralight long-endurance, unmanned aircraft for various vehicle sizes and mission profiles. The calculations and tabulations presented are based on a particular vehicle configuration tailored to long duration missions, whose glide ratio at the selected design speed is 27.6. Fossil fuel combustion is used by the powerplant, together with a variable-pitch propeller. It is noted that, for the case of a 100-lb payload, the vehicle would resemble a light, slightly enlarged sailplane; operations at 90,000 ft stress the importance of powerplant design, and call for exceptionally low wing loading.

O.C.

N86-15158*# McDonnell-Douglas Astronautics Co., Houston, Tex.

IMPLEMENTING QUALITY/PRODUCTIVITY IMPROVEMENT INITIATIVES IN AN ENGINEERING ENVIRONMENT

R. R. RUDA *In* NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 1-9 1985 refs

Avail: NTIS HC A25/MF A01 CSCL 05A

Quality/Productivity Improvement (QPI) initiatives in the engineering environment at McDonnell Douglas-Houston include several different, distinct activities, each having its own application, yet all targeted toward one common goal - making continuous improvement a way of life. The chief executive and the next two levels of management demonstrate their commitment to QPI with hands-on involvement in several activities. Each is a member of a QPI Council which consists of six panels - Participative Management, Communications, Training, Performance/Productivity, Human Resources Management and Strategic Management. In addition, each manager conducts Workplace Visits and Bosstalks, to enhance communications with employees and to provide a forum for the identification of problems - both real and perceived. Quality Circles and Project Teams are well established within McConnel Douglas as useful and desirable employee involvement teams. The continued growth of voluntary membership in the circles program is strong evidence of the employee interest and management support that have developed within the organization. Author

N86-15160*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.

SELF-RENEWAL: A STRATEGY FOR QUALITY AND PRODUCTIVITY IMPROVEMENT

D. H. HUTCHINSON *In* NASA. Johnson (Lyndon B.) Space Center R and D Productivity: New Challenges for the US Space Program p 18-31 1985 refs

Avail: NTIS HC A25/MF A01 CSCL 14D

Productivity improvement is discussed. The concept of productivity improvement is supplemented with two additional concepts of productivity improvement: effectiveness and innovation. Case studies are provided to illustrate concepts. R.J.F.

N86-19636*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NONDESTRUCTIVE TECHNIQUES FOR CHARACTERIZING MECHANICAL PROPERTIES OF STRUCTURAL MATERIALS: AN OVERVIEW

A. VARY and S. J. KLIMA Dec. 1985 21 p refs Proposed for presentation at the 31st International Gas Turbine Conference, Dusseldorf, West Germany, 8-12 Jun. 1986; sponsored by ASME (NASA-TM-87203; E-2858; NAS 1.15:87203) Avail: NTIS HC A02/MF A01 CSCL 14D

An overview of nondestructive evaluation (NDE) is presented to indicate the availability and application potentials of techniques for quantitative characterization of the mechanical properties of structural materials. The purpose is to review NDE techniques that go beyond the usual emphasis on flaw detection and characterization. Discussed are current and emerging NDE techniques that can verify and monitor entrinsic properties (e.g., tensile, shear, and yield strengths; fracture toughness, hardness, ductility: elastic moduli) and underlying microstructural and morphological factors. Most of the techniques described are, at present, neither widely applied nor widely accepted in commerce and industry because they are still emerging from the laboratory. The limitations of the techniques may be overcome by advances in applications research and instrumentation technology and perhaps by accommodations for their use in the design of structural parts. Author

N86-19638# Technische Hogeschool, Delft (Netherlands). Dept. of Mechanical Engineering.

DEVELOPMENTS IN QUALITY CONTROL [DE ONTWIKKELING VAN DE KWALITEITSBEHEERSING]

M. A. A. KOOTER 31 Oct. 1983 51 p refs In DUTCH (REPT-186) Avail: NTIS HC A04/MF A01

Developments of quality control and in particular the role of workers and quality managers in it, were surveyed. An increase in demands for quality from the outside (market shift), preventive quality care efficiency, and employee requests for more responsibility are discerned. A motivation improvement by decentralization, consciousness awakening, participation, and self-(quality)control in the production sector is pursued. Quality section tasks are shifted to the control and support of this self-control. Results are cost reduction and product improvement. Certification as a result of acknowledged quality control consolidates competitivity. Author (ESA)

N86-20047# Stanford Univ., Calif. Lab. for Computational Statistics.

THE BOOTSTRAP METHOD FOR ASSESSING STATISTICAL ACCURACY

B. EFRON and R. TIBSHIRANI Oct. 1985 57 p (Contract N00014-83-K-0472)

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(AD-A161257; LCS-TR-19) Avail: NTIS HC A04/MF A01 CSCL 12A

This is an invited review of bootstrap methods. It begins with an exposition of the bootstrap estimate of standard error for one-sample situations. Several examples, some involving quite complicated statistical procedures, are given. The bootstrap is then extended to other measures of statistical accuracy, like bias and prediction error, and to complicated data structures such as time series, censored data, and regression models. Several more examples are presented illustrating these ideas. The last third of the paper deals mainly with bootstrap confidence intervals. The paper ends with a FORTRAN program for bootstrap standard errors. GRA

N86-24256# Northwestern Univ., Evanston, III. Dept. of Mechanical and Nuclear Engineering.

COMPUTER-AIDED ENGINEERING

H. H. FONG, F. M. SKALAK, W. K. LIU, J. Y. LEUNG, and K. H. HSU 26 Jun. 1985 6 p Presented at Pressure Vessels and Piping Conference and Exhibition, New Orleans, La 23-26 Jun. 1985

(AD-A162811; AFOSR-85-1108TR) Avail: NTIS HC A02/MF A01 CSCL 09B

The procedures for analog Monte Carlo simulation of Markov processes are examined. Two variance reduction techniques are then included in a nonanalog formulation to increase the sampling efficiency for highly reliable systems, and a method for incorporating uncertainty in failure and repair rate data is outlined. Models for three classes of component dependencies appearing in reliability and availability problems are incorporated into the Markov formulation. They are: (1) shared repair crews between components, (2) load sharing between components, and (3) standby mode. Results are given for a series of model problems to demonstrate the efficiency of the methods as well as the effects of the dependencies on system unreliability and unavailability.

GRA

N86-26239# National Bureau of Standards, Gaithersburg, Md. Center for Basic Standards.

TECHNICAL ACTIVITIES 1983, CENTER FOR BASIC STANDARDS

K. G. KESSLER Oct. 1985 331 p

(PB86-140043; NBSIR-85/3254) Avail: NTIS HC A15/MF A01 CSCL 14B

The research and technical activities of the Center for Basic Standards during the Fiscal Year 1985 are summarized. These activities include work in the areas of electricity, temperature and pressure, mass and length, time and frequency, quantum metrology, and quantum physics. GRA N86-26276*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

LANGLEY AEROSPACE TEST HIGHLIGHTS, 1985 May 1986 100 p

(NÁSA-TM-87703; NAS 1.15:87703) Avail: NTIS HC A05/MF A01 CSCL 05A

The role of the Langley Research Center is to perform basic and applied research necessary for the advancement of aeronautics and space flight, to generate new and advanced concepts for the accomplishment of related national goals, and to provide research advice, technological support, and assistance to other NASA installations, other government agencies, and industry. Significant tests which were performed during calendar year 1985 in Langley test facilities, are highlighted. Both the broad range of the research and technology activities at the Langley Research Center and the contributions of this work toward maintaining United States leadership in aeronautics and space research, are illustrated. Other highlights of Langley research and technology for 1985 are described in Research and Technology-1985 Annual Report of the Langley Research Center.

N86-26359# SoHaR, Inc., Los Angeles, Calif. RELIABILITY PREDICTION FOR SPACECRAFT Final Report, Mar. 1983 - Jan. 1985

H. HECHT and M. HECHT Dec. 1985 152 p

(Contract F30602-83-C-0018)

(AD-A164747; RADC-TR-85-229) Avail: NTIS HC A08/MF A01 CSCL 22B

This study provides the basis for improving the utility of Mil-Hdbk-217 for reliability prediction of spacecraft components and systems. The reliability performance histories of 300 satellite vehicles, which were launched between the early 1960's through Jan. 84, were reviewed and analyzed during the course of the study. Analysis of over 2500 reports of malfunctions indicated strong evidence of a decreasing failure rate with time in orbit. The cause for the decreasing hazard was found to be traceable primarily to design and environmental causes. In general, however, it was found that current predictions overestimate the failure rate by at least a factor of two and that the excess of predicted over observed failures increases with time in orbit. Three methods are provided for spacecraft reliability prediction. In order to account for the decreasing hazard, two of the procedures use a Weibull model with parameters based upon similar spacecraft mission types. A third method uses modifications of Mil-Hdbk-217 procedures to account for the overestimation of failure rates which result when current procedures are used. GRA

N86-26409# National Bureau of Standards, Gaithersburg, Md. Office of Standard Reference Data.

STANDARD REFERENCE DATA PUBLICATIONS, 1964-1984 J. C. SAUERWEIN and G. R. DALTON Dec. 1985 147 p (PB86-155587; NBS-SP-708; LC-85-600607) Avail: NTIS HC A07/MF A01; also available SOD \$5.00 as SN003-003-02705-7 CSCL 07D

The National Bureau of Standards' Office of Standard Reference Data manages a network of data centers that prepare evaluated data bases of physical and chemical properties of substances. Data bases are available in printed form, on magnetic tapes and through on-line computer networks. This document provides a comprehensive list of the products available from the National Standard Reference Data System (NSRDS) for the years 1964 to 1984, including indexes qualified by author, material, and property terms. Ordering information and current prices can be found at the end of this document. GRA

N86-31548*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NASA'S AIRCRAFT ICING ANALYSIS PROGRAM

R. J. SHAW 1986 26 p Presented at the International Conference of the Aeronautical Sciences (ICAS), London, England, 7-12 Sept. 1986

(NASA-TM-88791; E-3121; NAS 1.15:88791) Avail: NTIS HC A03/MF A01 CSCL 01C

An overview of the NASA ongoing efforts to develop an aircraft icing analysis capability is presented. Discussions are included of the overall and long term objectives of the program as well as current capabilities and limitations of the various computer codes being developed. Descriptions are given of codes being developed to analyze two and three dimensional trajectories of water droplets, airfoil ice accretion, aerodynamic performance degradation of components and complete aircraft configurations, electrothermal deicer, fluid freezing point depressant antideicer and electro-impulse deicer. The need for bench mark and verification data to support the code development is also discussed, and selected results of experimental programs are presented. Author

N86-32418# General Accounting Office, Washington, D. C. Resources Community and Economic Development Div.

AIR SAFETY: FEDERAL AVIATION ADMINISTRATION'S ROLE IN DEVELOPING MID-AIR COLLISION AVOIDANCE BACK-UP SYSTEMS

Apr. 1986 19 p

(PB86-197506; GAO/RCED-86-105FS; B-222851) Avail: NTIS HC A02/MF A01 CSCL 01B

This FAA report on the development of mid-air collision avoidance back-up systems contains the following: Airborne collision avoidance system availability; Difference between the traffic alert and collision avoidance system and the beacon collision avoidance system; Traffic alert and collision avoidance system projected commercial availability date; Airborne collision avoidance system and threat alert and collision avoidance system cost and effectiveness. GRA

N86-32660# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Product Assurance Div.

THE QUALIFICATION AND PROCUREMENT OF TWO-SIDED PRINTED CIRCUIT BOARDS (FUSED TIN-LEAD OR GOLD PLATED FINISH)

Oct. 1985 81 p

(ESA-PSS-01-710-ISSUE-1; ISSN-0379-4059; ETN-86-97797) Avail: NTIS HC A05/MF A01

Requirements for evaluation, qualification, and procurement of two-sided printed-circuit boards with fused tin-lead or gold-plated finish by ESA are defined. The mandatory test methods are described, and details of accept/reject criteria are given. ESA

N86-32766# Stanford Univ., Calif. Dept. of Statistics. SURVEY OF SOVIET WORK IN RELIABILITY A. L. RUKHIN 29 Apr. 1986 21 p (Contract N00014-76-C-0475) (AD-A167607; TR-373) Avail: NTIS HC A02/MF A01 CSCL 14D

We review the research of the Soviet school in reliability theory for the last twenty years. The main subjects under review are complex systems and their reliability, families with monotone failure rate, optimal maintenance and control, and statistical problems of reliability theory (121 defs.). GRA

LEGALITY, LEGISLATION, AND POLICY

Includes Laws and Legality, Insurance and Liability, Patents and Licensing, Legislation and Government, Regulation, Appropriations and Federal Budgets, Local, National, and International Policy.

A86-11023

SPACE WARC '85 - A LOOK BACK

A. L. MOORE and H. RADIN (Satellite Systems Engineering, Inc., Bethesda, MD) Satellite Communications (ISSN 0147-7439), Nov. 1985, p. 67, 68, 70.

A review of the World Administrative Conference on the Use of Geostationary Orbit and Planning of Space Services is provided. Representatives from 112 nations including developing countries participated in the conference. The discussions between developed and developing countries over guaranteed access to the geostationary orbit, sovereignity over the geostationary orbit above the territorial rights, and the planning of services and number of bandwidths to be used is described. The conclusions reached are given; a compromise between the developed and developing nations was achieved. The U.S.'s reservations about certain limitations in the Final Acts of the conference are discussed. Some topics which were not resolved at the conference are presented.

A86-15663#

FUTURE WORLD METEOROLOGICAL SATELLITE SYSTEMS

E. L. HEACOCK (NOAA, Rockville, MD), IU. A. AFANASEV (Gosudarstvennyi Nauchno-Issledovatel'skii Tsentr Izucheniia Prirodnykh Resursov, Moscow, USSR), C. HONVAULT (ESA, Paris, France), T. YOSHIDA (Meteorological Satellite Center, Japan), and U. V. GOPALA RAO (Directorate of Satellite Meteorology, India) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 12 p.

(IAF PAPER 85-87)

As a result of the activity of the NOAA, ESA, the USSR State Research Center for Natural Resources Exploration, Japan's Meteorological Satellite Center, and India's Directorate of Satellite Meteorology, a system of world weather satellites provides weather and environmental data for more than 120 countries. Each agency makes decisions that control the type and quantity of data available to the world for the remainder of this century. The environmental and meteorological systems in operation (Meteor-2, Meteosat, POES, and GOES), the experimental satellites (Kosmos-1500, Kosmos-1602, and Japan's GMS-4), and future plans for the meteorological systems of the U.S., ESA, Japan, and the USSR are described. In particular, the developmental details of Japan's GMS include provision of hourly observations which will cover global area from 50 deg N to 10 deg N, and replacement of the analog HR-FAX mode of operation by the digital stretched VISSR mode. The planned advances in USSR's Kosmos satellites include an increased number of parameters to be measured, increased accuracy and higher spatial resolution of the images, and more efficient data handling. LS.

A86-15903*#

TECHNOLOGY PROGRAMS AND RELATED POLICIES -IMPACTS ON COMMUNICATIONS SATELLITE BUSINESS VENTURES

J. S. GREENBERG (Princeton Synergetics, Inc., Princeton, NJ) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 13 p. NASA-sponsored research. (IAF PAPER 85-433)

The DOMSAT II stochastic communication satellite business venture financial planning simulation model is described. The specification of business scenarios and the results of several analyses are presented. In particular, the impacts of NASA on-orbit propulsion and power technology programs are described. The effects of insurance rates and self-insurance and of the use of the Space Shuttle and Ariane transportation systems on a typical fixed satellite service business venture are discussed. C.D.

A86-15905#

INSURANCE FOR SPACE VENTURES

B. STOCKWELL (Corroon and Black Inspace, Inc., Washington, DC) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 11 p.

(IAF PAPER 85-435)

The coverage currently provided and necessary changes for the insurance of commercial space missions are studied. The 17 percent increase in launch insurance rates, the limited number of underwriters, and the strict policy terms that have resulted from numerous space mission failures are discussed. The coverages currently available are: (1) transit and storage, (2) launch delay, (3) third-party liability, (4 launch and commissioning, (5) in-orbit, and (6) political risk. The separation of launch risk into a vehicle and a spacecraft phase is analyzed. The need for additional policies to cover the new payloads being marketed, and increasing premiums have led to the development of a new means of providing insurance. Alternative means of supplying coverage which include the partition of risks in order to introduce more underwriters into the market, the formation of a cooperative by a pool of users who collectively self-insure the first loss in a series of launches, and the formation of a cooperative by the launch service vendor are being investigated. LE.

A86-15941#

ANTHROPOLOGY AND THE HUMANIZATION OF SPACE

B. R. FINNEY (Hawaii, University, Honolulu) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 16 p. refs

(IAF PAPER 85-497)

The role of anthropology in the colonization of space is studied. Some problems that would be encountered in space living such as, isolation from earth, family, and friends, small living space, psychological strain, and interaction of heterogenous groups are described. The understanding of various cultures in order to have successful space living is discussed; the need for good cross-cultural relations in heterogenous space crews and the use of earth practices and institutions in space is analyzed. New cultures and societies will evolve to adapt to extraterrestrial environments once man settles space; the problems of reproduction and demographics are investigated. The application of anthropology to human expansion into space, taking into account possible contact with extraterrestrials, is discussed.

A86-15942#

GOVERNMENT IN ACTION - THE ROLE OF POLITICAL SCIENCE IN OUTER SPACE ACTIVITIES

E. GALLOWAY (International Academy of Astronautics; International Institute of Space Law, Washington, DC) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 8 p. refs

(IAF PAPER 85-498)

In this paper political science is examined as one of the social sciences in the context of the impact of science and technology on society. The ways in which political science concepts are involved in multidisciplinary space projects are explained by examples from U.S. experience, particularly when decisions were made in 1957-58 on organization of the government for conducting space activities. Analysis is made of the roles in space activities of the President, Vice President, Executive agencies, and the Congress (Senate and House of Representatives).

A86-15943#

ECONOMIC EQUITY AND INTERNATIONAL COOPERATION - THE EXAMPLE OF E.S.A

J. M. CONTANT (Aerospatiale, Direction Generale, Paris, France), G. DONDI (ESA, Contracts Dept., Paris, France), E. IGENBERG (Muenchen, Technische Universitaet, Munich, West Germany), and J. PH. BOISSIN (Paris IX, Universite, France) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 10 p. refs

(IAF PAPER 85-499)

An interactive multicriteria evaluation model is used to assess the advantages accruing to European countries involved in space activities through the European Space Agency. The advantages are defined in both financial and nonfinancial terms, and the relative position of a group of countries is introduced. A disaggregative approach is used to estimate the relative importance of each criterion, and a series of evaluation functions are determined. Using these intermediate results, the advantages derived by ESA member states at the end of 1984 are assessed using an aggregative approach, and the consistency of the evaluation criteria is verified. C.D.

A86-17743

INTERNATIONAL COOPERATION AND COMPETITION IN CIVILIAN SPACE ACTIVITIES

R. A. WILLIAMSON (Office of Technology Assessment, Washington, DC) Space Policy (ISSN 0265-9646), vol. 1, Nov. 1985, p. 409-414. refs

This article considers how the U.S.A. can best maintain its commercial and governmental competitiveness in space, while facilitating private investment and international marketing, and at the same time keeping up significant cooperation with other nations. The current state of U.S. civilian space activities in each of these areas is summarized, and several alternative solutions are presented. The article concludes that strengthening U.S. competition with other space-capable nations, and improving U.S. ability to cooperate effectively, will require careful coordination of the activities of federal agencies with each other and with the private sector. Author

A86-18368

SPACE LAW CHALLENGED

D. D. SMITH (Schnader, Harrison, Segal and Lewis, Washington, DC) Space (ISSN 0267-954X), vol. 1, Sept. 1985, p. 23, 43.

The development of new agreements in order to promote international and regional cooperation in the development of space for scientific and commercial purposes is examined. The inabilities of existing space policies and laws to address the concerns arising from the use of the Space Shuttle are described. The need to establish terms by which participating and nonparticipating nations will have access to the Space Shuttle's facilities are discussed. An interpretation of liability laws in regard to Space Shuttle issues is presented.

A86-18381

HUMAN DEVELOPMENT AND THE CONQUEST OF SPACE

S. A. HEMPENIUS and C. VOUTE (International Institute for Aerial Survey and Earth Sciences, Enschede, Netherlands) Space Policy (ISSN 0265-9646), vol. 1, May 1985, p. 179-186. refs

Space age ethics are to be distinguished as a separate set of ethical concepts for several reasons: outer space constitutes a unifying element for mankind; the unique space environment has an international statute; and the impact of space science and the utilization of space technology will always have both positive and negative international consequences and repercussions. Its main objective is an immaterial output-related activity and much of its waste is equally immaterial. Space technology carries another hazard with it the danger of domination by extrovert cultures. Proper development of space technology requires international cooperation, scientific creativity and technological innovation combined with sociopolitical, economic and cultural aims and objectives and ethical values. Norms and objectives have to take into account religious concepts, humanistic viewpoints and

sociocultural criteria. The ethics of the conquest of space have to consider the benefit of all mankind and that of each single individual, group and society as complementary and of equal importance. Author

A86-18384

US SPACE COMMERCIALIZATION - EFFECTS ON SPACE LAW AND DOMESTIC LAW

H. R. MARSHALL, JR. (U.S. Department of State, Bureau of Oceans and International Environmental and Scientific Affairs, Washington, DC) Space Policy (ISSN 0265-9646), vol. 1, May 1985, p. 204-210.

American attitudes and legislation concerning the commercialization of space are briefly reviewed. Emphasis is given to the privatization policy of the Reagan administration and its potential for causing conflicts between private space users and international space law. Efforts to privatize the Landsat program and expendable launch vehicle (ELV) development are discussed in detail.

A86-18389

THE USSR AND SATELLITE COMMUNICATIONS COMPETITION AND COOPERATION

J. D. H. DOWNING (Hunter College, New York) Space Policy (ISSN 0265-9646), vol. 1, Aug. 1985, p. 250-262. refs

This article examines the USSR's satellite communications provision in the international arena. First outlined are the Intercosmos programme, collaboration between the USSR and France and India, and maritime satellite communications. Then discussed in detail are the INTERSPUTNIK system, and Soviet International coverage and competitiveness in television. In conclusion, the complex interaction and overlap between cooperation and competition in space is explained. Author

A86-18392

THE PARTICIPATION OF DEVELOPING COUNTRIES IN SPACE RESEARCH

J. G. ROEDERER (Alaska, University, Fairbanks) Space Policy (ISSN 0265-9646), vol. 1, Aug. 1985, p. 311-317.

The Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (Unispace 82) identified crucial problems and made recommendations on strategies for developing countries to bridge the gap with advanced nations in the area of space technology. This article addresses some issues which, although implicit in the Unispace Report, are not discussed in detail therein. The role of space science and related scientific research is particularly emphasized. Close attention is paid to the role of human factors, such as the motivation to conduct research, the motivation to engage in international cooperation, and the motivation to utilize and exploit space. Possible opportunities for space research for developing countries, as well as relevant issues concerning management of space, are briefly discussed. Author

A86-18394

INTELSAT AND THE CHALLENGE OF COMPETITIVE SYSTEMS

J. N. PELTON (INTELSAT, Washington, DC) Space Policy (ISSN 0265-9646), vol. 1, Aug. 1985, p. 322-329. refs

Intelsat represents an intergovernmental international organization, established under two international treaties. Intelsat, which has a membership of 109 countries, provides services to 165 different countries and territories around the world. It is pointed out that Intelsat does not have a monopoly on international telecommunications. Current forms of competitions are discussed. taking into account the problems posed by a totally unregulated and competitive market in international telecommunications. Attention is given to the issue of Intelsat's own accountability, the U.S. policy of deregulation, Intelsat's technological and service innovations record, the future potential of the Intelsat Business Service, the need to provide effective interconnection to fiber optic systems, the achievement of global interconnectivity, and an evaluation of Intelsat's performance. G.R

A86-18848

RECENT DEVELOPMENTS IN AVIATION CASE LAW

W. D. CARTER, JR. (Fulbright and Jaworski, Houston, TX) Journal of Air Law and Commerce (ISSN 0021-8642), vol. 51, no. 1, 1985, p. 51-118. refs

A review of cases pertaining to recent aviation decisions is presented. Cases regarding federal subject matter, jurisdiction, personal jurisdiction, death in aircraft crashes in water, and federal removal are analyzed. Governmental liability and exception are studied. Cases concerning air carrier liability, including products damage and negligence, are examined. The applicability of the Warsaw Convention to notice of claims, limitation on liability, and damage recovery is investigated. General, and pilot qualification and airworthiness certificate insurance exclusions are discussed. Cases involving damage and the calculation of damage incurred in an aircraft accident are described.

A86-19261

MANAGEMENT OF OUTER SPACE

L. PEREK (Ceskoslovenska Akademie Ved, Astronomicky Ustav, Prague, Czechoslovakia) Earth-Oriented Applications of Space Technology (ISSN 0277-4488), vol. 5, no. 3, 1985, p. 247-252. refs

The control of outer space is necessary in order to protect space activities and the earth environment and to foster international cooperation. Existing United Nations regulations regarding jurisdiction, damage responsibility, announcement of launches, and enviromental pollution are examined. The roles of the International Telecommunication Union in monitoring space communications and nongovernmental organizations in controlling space studies ranging from astrodynamics to biology are described. Proposed methods of tracking satellites, reducing collision probability especially in geostationary orbit, and preventing pollution of the ground, and the high and low atmosphere are analyzed.

I.F.

A86-19861#

NATIONAL AND INTERNATIONAL COOPERATION IN REMOTE SENSING AND APPLICATIONS

R. J. KEATING (NOAA, National Environmental Satellite, Data, and Information Service, Washington, DC) AIAA, Aerospace Sciences Meeting, 24th, Reno, NV, Jan. 6-9, 1986. 8 p.

(AIAA PAPER 86-0412)

This paper provides an overview of the United States remote sensing satellite systems and how they complement those of our foreign partners. In addition, the paper describes the international cooperative efforts to achieve complementarity and compatibility of these satellite systems. Specific uses of the data and their applications are described. Author

A86-21123#

THE NEEDS OF DEVELOPING COUNTRIES IN THE APPLICATION OF SATELLITE TECHNOLOGY FOR DISASTER MANAGEMENT

C. VOUTE (International Institute for Aerospace Survey and Earth Sciences, Enschede, Netherlands) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1 . Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 247-261. refs

The possible use of space technology for disaster management is discussed in terms of disaster prevention, disaster preparedness and disaster relief operations, with emphasis on remote sensing applications. Specific needs of developing countries are identified. It is suggested that remote sensing imagery should not only be used for disaster prevention measures, disaster preparedness planning and damage assessment in case of emergencies, but also for audio-visual training programs and for on-site information of relief workers. Author

10 LEGALITY, LEGISLATION, AND POLICY

A86-21126#

USE OF SATELLITE DATA IN INTERNATIONAL DISASTER MANAGEMENT THE VIEW FROM THE U.S. DEPARTMENT OF STATE

L. A. ROSE (U.S. Department of State, Bureau of Oceans and International Environmental and Scientific Affairs, Washington, DC) and P. F. KRUMPE (Agency for International Development, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings. Volume 1 . Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 301-306.

Requirements are elaborated that must be met in a joint program wherein the U.S. Department of State and the U.S. Agency for International Development are actively exploring ways of using satellite data in emergency preparedness and disaster warning worldwide. Considerations that must be taken into account include: the limits of satellite technology and data in providing effective disaster warning; the fact that cost and competing claims on national resources do not permit research and development specifically targeted at creation of disaster early warning capabilities for satellites; the need of disaster-prone nations to provide substantial resources of their own to ensure that satellite warnings reach the affected areas in time; the continuing impossibility of precise prediction of natural disasters; and the long lead-time to establish a truly global disaster warning system. D.H.

A86-22242

EUROPE - TOWARDS A NEW LONG-TERM PROGRAMME

R. GIBSON Space Policy (ISSN 0265-9646), vol. 1, Feb. 1985, p. 3-6.

The establishment of a new space program for Europe by the European Space Agency (ESA) is examined. The funding of mandatory and optional programs by the ESA is discussed. Budgetary allocations for programs in the areas of science, telecommunications, earth observations, microgravity research, support technology, launchers, and orbiting capacity are studied. The different views of ESA members on the development of launchers and in-orbit infrastructures are analyzed. The involvement of ESA in the U.S. Space Station program or development of a program independently is investigated.

A86-22244

INTERNATIONAL INVOLVEMENT IN THE US SPACE STATION PROGRAMME

J. M. LOGSDON (George Washington University, Washington, DC) Space Policy (ISSN 0265-9646), vol. 1, Feb. 1985, p. 12-25. refs

This article considers the issues surrounding the nature and extent of involvement in the U.S. space station initiative. The motives and objectives of U.S. cooperation with its allies are analyzed from the perspective of both the USA and its potential partners. Guidelines for the forthcoming negotiations between these parties are elaborated through a review of past experience in international space cooperation. Developing a framework for collaboration will require significant trade-offs and will have to accommodate a number of not always consistent interests.

Author

A86-24122

UNDERWRITERS WORLDWIDE INCURRED \$600 MILLION IN UNEXPECTED LOSSES, SIGNIFYING CHANGES AHEAD IN SPACE INSURANCE

H. J. COLEMAN Commercial Space (ISSN 8756-4831), vol. 1, Fall 1985, p. 61-63, 65.

The effect of satellite losses on insurability and space commercialization is examined. The possibility of government intervention is discussed; however, most groups including NASA do not support government involvement. New plans for insuring space projects are proposed; one method is for manufacturers to fund their own insurance. The changes in insurance policy terms, the excessive premiums of 17-20 percent, and the shortages in insurance availability will impact on the number of space projects being

developed. The need for improved technical designs and test requirements in order for the insurance companies to risk providing coverage is investigated. The use of third-party legal liability insurance is analyzed. I.F.

A86-24127

FUTURE SPACE GOALS - NATIONAL COMMISSION DEFINES U.S. OPTIONS FOR THE 21ST CENTURY

A. LAWLER Commercial Space (ISSN 8756-4831), vol. 1, Fall 1985, p. 88, 89, 91.

The objectives of the National Commission on Space are discussed. The need for proper infrastructure in order to implement a national space policy is examined. Methods of integrating industry into national space programs and encouraging commercialization are analyzed. NASA current function in space development and its role following the commission's proposals are investigated.

I.F.

A86-24598#

THE EVOLUTION OF THE AGENCY'S PATENT POLICY R. OOSTERLINCK (ESA, Directorate of Administration, Paris,

France) ESA Bulletin (ISSN 0376-4265), no. 44, Nov. 1985, p. 80-83.

The development of ESA's current 'license policy' for patents is discussed. Evolving out of the ESRO and ELDO policies which it took over, the ESA guidelines reflect the ESRO promotion of space applications for industry and the ELDO concern with the protection of information against nonpeaceful applications. Specifically, the contractor retains title to his patents but must grant a license to ESA and its member states to be used for their purposes in the field of space research and technology, and must pay ESA royalties for any other exploitation. In addition, the Agency may take title to an invention if the subcontractor abandons or declines to patent it; the subcontractor is not obliged to license his background patents to others, and he will be indemnified if he agrees to third party reproduction; and in-house inventions are Agency-owned with incentive rewards for the inventor. R.R.

A86-24675

INTERNATIONAL SPACE LAW AND DIRECT BROADCAST SATELLITES

H. M. WHITE, JR. (North Carolina, University, Chapel Hill) and R. LAURIA Space Communication and Broadcasting (ISSN 0167-9368), vol. 3, Dec. 1985, p. 321-335. refs

Legal principles for space communications are discussed in terms relating to direct broadcast satellites (DBSs). The resolutions and documents of the Legal and Scientific and Technical Subcommittees of the Committee on the Peaceful Use of Outer Space which are to deal with all space related issues, the Interational Telecommunication Union which is to establish guidelines and criteria to maximize space communications and DBSs, and the DBS Working Group which reports on the technical feasibility of communicating with DBSs, are examined. Various proposals regarding the development of technical procedures, international cooperative arrangements, and guiding principles for the application of DBSs are investigated. The issues of suppremacy of national sovereignty and requirement of prior consent versus the supremacy of personal sovereignty and the principle of free flow of information, which are major unresolved issues regarding the use of DBSs, are analyzed. 1 F

A86-26546

SPACE LAW IN THE UNITED NATIONS

M. BENKO, W. DE GRAAFF, and G. C. M. REIJNEN Dordrecht, Martinus Nijhoff Publishers, 1985, 275 p. refs

Problems relating to the peaceful uses of outer space currently being debated in the United Nations are analyzed from a technological and legal aspect. The remote sensing of the earth with satellites for meteorological, and earth resources, and military applications is discussed. The difficulties in establishing principles on remote sensing due to disagreements on the access to and the dissemination of the data are examined. Existing nuclear power sources and present deliberations in the U.N. are described. U.N. discussions concerning the delimitation of outer space, outer space activities, and the utilization of the geostationary orbit are studied. Existing or planned military systems for outer space, treaties governing the militarization of outer space, and proposed measures on the prevention of an arms race in outer space are reviewed.

I.F.

A86-27877#

THE NEW SPACE RACE - REMARKS

J. GREY (AIAA, New York) IN: Space, our next frontier; Proceedings of the Conference, Dallas, TX, June 7, 8, 1984. Dallas, TX, National Center for Policy Analysis, 1985, p. 21-24.

An evaluation is made of the U.S. posture in the emerging international competition for preeminence in launch vehicle and profitability, telecommunications capability satellite performance capabilities, space industrialization, etc. Analogies are drawn between European and Japanese approaches to electronics and commercial aircraft development in the past and their current efforts toward commercial exploitation of satellite-launching systems. The need for U.S. regulatory organizations to reconsider existing antitrust legislation in order to facilitate competitive response to this challenge by U.S. industries is noted. Innovative contractual arrangements among research and development organizations are suggested. O.C.

A86-27881#

CAPITALISM AND DEMOCRACY ON THE HIGH FRONTIER

A. DULA (Dula, Shields and Egbert, Houston, TX) IN: Space, our next frontier; Proceedings of the Conference, Dallas, TX, June 7, 8, 1984 . Dallas, TX, National Center for Policy Analysis, 1985, p. 93-106.

Outer space is the latest spiritual and economic frontier to challenge free enterprise capitalism. Before business can develop the vast resources of space for the benefit of all humanity, a simple and flexible legal regime must evolve to authorize and supervise commercial space activities. This article outlines present space activities and speculates on what space industry could accomplish by the year 2020. The framework of existing law that influences business in space is examined, with special reference to the history of the first private spaceflight. A few policy suggestions, emphasizing minimum regulation, are offered to promote the growth of commercial space activities.

A86-27883#

SPACE LAW - THE DISILLUSIONED MAIDEN IN THE MILITARY GARDEN OF EDEN

G. S. ROBINSON (Smithsonian Institution, Washington, DC) IN: Space, our next frontier; Proceedings of the Conference, Dallas, TX, June 7, 8, 1984 . Dallas, TX, National Center for Policy Analysis, 1985, p. 118-126.

The Outer Space Treaty of 1967 'set forth essential legal principles applicable to outer space activities in an enlightened fashion that has no precedent in any previous age of exploration'. This paper explores the numerous interpretations of the Treaty which treat it as though it were a precisely drafted legal document with the underlying spirit and intent disfranchised from consideration in those interpretations, particularly as they relate to the military use of space. The paper also examines the military-private sector relationship in developing space capabilities, and probes the possibilities of the private sector riding the coattails of the military into space to: (1) exploit indigenous resources through the principles of private enterprise, and (2) inculcate the military movement into space with underlying values deeper in context and broader in scope than those normally attendant to military tactical planning. Author

A86-27888#

SPACE COMMERCIALIZATION - AN AMERICAN CASE STUDY IN DENATIONALIZATION

C. STADD (Starstruck, Inc., Washington, DC) IN: Space, our next frontier; Proceedings of the Conference, Dallas, TX, June 7, 8, 1984 . Dallas, TX, National Center for Policy Analysis, 1985, p. 255-258.

The U.S. Federal government does not contest the right of private organizations to send vehicles into outer space as part of profit-making enterprise, as long as measures are taken to safeguard national security and public safety, as well as any international liability problems that may ensue. It is presently suggested that existing laws, regulations, and agencies are sufficient to provide the necessary overview. With the creation of the Office of Commercial Space Transportation by Presidential order, and the recent congressional passage of statutes designating the Department of Transportation as lead agency, regulatory mechanisms will begin to fade as a primary impediment in the policy area to commercial efforts toward space industrialization.

O.C.

A86-28582

ESA SPACE STATION PLANNING

J. COLLET (ESA, Directorate of Space Transportation Systems, Paris, France) IN: Europe/United States space activities . San Diego, CA, Univelt, Inc., 1985, p. 97-103. (AAS 85-113)

The evolution of the European Space Station program, Columbus, is briefly described. Considerations is given to the technical issues addressed during the planning phase of the initial Columbus Preparatory Program (CPP), including: the preliminary cost and schedule baselines for development and operation of Columbus hardware; design definition with respect to the pressurized module (PM) and supporting platforms of the Columbus Space Station; and the design of servicing vehicles and resource modules (RMs) to support PM operations in the free-flying mode. The role of cooperative agreements between ESA and NASA in the development of preliminary Columbus Space Station designs is also discussed. I.H.

A86-28583

JAPANESE POLICY ON PARTICIPATION IN THE SPACE STATION PROGRAM

T. MORI (Science and Technology Agency, International Space Affairs Div., Tokyo, Japan) IN: Europe/United States space activities . San Diego, CA, Univelt, Inc., 1985, p. 105-112. (AAS 85-114)

Some of the ways that Japan can benefit from participation in the NASA Space Station program are discussed. Consideration is given to four goals of the Japanese space program which would be significantly advanced by participation in Space Station, including: promotion of advanced technology development on earth; enhancement of space operations and activities; promotion of international cooperation in large-scale space projects; and utilization of the space environment for commercial applications such as materials processing, earth observation, pharmaceuticals production, and communications. A list of some possible missions for a Japanese Space Station module is provided. I.H.

A86-28779

THE CIVILIAN SPACE PROGRAM - A WASHINGTON PERSPECTIVE

R. H. WARE (Cooperative Institute for Research in Environmental Sciences, Boulder, CO) and P. P. CHANDLER (Office of Technology Assessment, Washington, DC) IN: The case for Mars II . San Diego, CA, Univelt, Inc., 1985, p. 49-64.

(AAS 84-153)

The rationale is discussed for obtaining additional space infrastructure (spacecraft - including Space Stations and launch and transportation systems) to move forward in America's second quarter century of space activities, and the broader policy questions arising from NASA's proposal for obtaining a particular constellation of infrastructure elements are examined. A table of possible

A86-28780

THE MARS BASE - INTERNATIONAL COOPERATION

N. C. GOLDMAN (Texas, University, Austin) IN: The case for Mars II . San Diego, CA, Univelt, Inc., 1985, p. 65-71. refs (AAS 84-154)

Views are given on the probability of cooperation or competition being the enabling force for establishing a human presence on Mars within the next half century. Science cannot be a political driver for such a large project. Several options are considered for organizing a U.S.-sponsored joint mission to Mars. The options are extrapolated from past and present experiences of NASA in cooperative space missions, especially in the Spacelab and the Space Station, as well as from the Western experience in cooperative international space organizations such as the International Telecommunications Satellite Consortium (Intelsat) and the European Space Agency (ESA). The Mars Mission may call forth hybrid or new organizational principles in keeping with the seminal and massive endeavor. D.H.

A86-28786* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

SPACE STATION - THE FIRST STEP

H. C. MANDELL, JR. (NASA, Johnson Space Center, Houston, TX) IN: The case for Mars II . San Diego, CA, Univelt, Inc., 1985, p. 157-170.

(AAS 84-160)

The United States Space Station program, begun in Fiscal Year 1985 under significant cost constraints, should cause all those involved in the planning of manned interplanetary flight to revise their impressions of the cost and practicality of planetary missions. The presence of the Space Shuttle, as well as arrival of a capable Space Station, will provide a major impetus to planetary programs, both by removing most of the real barriers to extended manned space flights and by proving that significant manned space ventures may be performed very economically. Author

A86-29696

STATUS OF SPACE COMMERCIALIZATION IN THE USA

J. M. LOGSDON (George Washington University, Washington, DC) Space Policy (ISSN 0265-9646), vol. 2, Feb. 1986, p. 9-15. refs

Positive and negative developments affecting space commercialization in the USA are discussed. A 75 percent reduction for one year in the potential revenue from space activities, a decrease in the amount of private investment, a financial loss by space commercialization investors, an increase in insurance premium costs, and the slow advancement of material processing in space are described as factors which have hindered space commercialization activities. Progress has been achieved in the formation of a research base and the infrastructure required for the realization of the economic potential of space activities. The future use of the Space Shuttle and its pricing policy, the development and operation of a Space Station, NASA's Commercial Space Policy, and the activities of the Office of Commercial Programs are examined. I.F.

A86-29698

US-SOVIET INTERGOVERNMENTAL AGREEMENT ON COOPERATIVE SPACE ACTIVITIES - SHOULD IT BE RE-ESTABLISHED?

P. P. CHANDLER (DFVLR, Cologne, West Germany) Space Policy (ISSN 0265-9646), vol. 2, Feb. 1986, p. 28-36. refs

Political and scientific policies which need to be considered to establish a US-Soviet agreement on cooperative space activities are analyzed. The need to limit the amount of technology exchanged in order to protect national security is discussed, while the use of scientific and technological cooperation to encourage liberalization within the Soviet society and reduce Soviet belligerence abroad is examined. The development of either shortor long-term cooperative programs is studied, and basic guidelines to be followed to insure space cooperation are described. I.F.

A86-30290

A CHRONICLE OF POLICY AND PROCEDURE - THE FORMULATION OF THE REAGAN ADMINISTRATION POLICY ON INTERNATIONAL SATELLITE TELECOMMUNICATIONS

R. R. COLINO (INTELSAT, Washington, DC) Journal of Space Law, vol. 13, no. 2, 1985, p. 103-156. refs The developments which led to a new FCC policy on

The developments which led to a new FCC policy on international satellite telecommunications systems are reviewed. The policies and functions of Intelsat established in 1964 to provide world-wide telecommunication services are described. Beginning in March 1983 the FCC began to receive applications from private corporations to construct and operate international satellite communication systems independent of Intelsat. The FCC, Departments of State and Commerce, Congress, and the Executive Branch analyzed the applications and their effect on Intelsat; foreign policy concerns, domestic issues, and economics are examined. The effects of the Presidential and FCC decision on November 28, 1984 which approved the applications, but required coordination with Intelsat are studied. The formation of new rules for operation of satellite communication system by the FCC is discussed. I.F.

A86-32562

SPACE INSURANCE - A RESOURCE FOR COMMERCIAL SPACE ACTIVITIES

D. E. CASSIDY (Marsh and McLennan Aviation and Aerospace Services, Washington, DC) IN: EASCON '85: National space strategy - A progress report; Proceedings of the Eighteenth Annual Electronics and Aerospace Systems Conference, Washington, DC, October 28-30, 1985 . New York, Institute of Electrical and Electronics Engineers, Inc., 1985, p. 325-327.

Insurance market conditions are discussed as they affect the insurability of present and future space systems including boosters and transfer vehicles. Particular attention is focused on the need for space insurance by commercial space enterprises, and the importance of demonstrated repeatibility of successes in preserving insurance as a resource for space commercialization. Available insurance coverages are also discussed. Author

A86-33604

HISTORY OF BRITISH SPACE SCIENCE

H. MASSEY and M. O. ROBINS Cambridge and New York, Cambridge University Press, 1986, 535 p. refs

British involvement in space science experiments between 1957 and 1981 is recounted. Cooperation with NASA is described in some detail, and the part played by Britain in establishing European cooperation in space science is addressed, as is the more modest cooperative program with Commonwealth countries. The topics considered include: the Skylark rocket program, the Ariel program, the European Space Research Organization, the small Skua and Petrel rockets for scientific purposes, the Trend Committee and the Science Research Council, the transformation of ESRO into ESA, the Space Science Committee for Europe. C.D.

A86-34134

THE HEAVENS AND THE EARTH: A POLITICAL HISTORY OF THE SPACE AGE

W. A. MCDOUGALL (California, University, Berkeley) Research supported by the University of California. New York, Basic Books, Inc., 1985, 570 p. refs

The first comprehensive political history of the space race is presented. The subjects covered range from the utopian fantasies of the nineteenth century pioneers of rocketry to the Strategic Defense Initiative, and shows how international competition and the cold war created the impetus for state-directed technological change. The significance of this competition for the survival of Western values is emphasized. C.D.

A86-34228

AIRLINE INDEMNITY AGREEMENTS - WILL THE CONTRACTS SHIFT YOUR RISKS?

S. C. KENNEY (Fisher and Hurst, San Francisco, CA) Journal of Air Law and Commerce (ISSN 0021-8642), vol. 51, Spring 1986, p. 613-657. refs

Indemnity issues related to the aviation industry are investigated. The use of interairline agreements between airline carriers and airport users are analyzed. The importance of properly drafted airport user indemnity agreements is discussed and three types of agreements are studied. Examples of interairline and airport user agreements are presented. I.F.

A86-35562#

EUROPE AIMS FOR SPACE INDEPENDENCE

P. LANGEREUX Aerospace America (ISSN 0740-722X), vol. 24, April 1986, p. 50-54, 56 (3 ff.).

The formation of ESA in 1975 established a unified organization to direct European space efforts into the 21st century. The initial thrusts were the Ariane launcher used for communications satellites and joint programs with the U.S. The 1985-95 expenditures will be double those from 1975-85, with major programs being the Ariane 5 heavy-lift vehicle, the Hermes spaceplane and an in-orbit infrastructure which encompasses the Columbus space station segment and a DRS satellite. Controversy persists due to European plans for free-flying, pressurized, dockable Space Station modules while NASA is requiring that the Initial Operational Station be a set configuration. It is notable that the Ariane 5 is actually a new, not derivative, design, and will be powerful enough to lift space station segments, or the Hermes, into LEO. The HOTOL, a British spaceplane under study, is expected to take longer than the Hermes to develop. Cornerstone science missions will include an asteroid or cometary sample return mission, orbiting unmanned X, solar and UV observatories, and a Saturn orbiter. The Eureca is a means to perform materials science, biology, fluid physics and other basic experimentation on orbit to identify potential space industrial processes. MSK

A86-36449

SOVIET SPACEFLIGHT COMES OF AGE

P. PESAVENTO New Scientist (ISSN 0028-6664), vol. 110, April 10, 1986, p. 44-47.

The evolution of Soviet spaceflight is traced, beginning with the launch of the Vostok 1 in 1961, and ending with the launch of the space station Mir in February, 1986. With the success of the Vostok 1 mission, the Soviets were in the lead with regard to space exploration; until 1967 when the Soyuz 1 mission failed. By 1971, the U.S.S.R. had sent five unmanned Soyuz-Luna aircraft around the moon, and from mid-1974 to 1981, 21 Salyut crews inhabited five space stations. Two pieces of Soviet hardware that are of particular interest are the Kosmolyot spaceplane and the Soviet version of the space shuttle; the spaceplane may carry crews within the next two years, while the shuttle will make its first flight by the early 1990's. In addition, there is evidence that the Soviets plan to send cosmonauts to the planets. K.K.

A86-42236

DEVELOPING THE FINAL FRONTIER: INTERNATIONAL COOPERATION IN THE PEACEFUL USES OF OUTER SPACE

A. FLORINI Research supported by the James S. McDonnell Foundation, Armand Hammer Foundation, and Carnegie Corp. New York, United Nations Association of the United States of America, Inc., 1985, 79 p.

This history and law of human activity in outer space is examined, current space programs are reviewed, and the major policy issues facing the U.S. and the world are outlined. The launching of Sputnik is discussed as well as the formation of NASA, the race to the moon, the Apollo-Soyuz Test Project, the Outer Space Treaty and the Moon Treaty. NASA's Space Shuttles are considered as well as U.S. scientific aspirations in space; the Salyut space stations; ESA's Ariane, Spacelab, and EURECA projects; and the space programs of Japan, China, India, and Canada. A treatment is provided of the Space Station from the point of view of international cooperation and the military. The militarization of outer space is discussed, with particular emphasis on antisatellite systems and 'SDI'. Multilateral initiatives are also outlined. K.K.

A86-43335

SPACE STATIONS: LEGAL ASPECTS OF SCIENTIFIC AND COMMERCIAL USE IN A FRAMEWORK OF TRANSATLANTIC COOPERATION; PROCEEDINGS OF THE INTERNATIONAL COLLOQUIUM, HAMBURG, WEST GERMANY, OCTOBER 3, 4, 1984

K.-H. BOECKSTIEGEL, ED. (Koeln, Universitaet, Cologne, West Germany) Colloquium organized by the Universitaet Koeln and DGLR; Supported by BMFT. Cologne, West Germany, Carl Heymanns Verlag (Schriften zum Luft- und Weltraumrecht. Volume 5), 1985, 262 p. In English and German. For individual items see A86-43336 to A86-43350.

American experiences and perspectives regarding an international cooperation on a permanently manned space station are considered along with European experience and perspectives, the relevance of general multilateral space conventions to space stations, possible models for specific space agreements, agreements between States and with International Organizations, and contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles. Attention is given to contractual and related agreements required for a satellite launch, applicable law and dispute settlement, forms of coverage and current market situation in the case of insurance, state supervision and registration, and legal questions which need to be addressed in the case of the Space Station. Other questions explored are related to legal aspects of stations in space, space stations and the law concerning intellectual property, aspects of law and practice in the U.S., and the experience of the European Space Agency. GR

A86-43339

POSSIBLE MODELS FOR SPECIFIC SPACE AGREEMENTS

P. P. C. HAANAPPEL (McGill University, Montreal, Canada) IN: Space stations: Legal aspects of scientific and commercial use in a framework of transatlantic cooperation; Proceedings of the International Colloquium, Hamburg, West Germany, October 3, 4, 1984 . Cologne, West Germany, Carl Heymanns Verlag, 1985, p. 59-68. refs

At the present time, space stations are in the developmental and experimental stages, while the operational stage will only be reached in the 1990s. Questions are, therefore, considered regarding the advisability of the development of rules and regulations for space stations ahead of impending technical and economic developments. It appears that the answer to these questions can be put in the broader framework of the relationships between law and technology and between law and economics. It is pointed out that the law does not precede technological developments. Rather it reacts to them ex post facto, once they have taken place. It is recommended that caution should be exercised in the legislative process so as not to hamper technological and economic developments regarding space stations. Attention is given to participants in space station activities, government regulation of space station activities by private enterprises, prolonged human presence in outer space, conflicts of law, and contractual and extra-contractual relations. G.R.

A86-43340

AGREEMENTS BETWEEN STATES AND WITH INTERNATIONAL ORGANIZATIONS

M. G. BOURELY IN: Space stations: Legal aspects of scientific and commercial use in a framework of transatlantic cooperation; Proceedings of the International Colloquium, Hamburg, West Germany, October 3, 4, 1984. Cologne, West Germany, Carl Heymanns Verlag, 1985, p. 71-87. refs

The present paper is concerned with the form and the contents of agreements governing international cooperation in the construction, transport, and assembly in space of space stations within the framework of the American program. Attention is given to agreements to be drawn up in the future, taking into account the absence of precedents for such agreements. It is pointed out, however, that there are a number of international cooperative activities, both past and present, which have points in common with the space station project. In a review of such past arrangements, elements which have already formed part of an international cooperative program are considered. These elements are related to the construction of hardware, the transport of hardware, the use of hardware in orbit, man's participation in the use of space, and in-orbit rendezvous. The American offer is discussed along with international agreements between European partners, and transatlantic international agreements. G.R.

A86-43342

CONTRACTUAL AND RELATED AGREEMENTS REQUIRED FOR A SATELLITE LAUNCH

R. F. STOWE (Satellite Business Systems, McLean, VA) IN: Space stations: Legal aspects of scientific and commercial use in a framework of transatlantic cooperation; Proceedings of the International Colloquium, Hamburg, West Germany, October 3, 4, 1984. Cologne, West Germany, Carl Heymanns Verlag, 1985, p. 101-108.

This paper is mainly concerned with the experiences of a communications carrier which utilizes satellites for its principal transmission facilities. Developments related to the fourth satellite of this company provide, in particular, an informative case and interesting current inventory of contractual and legal requirements for construction and launch of a spacecraft by a private firm. Attention is given to the development of the fundamental agreement with the spacecraft's prime contractor, the need for launch support services for ejection of he satellite from the Shuttle, the need for orbital tracking services which can monitor and command the satellite as it moves around the earth, the arrangement for appropriate insurance coverage, and the most recent development in new financing techniques in the space area. G.R.

A86-43343

APPLICABLE LAW AND DISPUTE SETTLEMENT

K.-H. BOECKSTIEGEL (Koeln, Universitaet, Cologne, West Germany) IN: Space stations: Legal aspects of scientific and commercial use in a framework of transatlantic cooperation; Proceedings of the International Colloquium, Hamburg, West Germany, October 3, 4, 1984. Cologne, West Germany, Carl Heymanns Verlag, 1985, p. 109-116. refs

The development, construction, and operation of space stations will require the cooperation of many institutions, bodies, and persons. A formal settlement procedure will be required in cases in which agreement by negotiation cannot be reached, and questions regarding the applicable law arise. Treaties relating to space stations are discussed, taking into account the applicable law, and dispute settlement. Problems concerning contracts are also investigated, giving attention to questions regarding the substantive law applicable to a contract, the assurance of mandatory dispute settlement with regard to commercial contracts, the inclusion of arbitration clauses in the contract, and the choice of arbitration as the exclusive dispute settlement machinery even in cases in which a state or state institution is one of the contractual partners.

A86-43344

INSURANCE - FORMS OF COVERAGE AND CURRENT MARKET SITUATION

A. BAUER (Deutscher Luftpool, Munich, West Germany) IN: Space stations: Legal aspects of scientific and commercial use in a framework of transatlantic cooperation; Proceedings of the International Colloquium, Hamburg, West Germany, October 3, 4, 1984 . Cologne, West Germany, Carl Heymanns Verlag, 1985, p. 117-126.

The present paper provides a look at insurance aspects of space risks, taking into account the approaches used to deal with these risks. Various types of risks arising in connection with space-related material are mainly concerned with four principal stages, including the construction phase, the prelaunch phase, the launch phase, and the in-orbit phase. An outline is presented of the basic forms of insurance coverage in the considered cases. Certain risks which remain are related to the loss of direct revenues, incentive payments, and indirect losses. Indirect losses, for instance, can be incurred by satellite systems users when, resulting from failures of any kind or even only late delivery by the manufacturer, the commissioning of a satellite system will be delayed. Attention is also given to Third Party Legal Liability insurance. G.R.

A86-43345

STATE SUPERVISION AND REGISTRATION

W. VON KRIES (DFVLR, Bonn, West Germany) IN: Space stations: Legal aspects of scientific and commercial use in a framework of transatlantic cooperation; Proceedings of the International Colloquium, Hamburg, West Germany, October 3, 4, 1984. Cologne, West Germany, Carl Heymanns Verlag, 1985, p. 129-136. refs

The basic provisions of the 1967 Outer Space Treaty dealing with state supervision, registration, and related legal issues are examined in the context of space station operations, taking into account also the 1976 Registration Convention. Three major developments considered are related to the unprecedented technical nature of future space stations, the expected intensive international participation in space station operations, and the anticipated high level private sector involvement in space station activities. The technological characterization of space stations is discussed, and questions regarding the legal characterization of space stations are examined. Attention is given to space stations as 'space objects', the registration of space stations, and space stations as launching facilities. Problems concerning the jurisdiction and control over space stations are also considered, taking into account the Space Shuttle/Spacelab precedent, the case of Columbus, and the integrated supervision and control of space station operations. GR

A86-43346* National Aeronautics and Space Administration, Washington, D.C.

THE SPACE STATION - PAST, PRESENT AND FUTURE WITH SOME THOUGHTS ON SOME LEGAL QUESTIONS THAT NEED TO BE ADDRESSED

S. N. HOSENBALL (NASA, Washington, DC) IN: Space stations: Legal aspects of scientific and commercial use in a framework of transatlantic cooperation; Proceedings of the International Colloquium, Hamburg, West Germany, October 3, 4, 1984. Cologne, West Germany, Carl Heymanns Verlag, 1985, p. 137-142.

The history of the concept of a space station is briefly considered, taking into account a story written by Hale (1869), quantitative work provided by Oberth and Tsiolkovsky, von Braun, and the U.S. decision regarding the establishment of a space station. Arguments in favor of constructing a space station are related to the utility of a laboratory in earth orbit, the importance of a repair and maintenance base for satellites, the provision of capabilities for the commercial utilization of space, and the employment of a space station as a staging base for missions to the moon, Mars, and, possibly, the asteroids. Plans for the implementation of the Space Station concept are discussed, taking into account also legal issues involved in such an implementation. Attention is given to questions regarding the applicability of the Liability convention, U.S. domestic law, the domestic law of other countries, and four treaties. G.R.

A86-43349

ASPECTS OF LAW AND PRACTICE IN THE UNITED STATES

B. LUXENBERG (DOC, Washington, DC) IN: Space stations: Legal aspects of scientific and commercial use in a framework of transatlantic cooperation; Proceedings of the International Colloquium, Hamburg, West Germany, October 3, 4, 1984. Cologne, West Germany, Carl Heymanns Verlag, 1985, p. 175-185. refs

The establishment of a permanently orbiting space station will usher in a new era, in which a significant shift will occur toward private entrepreneurial activity in space. However, in order to provide an incentive to private entities to engage in such ventures, the protection of intellectual property resulting from space station activities must be assured. The international law of outer space is considered along with developments regarding intellectual property rights in the case of NASA, commercial activities in space, national policy on space commercialization, and issues for the future. It is pointed out that NASA has developed flexible legal arrangements for companies pursuing commercial space ventures in the shuttle era and that this policy will undoubtedly carry over into the space station. G.R.

A86-44540

THE BROKER'S ROLE IN SPACE INSURANCE

B. STOCKWELL (Corroon and Black Inspace, Inc., Washington, DC) IN: Space - Technology and opportunity; Proceedings of the Conference, Geneva, Switzerland, May 28-30, 1985 . Pinner, England, Online Publications, 1985, p. 163-171.

In the international space insurance marketplace the broker is a key player. By arranging the support of the world underwriting market for the financial risks facing commercial aerospace clients, the broker provides the assurances necessary for the commercialization of space. It is a task that has become increasingly difficult in the wake of the unprecedented total losses of 1984. A now uncooperative and uncertain insurance market has set new rules which are presenting new challenges to the broker. This paper will begin with a general description of the broker's role and then focus on a discussion of the emerging complexities of the broker's task in a difficult and changing industry. Author

A86-44541

INSURANCE AND COMMERCIAL SATELLITE SYSTEMS

M. C. NILSON (Advanced Business Communications, Inc., McLean, VA) IN: Space - Technology and opportunity; Proceedings of the Conference, Geneva, Switzerland, May 28-30, 1985 . Pinner, England, Online Publications, 1985, p. 181-187.

This paper explores the practical business reasons for insuring commercial satellites and their launches. The importance of insurance to operators of communications satellite systems is discussed. As examples of systems typical of those around the world, the United States domestic satellite systems are illustrated from a business viewpoint. Insurance coverage is found to be equal importance to governments or government designated organizations that operate satellite systems for revenue earning purposes. It is concluded that there will be a steady and increasing demand for all types of space insurance, including launch and commissioning, service interruption and launch delay categories of coverage. Author

A86-46375

SOMETHING HAS TO CHANGE

B. GOUDGE Space (ISSN 0267-954X), vol. 2, June-Aug. 1986, p. 46-50.

A matter of paramount importance to the continuing evolution of the space industry and in particular to the commercialization of space, is the survival of the space insurance market. From 1977 to 1985, insurers lost 900 million U.S. dollars while premiums for this period amounted to less than 535 million U.S. dollars. The evolution of the present state of affairs is traced and explanations and recommendations are provided. Excessive competition, poor judgement as to the appropriate premium and ignorance of the actual risks involved emerge as major factors. To date, the market responses to the present crisis have included severe rate increases and tightening up of policy terms while the insured's reaction has included the denial of any ability to pay premiums at much higher levels. To help remedy this situation it is suggested that insurers be actively involved in the strategic planning of projects. K.K.

A86-49454

THE SEARCH FOR COMMON GROUND

L. DAVID Space World (ISSN 0038-6332), vol. W-7-271, July 1986, p. 25-29.

Prospects are considered for international - specifically U.S.-Soviet - cooperation on missions to Mars. It has been pointed out that sharing the effort can make possible missions that would be prohibitively expensive for a single nation. Furthermore, the cooperative venture is envisioned as an opportunity to inspire better working relationship among countries, enhance understanding of other cultures and reduce workd tensions. Senator Matsunage (D-Hawaii) is a strong proponent of joint missions, having sponsored a Senate Joint Resolution calling for the President to direct NASA to explore the coordination of the unpiloted Soviet mission to the Martian moon Phobos in 1988 and the 1990 American Mars orbiter robot flight. Roald Sagdeev, director of the Soviet Academy of Sciences' Space Research Institute, has proposed a cooperative scenario involving the return to earth by a Soviet spacecraft of samples of Mars rocks collected by a U.S. roving robot vehicle; the U.S. National Commission on Space, recognizing certain difficulties, nonetheless calls this 'an extremely worthwhile project'. One danger is the 'risk of technology transfer'. Management, ownership, usage, data rights and operational responsibilities are issues that can be made more difficult by language and cultural differences. A new advocate for a joint project is the group called Search for Common Ground, which sees compelling reasons for the U.S. to cross interplanetary space with the Soviets. In a sidebar, a proposal is made for a joint biological research module in earth orbit to study returned Mars rock samples without risk of contaminating the earth with alien organisms. D.H.

N86-12163# State Dept., Washington, D. C. Bureau of Public Affairs.

US SPACE PROGRAMS: COOPERATION AND COMPETITION FROM EUROPE

H. R. MARSHALL, JR. and C. SABOE, ed. May 1985 6 p (BPA-CP-695) Avail: NTIS HC A02/MF A01

International activities demonstrate the many applications of space science and technology for peaceful purposes and provide opportunities for contribution by scientists of other countries to the tasks of increasing human understanding and use of space. Cooperative activities range from flight of foreign spacecraft to groundbased study and analysis of data. Activities include contributions of experiments or payloads to be flown in space, joint projects to develop flight hardware, use of data provided by satellites, and joint publication of scientific results. These cooperative programs are generally carried out under government-to-government science and technology agreements coordinated by the State Department. In addition, NASA provides, on a reimbursable basis, commercial services such as deployment of telecommunication satellites. G.L.C.

N86-13230*# ECON, Inc., Alexandria, Va.

FEDERAL GOVERNMENT PROVISION OF THIRD-PARTY LIABILITY INSURANCE TO SPACE VEHICLE USERS Final Report

2 Jan. 1985 138 p refs

(Contract NASW-3339)

(NASA-CR-176346; NAS 1.26:176346; ECON-84-101) Avail:

NTIS HC A07/MF A01 CSCL 05C

Support decisions concerning the provision by the Federal Government of third-party liability insurance for commercial space activities were studied. The practices associated with third-party liability insurance in the marine, aviation, and electric utility industries in addition to those industries associated with space missions were reviewed. Theoretical considerations of rate setting are discussed and a methodology to determine the period of time over which the insurers of each industry intend to set aside reserves to recover from a maximum liability loss should one occur is introduced. The data were analyzed to determine the setaside period in each industry, and to suggest reasonable standards from the insurer's point of view. Criteria for Federal provision of insurance are discussed, an interpretation of the Price-Anderson Act, determinants of the availability of commercial insurance, potential insurer liability, and measures of reasonableness for premium rates from the user's point of view are presented. Options available to the government regarding third part liability protection are presented. Author

N86-13234# Committee on Appropriations (U. S. Senate). NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

In its Dept. of HUD, and Certain Independent Agencies Appropriations for Fiscal Year 1986, Pt. 1 p 1-407 1985 refs Avail: Subcommittee of the Committee on Appropriations

In response to Public Law 98-371, dated July 18, 1984. the NASA Advanced Technology Advisory Committee (ATAC) has studied automation and robotics for use in the Space Station and prepared this report to the House and Senate Committees on Appropriations. The report is divided into two volumes: the Executive Overview, Volume 1, presents the major findings of the study and recommends to NASA principles for advancing automation and robotics technologies for the benefit of the Space Station and of the U.S. economy in general; the Technical Report, Volume 2, provides background information on automation and robotics technologies and their potential. As a result of its study, the Advanced Technology Advisory Committee believes that a key element of technology for the Space Station is extensive use of advanced general-purpose automation and robotics. This could include many systems and devices (such as computer vision, expert systems, and dexterous manipulators) that have been made possible by recent advances in artificial intelligence, robotics, computer science, and microelectronics. Author

N86-15166*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. GOVERNMENT-TO-GOVERNMENT COOPERATION IN SPACE

STATION DEVELOPMENT

S. H. NASSIFF *In its* R and D Productivity: New Challenges for the US Space Program p 88-108 1985

Avail: NTIS HC A25/MF A01 CSCL 05A

A memoranda of understanding was recently signed between the United States (NASA) and three international Space Station partners - Canada, European Space Agency (ESA), and Japan. The international partners are performing parallel Phase B preliminary design studies, concurrent with the U.S., on their proposed elements/systems for possible integration and operation with the U.S. Space Station System complex. During the 21-month Space Station Phase B study, a large amount of technical interface data will have to be transferred between the U.S. and the international partners. Scheduled bilateral technical coordination meetings will also be held. The coordination and large number of interfaces required to integrate the international requirements into the Space Station require a clean interface management organizational structure and operation procedures to accomplish the integration task. The international coordination management organizational structure, management tools, and communications network are discussed including the proposed international elements/systems being studied by the international partners.

Author

N86-16152# Committee on Science and Technology (U. S. House).

THE ROLE OF TECHNICAL INFORMATION IN US COMPETITIVENESS WITH JAPAN

Washington GPO 1985 298 p refs Hearings before the Subcommittee on Science, Research and Technology, 99th Congr., 1st Sess., no. 27, 26-27 Jun. 1985

(GPO-51-564) Avail: Subcommittee on Science, Research and Technology

Hearings were held before the U.S. House of Representatives Subcommittee on science, research and technology. The role of technical information in US competetiveness with Japan was discussed. The strength of the US and Japan in selected high technology fields was compared. The shortage of Japanese language experts is attributed as one of the causes of a one way information flow from the US to Japan. The progress made on the availability of Japanese scientific information in the US, and the comparative strength of the US and Japan in selected high technology fields is investigated. E.A.K.

N86-17409# Department of Transportation, Washington, D. C. Office of Commercial Space Transportation.

REGULATORY ASPECTS OF COMMERCIAL, SPACE TRANSPORTATION

H. R. SCHMIDT *In* Johns Hopkins Univ. The 1985 JANNAF Propulsion Meeting, Volume 1 p 291-297 Apr. 1985 refs Avail: Chemical Propulsion Information Agency, Johns Hopkins Rd., Laurel, Md. 20707 HC \$78.98 CSCL 22A

Expendable launch vehicles (ELV's), developed and constantly improved over more than two decades, represent a major national investment and resource needed to ensure continued U.S. leadership in this technology. The policy background preceding P.L. 98-575, The Commercial Space Launch Act, giving the Secretary of Transportation exclusive authority to issue licenses for commercial space launches and launch operations, is reviewed. The launch license process developed to implement the licensing of commercial launch sites, a more complex issue in the preliminary planning stage, is briefly discussed. The central issues involved in setting liability insurance levels for damage caused to persons or property by this commercial space activity, as required by the Act, are summarized. Thus, the framework for a regulatory environment which facilitates growth of this new industry is well underway. Author

N86-19284# Committee on Science and Technology (U. S. House).

HIGH SPEED AERONAUTICS

Washington GPO 1985 195 p Hearing before the Subcommittee on Transportation, Aviation and Materials of the Committee on Science and Technology, 99th Congress, 1st Session, no. 21, 24 Jul. 1985

(GPO-51-341) Avail: Subcommittee on Transportation, Aviation and Materials

Testimonies on the research and development of hypersonic speed aviation is presented. The effect of high speed aircraft on space flight is noted. The need to press forward in this research in order to keep up with other countries is emphasized. Budgetary requirements are also considered.

N86-20174# Committee on Science and Technology (U. S. House).

AUTHORIZING APPROPRIATIONS FOR LANDSAT COMMERCIALIZATION

Washington GPO 1985 6 p Rept. to accompany H.S. 2800 presented by the Committee on Science and Technology to the 99th Congr., 1st Sess., Jun. 1985

(H-REPT-99-177; GPO-61-006) Avail: US Capitol, House Document Room

Appropriations for 1985 through 1989 for transfer to the private sector of the LANDSAT system by the Federal Government are described. B.G.

N86-20175# Comptroller General of the United States, Washington, D.C.

FEDERAL AGENCIES' POLICIES AND PRACTICES ARE IN ACCORDANCE WITH PATENT AND TRADEMARK AMENDMENTS OF 1980

1985 45 p

(B-207939; REPT-3) Avail: NTIS HC A03/MF A01

Implementation of Patent and Trademark Amendments of 1980 by 10 federal agencies was examined. Federal research and development procurement policies, regulations, and practices were reviewed for each agency. The 1984 funding agreements with contractors and grantees and the research and development titling and licensing activities of the agencies since the passage of the law were reviewed. The role of the Dept. of Commerce in implementing the Act was determined. How small businesses and nonprofit organizations viewed the changes in research and development activities was discussed. B.G. N86-20177# Committee on Science and Technology (U. S. House).

TECHNOLOGY TRANSFER

Washington GPO 1985 259 p Hearings before the Subcommittee on Science, Research and Technology, 99th Congr., 1st Sess., no. 22, 21-22 May 1985

(GPO-49-539) Avail: Subcommittee on Science, Research and Technology

Budget restraints; assessment; of changes in technology transfer since 1980; redefining of Federal role in technology transfer; cooperative agreements; invention policy; transfer of technology from Federal laboratories; and flow of American Commercial products developed from government research were discussed. B.G.

N86-20436# Committee on Science and Technology (U. S. House).

SPACE SCIENCE: PAST, PRESENT AND FUTURE

Washington GPO 1985 210 p Hearings before the Subcommittee on Space Science and Applications of the Committee on Science and Technology, 99th Congress, 1st Session, no. 60, 8-10 Oct. 1985

(GPO-55-239) Avail: Subcommittee on Space Science and Applications CSCL 22A

The Congressional Subcommittee on Space Science and applications held hearings on Space Science: past, present and future. Topics discussed include: space sciences and exploration, space physics, Earth observations from space, Earth sciences, planetary and solar system formation, weather observations from space, biology studies from space, solar system space physics, and solar-terrestrial sciences. E.A.K.

N86-20464# Congressional Budget Office, Washington, D. C. BUDGET EFFECTS OF THE CHALLENGER ACCIDENT D. H. MOORE and P. H. JOHNSTON, ed. Mar. 1986 23 p Avail: NTIS HC A02/MF A01

The preliminary estimates of the effects of the Challenger accident on the NASA budget for FY 1986 and 1987 are presented. E.A.K.

N86-21434# National Technical Information Service, Springfield, Va.

INFORMATION FOR THE DEVELOPING WORLD: NTIS'S (NATIONAL TECHNICAL INFORMATION SERVICES'S) ROLE IN INFORMATION TRANSFER TO DEVELOPING COUNTRIES

J. F. CAPONIO 1985 17 p Presented at the International Federation of Library Association Conference, Chicago, Ill., 1985 (PB85-243269) Avail: NTIS HC A02/MF A01 CSCL 05B

There is a great need for technical information in developing countries. Technical information is broadly defined to include all knowledge relating to how any specific economic activity is carried out. The techniques used by the National Technical Information Service (NTIS) of the U.S. Department of Commerce in helping both individuals and institutions (ranging from small shopkeepers to technical institutes) in developing countries to solve their technical information needs by providing access to NTIS's vast collection of reports and documents are described. The need for technical information in developing countries are outlined, then the techniques and mechanisms being used in the transfer of technical information described and finally, the findings of a recent study illustrating how data from NTIS documents is being applied to address a wide range of technical problems in developing countries are described. The competent local implementing institutions, are vital links the chain of international information dissemination. GRA

N86-21453# Committee on Science and Technology (U. S. House).

ASSURED ACCESS TO SPACE DURING THE 1990'S

Washington GPO 1986 187 p Joint Hearings on HASC-99-9 before the Subcommittee on Space Science and Applications of the Committee on Science and Technology and the Subcommittee on Research and Development of the Committee on Armed Services, 99th Congress, 1st Session, no. 51, 23-25 Jul. 1985 (GPO-53-617) Avail: Subcommittee on Space Science and Applications

The Subcommittees on Space Science and applications, and the subcommittee on research and development held joint hearings on assured access to space during the 1990's. Topics discussed include: space transportation systems, launch vehicle requirements of the Space Station Program during the 1990's, commercial payloads and satellite launches, strategic defense initiative, DOD launch plans through the 1990's, space launch vehicle capacity, complementary expendable launch vehicles (CELV), and adequacy of the orbiter fleet to meet the launch requirements through the 1990's. E.A.K.

N86-21458# Committee on Science and Technology (U. S. House).

TECHNOLOGY TRANSFER

Washington GPO 1985 258 p Hearings before the Subcommittee on Science, Research and Technology of the Committee on Science and Technology, 99th Congress, 1st Session, no. 22, 21-22 May 1985

(GPO-49-539) Avail: Subcommittee on Science, Research and Technology

The Congressional Subcommittee on science, research and technology held hearings on primarily technology transfer. The legislation was proposed on: utilization of federal technology basic research, commercializing intellectual property, technology utilization, stimulation of global competition, improvement of city services, stimulation of local economics, Federal commercial cooperation, and technology transfer from Government to private sector. E.A.K.

N86-21540# Department of the Air Force, Washington, D.C. ROBOTIC REFUELING SYSTEM FOR TACTICAL AND STRATEGIC AIRCRAFT Patent Application

E. R. SCHULTZ, inventor (to Air Force) 12 Aug. 1985 17 p (AD-D011980; US-PATENT-APPL-SN-764820) Avail: NTIS HC A02/MF A01 CSCL 01B

A ground based aircraft refueling system uses existing air-to-air refueling technology. A fixed facility design attaches a moveable air-to-air type refueling boom and probe to an overhead track mounted on the ceiling of a TAB VEE aircraft shelter. Movement of the boom and probe is controlled from a remote control room protected from hazardous chemical and biological environments. In a second embodiment a moveable facility design mounts on the top of a tank truck a first boom attached at a right angle to an air-to-air type refueling second boom and probe. The booms and probe are remotely controlled from the truck cab which is protected from hostile chemical and biological environments. A third embodiment adds to the moveable facility design a second tank and nozzle outlet for spraying decontaminate.

Author (GRA)

N86-22114*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

RECONFIGURABLE WORK STATION FOR A VIDEO DISPLAY UNIT AND KEYBOARD Patent Application

N. L. SHIELDS (Essex Corp.), M. F. FAGG (Essex Corp.), D. E. HENDERSON (Essex Corp.), and F. D. ROE, inventors (to NASA) 5 Dec. 1985 $\,$ 17 p

(NASA-CASE-MFS-26009-1SB; NAS 1.71:MFS-26009-1SB;

US-PATENT-APPL-SN-805011) Avail: NTIS HC A02/MF A01 CSCL 05H

A reconfigurable workstation is illustrated having video, keyboard, and hand operated motion controller capabilities. The workstation includes main side panels between which a primary work panel is pivotally carried in a manner in which primary work panel may be adjusted and set in a negatively declined or positively inclined position for proper forearm support while operating hand controllers. A keyboard table supports a keyboard in such a manner that the keyboard is set in a positively inclined position with respect to the negatively declined work panel. Various adjustable devices are provided for adjusting the relative declinations and inclinations of the work panels, tables, and visual display panels. NASA

N86-22435# Committee on Science and Technology (U. S. House).

NASA'S LONG RANGE PLANS

Washington GPO 1986 224 p Hearings before the Subcommittee on Space Science and Applications of the Committee on Science and Technology, 99th Congress, 1st Session, no. 57, 17, 19, 1985

(GPO-55-035) Avail: Subcommittee on Space Science and Applications

The long range planning schedule for NASA programs is reviewed. Objectives are summarized for programs in space flight, space science and applications, space stations, space technology, and Space tracking and Data Systems. B.G.

N86-22444* National Aeronautics and Space Administration, Washington, D.C.

NASA PATENT ABSTRACTS BIBLIOGRAPHY: A CONTINUING BIBLIOGRAPHY. SECTION 2: INDEXES (SUPPLEMENT 28) Jan. 1986 478 p

(NASA-SP-7039(28)SECT-2; NAS 1.21:7039(28)SECT-2) Avail: NTIS HC A21 CSCL 05B

A subject index is provided for over 4800 patents and patent applications for the period May 1969 through December 1985. Additional indexes list personal authors, corporate authors, contract numbers, NASA case numbers, U.S. patent class numbers, U.S. Patent numbers, and NASA accession numbers. Author

N86-22448# Committee on Science and Technology (U. S. House).

AUTHORIZING APPROPRIATIONS FOR LANDSAT COMMERCIALIZATION

Washington GPO 1985 6 p Report to accompany H.R. 2800 presented to the Committee of the Whole House on the State of the Union by the Committee on Science and Technology, 99th Congress, 1st Session, 20 Jun. 1985

(HR-REPT-99-177; GPO-51-006) Avail: US Capitol, House Document Room

Amendments to the Land Remote Sensing Commercialization Act of 1984 to provide full authorization for the transfer to the private sector of the Federal Government's civil land remote sensing satellite (LANDSAT) system were summarized. Appropriations of \$295 million for fiscal years 1985 through 1989, of which not more than \$125 million is available for fiscal years 1985 and 1986, were authorized. Author

N86-23484# National Science Foundation, Washington, D.C. GUIDE TO PROGRAMS, FISCAL YEAR 1986: GUIDE DESCRIBING NATIONAL SCIENCE FOUNDATION PROGRAMS AND ACTIVITIES

Oct. 1985 90 p

(PB86-125184; NSF-85-40) Avail: NTIS HC A05/MF A01 CSCL 05A

The guide describes all of the Foundation's programs and activities. It is divided into chapters reflecting NSF's major divisions and details the areas of scientific and engineering research supported by each. Also included: a current NSF organization chart and the National Science Board's Criteria for the Selection of Research Projects. Author

N86-24673*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ICE DETECTOR Patent Application

L. M. WEINSTEIN, inventor (to NASA) 31 Mar. 1986 14 p (NASA-CASE-LAR-13403-1; NAS 1.71:LAR-13403-1; US-PATENT-APPL-SN-846429) Avail: NTIS HC A02/MF A01 CSCL 01C

An ice detector for aircraft that can accurately determine the presence and thickness of ice and control devices to remove it is proposed. A small depression on the surface of an aircraft structure is filled with a plastic or epoxy material. Two capacitance gauges and a temperature gauge are embedded in this material near the surface. When moisture forms on the surface the capacitance of each of the gauges changes. This signal combined with the signal from a temperature gauge determines whether the moisture is water or ice. If ice is present its thickness may be measured based on the output of the second capacitance gauge. Once the presence of ice is determined, the thickness is easily determined. The output of the device may be used to provide an indication to the pilot or to automatically control heating elements to remove the ice.

N86-24726# Presidential Commission on the Space Shuttle Challenger Accident, Washington, D.C.

REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, VOLUME 1

W. P. ROGERS, N. A. ARMSTRONG, D. C. ACHESON, E. E. COVERT, R. P. FEYNMAN, R. B. HOTZ, D. J. KUTYNA, S. K. RIDE, R. W. RUMMEL, J. F. SUTTER et al. 6 Jun. 1986 260 p refs Original contains color illustrations For other volumes, see N86-28974, N86-28975, N86-28976, and N86-28977 5 Vol. (AD-A171402) Avail: NTIS MF A01; also available GPO HC \$18.00

The findings of the Commission regarding the circumstances the Challenger accident are reported surrounding and recommendations for corrective action are outlined. All available mission data, subsequent tests, and wreckage analyses were reviewed and specific failure scenarios were developed. The Commission concluded that the cause of the Mission 51-L accident was the failure of the pressure seal in the aft field joint of the right solid rocket motor. The failure was due to a faulty design unacceptably sensitive to a number of factors. These factors were the effects of temperature, physical dimensions, the character of materials, the effects of reuse, processing, and the reaction of the joint to dynamic loading. In addition to analyzing the material causes of the accident, the Commission examined the chain of decisions that culminated in approval of the launch. It concluded that the decision making process was flawed in several ways including (1) failure in communication resulting in a launch decision based on incomplete and misleading information, (2) a conflict between engineering data and management judgements, and (3) a NASA management structure that permitted flight safety problems to bypass key Shuttle managers. M.G.

N86-24729* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SHUTTLE-LAUNCH TRIANGULAR SPACE STATION Patent

W. C. SCHNEIDER, inventor (to NASA), R. B. BERKA, inventor (to NASA), C. KAVANAUGH, inventor (to NASA), K. NAGY, inventor (to NASA), R. C. PARISH, inventor (to NASA), J. A. SCHLIESING, inventor (to NASA), P. D. SMITH, inventor (to NASA), F. J. STEBBINS, inventor (to NASA), and C. J. WESSELSKI, inventor (to NASA) 1 Apr. 1986 9 p Filed 9 Mar. 1984 Sponsored by NASA

(ŃASA-CASE-MSC-20676-1; US-PATENT-4,579,302; US-PATENT-APPL-SN-587764; US-PATENT-CLASS-244-159)

Avail: US Patent and Trademark Office CSCL 22B

A triangular space station deployable in orbit is described. The framework is comprized of three trusses, formed of a pair of generally planar faces consistine of foldable struts. The struts expand and lock into rigid structural engagement forming a repetition of equilater triangles and nonfolding diagonal struts interconnecting the two faces. The struts are joined together by node fittings. The framework can be packaged into a size and configuration transportable by a space shuttle. When deployed, the framework provides a large work/construction area and ample planar surface area for solar panels and thermal radiators. A plurity of modules are secured to the framework and then joined by tunnels to make an interconnected modular display. Thruster units for the space station orientation and altitude maintenance are provided.

Official Gazette of the U.S. Patent and Trademark Office

N86-25288# General Accounting Office, Washington, D. C. National Security and International Affairs Div.

NASA'S FIA (NATIONAL AERONAUTICS AND SPACE ADMINISTRATION'S FINANCIAL INTEGRITY ACT) PROGRAM: NASA'S PROGRESS IN IMPLEMENTING FINANCIAL INTEGRITY ACT REQUIREMENTS

Nov. 1985 54 p

(PB86-135100; GAO/NSIAD-86-3; B-216946) Avail: NTIS HC A04/MF A01 CSCL 05A

The National Aeronautics and Space Administration's (NASA's) continuing efforts to implement and comply with the Federal Manager's Financial Integrity Act (FIA) of 1982 (31 U.S.C. 3512 (b) and (c)) are reported. The review is part of a government wide assessment of 23 federal agencies. The GAO performed the reviews as part of their effort to enhance the federal government's ability to evaluate and improve internal controls and accounting systems. GRA

N86-26243* National Aeronautics and Space Administration, Washington, D.C.

SIGNIFICANT NASA INVENTIONS AVAILABLE FOR LICENSING IN FOREIGN COUNTRIES

1986 81 p

(NASA-SP-7038(08); NAS 1.21:7038(08)) Avail: NTIS SOD HC \$5.00 as 033-000-00986-1 CSCL 05B

Abstracts of various NASA-owned inventions which are available for foreign licensing in the identified countries are listed in accordance with the NASA Patent Licensing Regulations. Instructions for requested applicatons are explained. B.G.

N86-26529# Department of the Air Force, Washington, D.C. **POWER SENSING DEVICE Patent Application**

J. QUIROS, inventor (to Air Force) 19 Jul. 1985 12 p (AD-D012171; US-PATENT-APPL-SN-756549) Avail: NTIS HC

(AD-D012171; US-PATENT-APPL-SN-756549) Avail: NTIS HC A02/MF A01 CSCL 09E

A power sensing device is disclosed for use with an electrical alternating current (AC) power source, a primary load, and a plurality of secondary loads. The power sensing device detects when the primary load is turned on, and automatically supplies power from the electrical AC power source to the plurality of secondary loads in response thereto. The power sensing device also senses when the primary load is turned off, and removes electrical power from the plurality of secondary loads in response thereto.

Author (GRA)

N86-27130# Congressional Research Service, Washington, D.C. Office of Senior Specialists.

PUBLIC LAWS OF THE 98TH CONGRESS RELATING TO INFORMATION POLICY

S. N. MILEVSKI 14 Mar. 1986 101 p

(CRS-TK-7885-F) Avail: NTIS HC A06/MF A01

Statutes of the 98th Congress treating information related concerns are enumerated. Limited to public laws of a substantive nature, the topical overview of areas of congressional concern is divided into nine sections: Federal Information Resources Management; International Communications and Information Policy; Telecommunication, Broadcasting, and Satellite Transmission; Intellectual Property; Library and Archives Policies; Information Disclosure, Confidentiality and the Right of Privacy; Computer Security and Crime; Information Technology for Education, Innovation, and Competitiveness; and Government Information Systems, Clearinghouses, and Dissemination. Brief considerations of parallel developments in the executive branch and private sector for 1983 to 1984 are included, along with significant laws from the 95th through 97th Congresses. The appendix provides a compilation of information policy public laws, 1977 through 1984. Author

N86-27352*# National Aeronautics and Space Administration, Washington, D.C.

ACTIONS TO IMPLEMENT THE RECOMMENDATIONS OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT. REPORT TO THE PRESIDENT 14 Jul. 1986 52 p

Avail: NTIS HC A04/MF A01 CSCL 05A

The status of the implementation of the recommendations of the Presidential Commission on the Space Shuttle Challenger Accident is reported. The implementation of recommendations in the following areas is detailed: (1) solid rocket motor design; (2) shuttle management structure, including the shuttle safety panel and astronauts in management; (3) critical item review and hazard analysis; (4) safety organization; (5) improved communication; (6) landing safety; (7) launch abort and crew escape; (8) flight rate; and (9) maintenance safeguards. Supporting memoranda and communications from NASA are appended. J.P.B.

N86-27513* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla. **METHOD AND APPARATUS FOR OPERATING ON COMPANDED**

PCM VOICE DATA Patent F. BYRNE, inventor (to NASA) 13 May 1986 8 p Filed 28 Sep. 1984 Supersedes N85-29120 (23 - 18, p 3089) Sponsored

by NASA. Kennedy Space Center (NASA-CASE-KSC-11285-1; US-PATENT-4,588,986;

US-PATENT-APPL-SN-655601; US-PATENT-CLASS-340-347DD;

US-PATENT-CLASS-365-768; US-PATENT-CLASS-179-18BC)

Avail: US Patent and Trademark Office CSCL 17B

The method and apparatus constructed in accordance with this invention permits a plurality of parties to speak to each other on a conference line with a minimum of interference. The apparatus digitizes audio signals. Each of the parties has an audio transmitter and receiver provided for transmitting and receiving audio signals. The audio signals are converted to a PCM companded eight-bit parallel signal followed by a conversion to a serial signal for transmitting to a remote location and then reconverting each of the companded signals to a first-eight-bit parallel signal. The eight-bit signal provides one-half of a pre-programmed ROM. This eight-bit signal provides one-half of a sixteen-bit address of a lookup ROM. The other half of the sixteen-bit ROM address is supplied by another suscriber over an identical circuit.

Official Gazette of the U.S. Patent and Trademark Office

N86-28788* National Aeronautics and Space Administration, Washington, D.C.

NASA PATENT ABSTRACTS BIBLIOGRAPHY: A CONTINUING BIBLIOGRAPHY. SECTION 1: ABSTRACTS

Jul. 1986 52 p

(NASA-SP-7039(29)-SECT-1; NAS 1.21:7039(29)-SECT-1) Avail: NTIS HC A04 CSCL 05B

Abstracts are provided for 115 patents and patent applications entered into the NASA scientific and technical information system during the period January 1986 through June 1986. Each entry consists of a citation, an abstract, and in most cases, a key illustration selected from the patent application. Author

N86-28789* National Aeronautics and Space Administration, Washington, D.C.

NASA PATENT ABSTRACTS BIBLIOGRAPHY. A CONTINUING BIBLIOGRAPHY. SECTION 2: INDEXES (SUPPLEMENT 29) Jul. 1986 483 p

(NASA-SP-7039(29)-SECT-2; NAS 1.21:7039(29)-SECT-2) Avail: NTIS HC A21 CSCL 05B

Entries for over 4400 patents and patent applications citations for the period May 1969 through June 1986 are listed. Subject, invention, source, number, and accession number indexes are included. B.G.

10 LEGALITY, LEGISLATION, AND POLICY

N86-28800# National Defence Headquarters, Ottawa (Ontario). Directorate of Industry and Univ. Programs.

INTERNATIONAL INFORMATION EXCHANGE PROGRAMMES ARE NECESSARY

A. S. REEVES *In* AGARD The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes 5 p Jan. 1986

Avail: NTIS HC A05/MF A01

The economic and cultural ties between Canada, the U.S. and European nations are enhanced by various means of information exchange between and among countries. The benefits of two different but interconnected processes of technology transfer are discussed: the alerting of allies to information available and the exchange of document literature. Since concern about national security and proprietary information may preclude defence research and development programs from publishing; as do other disciplines, in the open literature, special exchange agreements are necessary. The programs which have existed for some years among various NATO countries usually limit the subject areas of common interest to be discussed, and the organizations to be included. This process is illustrated using the Canadian situation. Some of the existing Canadian exchange agreements are examined, showing how they operate, the types of information which are included, the routes by which information is passed from one country to another. The ways in which information passes through the documentation centers to become a valuable service to the end users and thus enhance research and development productivity are detailed. Specific examples of the use of international information exchange programs to some major defence projects are shown. The release of information is beneficial to the releasing country as well as to the receiving country because of the increased visibility of the information and the resulting reciprocal transfer of related data.

M.G.

N86-28806# General Accounting Office, Washington, D. C. Resources Community and Economic Development Div. UNIVERSITY FUNDING. ASSESSING FEDERAL FUNDING MECHANISMS FOR UNIVERSITY RESEARCH

Feb. 1986 37 p

(AD-A165721; GAO/RCED-86-75) Avail: NTIS HC A03/MF A01 CSCL 05A

Over 60 percent of university research funding comes from federal agencies, this research is a key element in the United States' international competitiveness and technology advancement. Others sources for research funding include industry, foundations, and state governments. Approximately 71 percent of the federal research funds are provided through one funding mechanism or category of federal financial support for scientific research -individual project grants. Some scientists and policymakers have questioned the consequences of such heavy reliance on individual project grants. For example, does this mechanism discourage the performance of innovative, high-risk, and interdisciplinary research? In response to the House Committee on Science and Technology's request that GAO assess the effects of; different funding mechanisms on the productivity and performance of research, GAO looked at: Whether particular funding mechanisms played a role in helping universities improve program guality. Whether two funding mechanisms -- individual project grants and center grants -- had different effects on the performance of research. GAO looked at five universities that, according to surveys of the scientific community carried out by two education and research organizations, had reputed improvement in program quality. GRA

N86-28974# Presidential Commission on the Space Shuttle Challenger Accident, Washington, D.C.

REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, VOLUME 2

1986 485 p For other volumes, see N86-24726, N86-28975, N86-28976, and N86-28977

(AD-A171403) SOD HC \$40.00 as 040-000-00503-0 in set with volume 3; NTIS MF A01

Volume 2 continues with the findings of the commission regarding the circumstances surrounding the Challenger accident. The report of an independent test team appointed to determine if the tests and analyses being performed by the Marshall Center and Morton Thiokol were adequate to provide the information needed by the panel is given. Some personal observations on the reliability of the shuttle is given by R. P. Feynman. The work schedules of NASA and contractor personnel involved in the launch processing at Kennedy and Marshall Centers are reviewed in terms of human factors analysis. In the flight readiness review treatment of O-ring problems case to case field joint and nozzle to case joint O-ring anomalies experiences in flight and documents are described. NASA's Prelaunch Activities Team, Mission Planning and Operations Team, Development and Production Team, and Accident Analysis Team reports are given. Finally, comments by Morton Thiokol on the NASA reports are presented. E.R.

N86-28975# Presidential Commission on the Space Shuttle Challenger Accident, Washington, D.C.

REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, VOLUME 3

1986 534 p For other volumes, see N86-24726, N86-28974, N86-28976, and N86-28977

(AD-A171403) SOD HC \$40.00 as 040-000-00503-0 in set with volume 2; NTIS MF A01

The report of the NASA Photo and TV Support Team is given. It describes the significant observed anomalies and related events of the STS 51-L accident and includes image enhancement results which were used to identify, locate, and determine time related characteristics of the events. The NASA Search, Recovery, and Reconstruction Task Force Team report is also given. It includes summaries of the surface search, sonar mapping, recovery, structural reconstruction and evaluations and conclusions drawn.

N86-28976# Presidential Commission on the Space Shuttle Challenger Accident, Washington, D.C.

REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, VOLUME 4

1986 828 p For other volumes, see N86-24726, N86-28974, N86-28975, and N86-28977

(AD-A171404) SOD HC \$47.00 as 040-000-00504-8 in set with volume 5; NTIS MF A01

This volume contains all the hearings of the Presidential Commission on the Space Shuttle Challenger accident from 6 February to 25 February 1986. Among others, the testimony of NASA's acting administrator William R. Graham is included. E.R.

N86-28977# Presidential Commission on the Space Shuttle Challenger Accident, Washington, D.C.

REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, VOLUME 5

1986 884 p For other volumes, see N86-24726, N86-28974, N86-28975, and N86-28976

(AD-A171404) SOD HC \$47.00 as 040-000-00504-8 in set with volume 4: NTIS MF A01

This volume contains all the hearings of the Presidential Commission on the Space Shuttle Challenger accident from 26 February to 2 May 1986. Among others is the testimony of L. Mulloy, Manager, Space Shuttle Solid Rocket Booster Program, Marshall Space Flight Center and G. Hardy, Deputy Director, Science and Engineering, Marshall Space Flight Center. E.R.

N86-30064# Joint Publications Research Service, Arlington, Va. WORLDWIDE REPORT: TELECOMMUNICATIONS POLICY, RESEARCH AND DEVELOPMENT

28 Apr. 1986 64 p Transl. into ENGLISH from various worldwide articles

(JPRS-TTP-86-011) Avail: NTIS HC A04/MF A01

Telecommunication topics addressed include: fiber optics, satellite communications, bids for construction of the Anik E Satellite, trillium telephone marketing, digital equipment, remote sensing, television relay stations, digital phone systems, and microwave links.

N86-30582# Army War Coll., Carlisle Barracks, Pa. TRANSFER OF HIGH-TECHNOLOGY TO THE SOVIET UNION. A PREDICAMENT FOR THE US

J. E. HOLLAND, JR. 21 Mar. 1986 29 p

(AD-A166469) Avail: NTIS HC A03/MF A01 CSCL 15D

Through reading Western open-source literature and by international purchases of U.S. computers and electronics, the Soviets have been able to modernize their military forces. This raises the question. Should U.S. technology be in the public domain and available for exploitation by the Soviet Union? The scope of Soviet information gathering operations raises concerns about the true Russian motivation for detente. Complicating the technology-transfer issue has been the prevailing attitude that parity promotes stability among world powers. As a result of this philosophy, the United States has found itself restrained from acquiring a significant technology advantage over the Soviet Union. The U.S. finds itself in the predicament of both needing a technology edge yet being unable to have a significant one. Thus, ensuring that the Soviets are not able to apply U.S. technology too quickly becomes an important aspect of the technology-transfer solution. Although technology controls are expensive and require the commitment of the American public, they are necessary. Should the Soviets gain technological parity, Then the U.S. would be compelled to match Soviet conventional forces to ensure that Russian expansionism is equally restrained. GRA

N86-30744*# Colorado Univ., Boulder. Center for Space Law and Policy.

A STUDY OF FACTORS RELATED TO COMMERCIAL SPACE PLATFORM SERVICES

S. N. HOSENBALL Aug. 1986 254 p

(Contract NAGW-884)

(NASA-CR-176881; NAS 1.26:176881) Avail: NTIS HC A12/MF A01 CSCL 22A

In the past four years, the issue of the commercial development of space has come to the forefront of the U. S. national space policy. Though the Administration, Congress and NASA have all shown strong support for encouraging the private sector to become more actively involved in the commercial utilization of space, the question remains whether they must do more to foster the creation and development of a viable U. S. commercial space industry. Marketing aspects, insurance and risk loss, tax related factors, space transportation, termination liability, institutional barriers, and procurement laws and regulations are discussed. B.G.

N86-31450# Committee on Appropriations (U. S. House). NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

In its Department of Housing and Urban Development-Independent Agencies Appropriations Bill, 1987 p 42-49 1986 Avail: US Capitol, House Document Room

Budget allocations for the orbital space station, space flight control and data communications, space shuttles, construction of new facilities, research and project management, Advanced Communications Technology Satellite (ACTS) program, space commercialization, and the shuttle infrared telescope facility (SIRTF) are discussed. B.G.

N86-32343# Societe Nationale Industrielle Aerospatiale, Saint-Medard-en-Jalles (France). Div. Systemes Balistiques et Spatiaux.

LEGISLATION FOR SOFTWARE RIGHTS PROTECTION AT LAST [ENFIN UN STATUT POUR LA PROTECTION DES LOGICIELS]

O. BRUN and M. F. MURPHY 1986 5 p

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The deficiencies of French jurisprudence and the content of a law to protect the rights for the exploitation of computer programs are discussed. The positive aspects of the law are shown. ESA

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FREEDOM OF INFORMATION ACT: NONCOMPLIANCE WITH AFFIRMATIVE DISCLOSURE PROVISIONS

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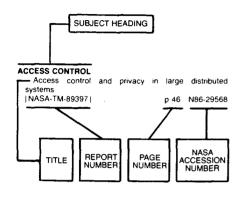
To determine whether federal agencies were complying with the Freedom of Information Act's (FOIA) affirmative disclosure requirements, we interviewed officials of component organizations of the 13 cabinet-level departments and the Veterans Administration and evaluated their procedures. Our review was designed to assess compliance efforts at these organizations only, and the results can not be projected to the departments as a whole or to other organizations subject to FOIA requirements. At the 14 organizations we found that: in 13 instances, the U.S. Government organizations did not publish or keep current information on their central and field organizations; in six instances, organizations' published statements on where the public could obtain information were out of date; and one organization did not publish procedural information on its system of hearings and appeals. Officials in the 14 organizations attributed noncompliance with subsection (a)(1) to such reasons as delays in internal rules clearance processes, frequent agency reorganizations, and administrative error. Officials in some organizations also felt that publication of organization material in The United States Government Manual was sufficient compliance. In 20 instances, 60% of the organizations were not in full compliance with subsection (a)(2) requirements. Thus, these organizations did not provide members of the public the means to routinely identify and inspect all materials they might require in dealing with the organizations. GRA

MANAGEMENT / A Bibliography for NASA Managers

SUBJECT INDEX

APRIL 1987

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

A

A-3 AIRCRAFT Is there life after 10,000 flight hours? p 79 A86-22402 ABILITIES Subjective workload and individual differences in information processing abilities [SAE PAPER 841491] p 2 A86-26011 ACCESS CONTROL Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29568 ACCIDENT INVESTIGATION Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 1 [AD-A171402] D 93 N86-24726 Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 2 [AD-A171403] p 95 N86-28974 Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 3 [AD-A171403] p 95 N86-28975 Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 4 [AD-A171404] p 95 N86-28976 Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 5 [AD-A171404] p 95 N86-28977 ACCIDENT PREVENTION Actions to implement the recommendations of the Presidential Commission on the Space Shuttle Challenger Accident. Report to the President p 94 N86-27352 ACCIDENTS

Budget effects of the Challenger accident

p 92 N86-20464 Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 1 [AD-A171402] p 93 N86-24726 Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 2 [AD-A171403] p 95 N86-28974

Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 3 [AD-A171403] p 95 N86-28975 Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 4

[AD-A171404] p 95 N86-28976 Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 5 [AD-A171404] p 95 N86-28977 ACCOUNTING

NASA's FIA (National Aeronautics and Space Administration's Financial Integrity Act) Program: NASA's progress in implementing Financial Integrity Act requirements [PB86-135100] p.94 N86-25288

ACCURACY The bootstrap method for assessing statistical accuracy [AD-A151257] p 81 N86-20047

- Composites in today's and tomorrow's U.S. airliners
- P 22 A86-47603
- Exploiting sequential phonetic constraints in recognizing spoken words
- [AD-A165913] p 34 N86-29120 Acoustics Division recent accomplishments and research plans [NASA-TM-89012] p 65 N86-31340
- ACQUISITION The discipline of software acquisition [AIAA PAPER 85-5056] p.36 A86-1141
- [AIAA PAPER 85-5056] p 36 A86-11412 Derivational analogy: A theory of reconstructive problem solving and expertise acquisition [AD-A156817] p 12 N86-10899 ADA (PROGRAMMING LANGUAGE)
- Ada instructional techniques for managers and programmers p 38 A86-28409 Ada (trademark) training curriculum: Software
- engineering for managers M101 teacher's guide [AD-A165123] p 8 N86-27941 ADAPTIVE CONTROL Role of robotics in solving production, social problems
- p 34 N86-26062 Leader-follower strategies under modeling and information uncertainties [DE86-000203] p 13 N86-27950

.

- Adaptive wall wind tunnels: A selected, annotated bibliography [NASA-TM-87639] p 26 N86-29871
- [NASĂ-TM-87639] p 26 N86-29871 AEROACOUSTICS Acoustics Division recent accomplishments and research plans [NASA-TM-89012] p 65 N86-31340
- AERODYNAMIC CONFIGURATIONS Langley aerospace test highlights, 1985 [NASA-TM-87703] p 81 N86-26276
- NASA and general aviation [NASA-SP-485] p 26 N86-30720 AERODYNAMIC INTERFERENCE
- Adaptive wall wind tunnels: A selected, annotated bibliography [NASA-TM-87639] p 26 N86-29871
- [NASĂ-ŤM-87639] p 26 N86-29871 **AERODYNAMICS** ASTROS - An advanced software environment for automated design [AIAA PAPER 86-0856] p 39 A86-38807 Cryogenic wind tunnels for high Reynolds number
- testing [NASA-TM-87743] p 26 N86-29872 AERONAUTICAL ENGINEERING
- Future directions in aeropropulsion technology
- P 49 AB6-11602 Aeronautical technology 2000: A projection of advanced vehicle concepts [NASA-CR-176322] p 23 N86-13235
- Cryogenic wind tunnels for high Reynolds number testing [NASA-TM-87743] p 26 N86-29872

Advanced instrumentation for aero	onautical propulsion
research	
[NASA-TM-88853] AERONAUTICAL SATELLITES	p 27 N86-32703
A shared satellite system would	satisfy many future
aviation needs	p 51 A86-20921
AEROSPACE ENGINEERING	•
Planning and monitoring reliability g	
with MIL-STDs and handbooks	p 79 A86-23009
Man's permanent presence in spa the Third Annual Aerospace Technol	logy Symposium
University of New Orleans, LA, Nover	nber 7, 8, 1985
	p 55 A86-32904
	ive key areas of
engineering technology in space Artificial intelligence - New tools for	p 73 A86-32930
managers	p 30 A86-34986
Cost containment and KSC Shutt	•
containment and aerospace construct	
Environment distantion of	p 19 A86-34989
Engineering flight simulation - A re [SAE PAPER 851901]	p 20 A86-36941
Trades and Analyses Management	
	p 21 A86-40514
NASA-universities relationships	in aero/space
engineering: A review of NASA's pro	
[NASA-CR-176307] Besearch and technology Fiscal Va	p 61 N86-12158
Research and technology Fiscal Ye [NASA-TM-86532]	p 62 N86-17225
Assured access to space during the	
[GPO-53-617]	p 92 N86-21453
Langley aerospace test highlights, 1	
[NASA-TM-87703] The information needs of scientist	p 81 N86-26276
The information needs of scientist aerospace	p 45 N86-28796
Activities report in aerospace resea	rch
[ETN-86-97190]	p 64 N86-28907
Data for selection of space material [ESA-PSS-01-701-ISSUE-1]	
AEROSPACE ENVIRONMENTS	p 77 N86-32584
Human development and the conqu	lest of space
Human development and the conqu	p 83 A86-18381
Human development and the conqu Management of outer space	p 83 A86-18381 p 84 A86-19261
Human development and the conqu Management of outer space The quantitative modelling of	p 83 A86-18381 p 84 A86-19261
Human development and the conqu Management of outer space	p 83 A86-18381 p 84 A86-19261
Human development and the conquestion of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY	p 83 A86-18381 p 84 A86-19261 i human spatial p 9 N86-33210
Human development and the conquination of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international	p 83 A86-18381 p 84 A86-19261 i human spatial p 9 N86-33210
Human development and the conquestion of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The
Human development and the conquination of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international	p 83 A86-18381 p 84 A86-19261 i human spatial p 9 N86-33210
Human development and the conquination of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499]	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ce
Human development and the conquestion of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assurant	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394
Human development and the conquination of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 Ice p 78 A86-22394 tt policy
Human development and the conquestion of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assurant	p 83 A86-18381 p 84 A86-19261 f human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22591 it policy p 85 A86-24598
Human development and the conquestion of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 Ice p 78 A86-22394 tt policy p 85 A86-24598 se productivity p 3 A86-34983
Human development and the conqui- Management of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ce p 78 A86-22394 tt policy p 85 A86-24598 e productivity p 3 A86-34983 we aware of how
Human development and the conquisition of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assurant The evolution of the agency's patert The role of the technologist in space Helicopter customer support - Aret great it can be	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394 nt policy p 85 A86-24598 e productivity p 3 A86-34983 we aware of how p 20 A86-35644
Human development and the conqui- Management of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394 t policy p 85 A86-22394 t policy p 85 A86-24598 re productivity p 3 A86-34983 we aware of how p 20 A86-35644 line actioneer
Human development and the conquisition of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are great it can be The field representative 'front	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394 t policy p 85 A86-22394 t policy p 85 A86-24598 re productivity p 3 A86-34983 we aware of how p 20 A86-35644 line actioneer
Human development and the conquestion of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are great it can be The field representative 'front I helicopter manufacturer field serv	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394 ht policy p 85 A86-22394 ht policy p 85 A86-24598 is productivity p 30 A86-35644 line actioneer'
Human development and the conquestion of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are great it can be The field representative 'front helicopter manufacturer field serv responsibilities World aerospace profile 1986 Bo	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 p 78 A86-22591 p 78 A86-22594 tt policy p 85 A86-24598 we aware of how p 20 A86-34983 we aware of how p 20 A86-35644 line actioneer' ice representative p 20 A86-35645 p 21 A86-44919
Human development and the conquination of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are great it can be The field representative 'front helicopter manufacturer field server responsibilities	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394 tt policy p 85 A86-24598 ice porductivity p 3 A86-34983 we aware of how p 20 A86-35644 line actioneer'
Human development and the conquestion of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are great it can be The field representative 'front helicopter manufacturer field services world aerospace profile 1986 Bc Productivity improvement in	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394 ht policy p 85 A86-24598 is productivity p 3 A86-34983 we aware of how p 20 A86-35644 line actioneer' ice representative p 20 A86-35645 p 20 A86-43919 engineering at p 5 N86-151778
Human development and the conquestion of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are great it can be The field representative 'front helicopter manufacturer field serv responsibilities World aerospace profile 1986 Bo Productivity improvement in Rocketdyne Chinese space and aviation indus breakthroughs	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394 it policy p 85 A86-24598 ice productivity p 35 A86-34983 we aware of how p 20 A86-35644 line actioneer'
Human development and the conquisite of auter space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are great it can be The field representative 'front helicopter manufacturer field serv responsibilities World aerospace profile 1986 Bc Productivity improvement in Rocketdyne Chinese space and aviation indus breakthroughs [NASA-TM-87973]	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394 ht policy p 85 A86-22394 ht policy p 85 A86-24598 is productivity p 30 A86-35644 line actioneer'
Human development and the conquestion of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are great it can be The field representative 'front Helicopter manufacturer field servicesponsibilities World aerospace profile 1986 Bc Productivity improvement in Rocketdyne Chinese space and aviation indus breakthroughs [NASA-TM-87973] Guide to Canadian aerospace relate	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394 tt policy p 85 A86-22394 tt policy p 85 A86-24598 we aware of how p 20 A86-35644 line actioneer'
Human development and the conquestion of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are great it can be The field representative 'front helicopter manufacturer field serv responsibilities World aerospace profile 1986 Bc Productivity improvement in Rocketdyne Chinese space and aviation indus breakthroughs [NASA-TM-87973] Guide to Canadian aerospace relate [AD-A167794]	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394 ht policy p 85 A86-22394 ht policy p 85 A86-24598 is productivity p 30 A86-35644 line actioneer'
Human development and the conquestion of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are great it can be The field representative 'front helicopter manufacturer field serv responsibilities World aerospace profile 1986 Bo Productivity improvement in Rocketdyne [NASA-TM-87973] Guide to Canadian aerospace relate [AD-A167794] EROSPACE MEDICINE Science requirements for Space	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394 ht policy p 85 A86-22394 ht policy p 85 A86-24598 ie productivity p 30 A86-35644 line actioneer'
Human development and the conquestion of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are great it can be The field representative 'front helicopter manufacturer field serv responsibilities World aerospace profile 1986 Bc Productivity improvement in Rocketdyne Chinese space and aviation indus breakthroughs [NASA-TM-87973] Guide to Canadian aerospace relate [AD-A167794] AEROSPACE MEDICINE Science requirements for Space [SAE PAPER 851368]	p 83 A86-18361 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394 nt policy p 85 A86-24598 e productivity p 3 A86-34983 we aware of how p 20 A86-35644 line actioneer' ice representative p 20 A86-35645 ice p 21 A86-44919 engineering at p 5 N86-15178 trips score major p 25 N86-32327 Station Laboratory p 52 A86-23582
Human development and the conquestion of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are great it can be The field representative 'front helicopter manufacturer field serv responsibilities World aerospace profile 1986 Bc Productivity improvement in Rocketdyne Chinese space and aviation indus breakthroughs [NASA-TM-87973] Guide to Canadian aerospace relate [AD-A167794] AEROSPACE MEDICINE Science requirements for Space [SAE PAPER 851368] An updated model for a Space	p 83 A86-18361 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394 nt policy p 85 A86-24598 e productivity p 3 A86-34983 we aware of how p 20 A86-35644 line actioneer' ice representative p 20 A86-35645 ice p 21 A86-44919 engineering at p 5 N86-15178 trips score major p 25 N86-32327 Station Laboratory p 52 A86-23582
Human development and the conquestion of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are great it can be The field representative 'front helicopter manufacturer field serv responsibilities World aerospace profile 1986 Bc Productivity improvement in Rocketdyne Chinese space and aviation indus breakthroughs [NASA-TM-87973] Guide to Canadian aerospace relate [AD-A167794] AEROSPACE MEDICINE Science requirements for Space [SAE PAPER 851368]	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394 tt policy p 85 A86-22394 tt policy p 85 A86-24598 we aware of how p 20 A86-35644 line actioneer'
Human development and the conquestion of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are great it can be The field representative 'front I helicopter manufacturer field serv versponsibilities World aerospace profile 1986 Bc Productivity improvement in Rocketdyne Chinese space and aviation indus breakthroughs [NASA-TM-87973] Guide to Canadian aerospace relate [AD-A167794] AEROSPACE MEDICINE Science requirements for Space [SAE PAPER 851368] An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] AEROSPACE SAFETY	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394 ht policy p 85 A86-22394 ht policy p 85 A86-24598 is productivity p 30 A86-35644 line actioneer'
Human development and the conquestion of outer space The quantitative modelling of habitability [INASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are great it can be The field representative 'front I helicopter manufacturer field server responsibilities World aerospace profile 1986 Bc Productivity improvement in Rocketdyne Chinese space and aviation indus breakthroughs [NASA-TM-87973] Guide to Canadian aerospace relate [AD-A167794] AEROSPACE MEDICINE Science requirements for Space [SAE PAPER 851368] An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] AEROSPACE SAFETY	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394 ht policy p 85 A86-22394 ht policy p 85 A86-24598 is productivity p 30 A86-35644 line actioneer'
Human development and the conquestion of outer space The quantitative modelling of habitability [NASA-CR-179716] AEROSPACE INDUSTRY Economic equity and international example of E.S.A [IAF PAPER 85-499] Have factory, will launch Decision making in product assuran The evolution of the agency's pater The role of the technologist in space Helicopter customer support - Are great it can be The field representative 'front I helicopter manufacturer field serv versponsibilities World aerospace profile 1986 Bc Productivity improvement in Rocketdyne Chinese space and aviation indus breakthroughs [NASA-TM-87973] Guide to Canadian aerospace relate [AD-A167794] AEROSPACE MEDICINE Science requirements for Space [SAE PAPER 851368] An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] AEROSPACE SAFETY	p 83 A86-18381 p 84 A86-19261 human spatial p 9 N86-33210 cooperation - The p 83 A86-15943 p 16 A86-20591 ice p 78 A86-22394 ht policy p 85 A86-22394 ht policy p 85 A86-24598 is productivity p 30 A86-35644 line actioneer'

AIR LAW

excellence through parametric models (A review) [SAE PAPER 851907] p 31 A80

p 31 A86-38556

AEROSPACE SCIENCES	
How NASA prepared to cope with disaster	AIRCRAFT COMMUNICATION
p 79 A86-25866	A shared satellite system would satisfy many future aviation needs p 51 A86-20921
Threat-strategy technique - A system safety tool for advanced design in Space Station hazard analysis p 79 A86-32947	A rapid evaluation approach for configuration
Actions to implement the recommendations of the Presidential Commission on the Space Shuttle Challenger	development of new aircraft [AIAA PAPER 85-3068] p 15 A86-10932
Accident. Report to the President p 94 N86-27352	A review of unconventional aircraft design concepts
AEROSPACE SCIENCES History of British space science Book	p 22 A86-48995 AIRCRAFT CONSTRUCTION MATERIALS
p 87 A86-33604	Composites in today's and tomorrow's U.S. airliners
AEROSPACE SYSTEMS Selecting interrelated R&D projects in space technology	p 22 A86-47603 AIRCRAFT CONTROL
planning p 54 A86-29750	Pilots of the future - Human or computer?
Aerospace and electronic systems - Advanced concepts and pioneering perspectives; Proceedings of the Sixth	p 1 A86-18541 Summary of results of NASA F-15 flight research
Symposium, Dayton, OH, November 14, 15, 1984 p 19 A86-31253	program [NASA-TM-86811] p 25 N86-26277
Projections of space systems opportunities and technologies for the 2000 to 2030 time period p 60 A86-48451	AIRCRAFT DESIGN Turboprop airliners get bigger - Will they have a market? p 66 A86-10568
Self-renewal: A strategy for quality and productivity	market? p 66 A86-10568 Large airplane derivative development methodology
improvement p 80 N86-15160 The key to successful management of STS operations:	[AIAA PAPER 85-3043] p 15 A86-10926
An integrated production planning system	Some comparisons of US and USSR aircraft design developments
p 12 N86-15161	[AIAA PAPER 85-3060] p 15 A86-10930
Mentoring as a communication channel: Implications for innovation and productivity p 4 N86-15164	A rapid evaluation approach for configuration development of new aircraft
Technical and management information system: The	[AIAA PAPER 85-3068] p 15 A86-10932
tool for professional productivity on the space station program p 41 N86-15171	Rapid sizing methods for airplanes [AIAA PAPER 85-4031] p 16 A86-10960
Primer on operating and support (O and S) costs for	Optimum wing - For all flight conditions?
space systems [AD-A162381] p 71 N86-24588	p 16 A86-11961 A self-repairing aircraft? new control methods for
Activities report in aerospace research	fighter stabilization p 16 A86-14243
[ETN-86-97190] p 64 N86-28907 Guide to Canadian aerospace related industries	Expert systems and their use in augmenting design optimization
[AD-A167794] p 26 N86-32327	[AIAA PAPER 85-3095] p 28 A86-14434
AEROSPACE TECHNOLOGY TRANSFER Technology base for the future of space	Assessing cost-effective weight saving in aircraft operations p 16 A86-20039
p 59 A86-45709	Airframe design to achieve minimum cost
AEROSPACEPLANES Spacecab II - A low-cost small shuttle for Britain	p 17 A86-22141 Tomorrow Concorde's successor?
p 53 A86-28725	p 17 A86-26299
Low cost access to space - A second-generation Shuttle concept p 55 A86-32913	Digital avionics for modern aircraft - A case study into the problems and promise of aircraft electronics
Can we develop the 1.5 million pound aerospace	p 18 A86-28346
plane? p 55 A86-34195 AGE FACTOR	2010 - The symbionic cockpit p 18 A86-28455 What technologies await the future airliner?
The functional age profile - An objective decision criterion	p 19 A86-31038
for the assessment of pilot performance capacities and capabilities p 3 A86-31823	X-aircraft for world leadership in aeronautics p 19 A86-31330
AGREEMENTS US-Soviet intergovernmental agreement on cooperative	Starship I - A weight control challenge for next
space activities - Should it be re-established?	generation business aircraft [SAWE PAPER 1682] p 20 A86-35223
p 87 A86-29698 Airline indemnity agreements - Will the contracts shift	Advanced concepts transport aircraft of 1995
your risks? p 88 A86-34228	[SAE PAPER 851808] p 20 A86-35438 Engineering flight simulation - A revolution of change
Possible models for specific space agreements p 88 A86-43339	[SAE PAPER 851901] p 20 A86-36941
Agreements between states and with international	Which transport technologies will fly? p 69 A86-41037
organizations on Space Station construction, transport and orbital assembly p 88 A86-43340	World aerospace profile 1986 Book
AIR LAW	p 21 A86-44919 A review of unconventional aircraft design concepts
Recent developments in aviation case law p 84 A86-18848	p 22 A86-48995
AIR TRAFFIC CONTROL	Aeronautical technology 2000: A projection of advanced vehicle concepts
A shared satellite system would satisfy many future aviation needs p 51 A86-20921	[NASA-CR-176322] p 23 N86-13235 Langley aerospace test highlights, 1985
Alerted monitors: Human operators aided by automated	[NASA-TM-87703] p 81 N86-26276
detectors [PB85-222750] p 4 N86-13906	Activities report in aerospace research [ETN-86-97190] p 64 N86-28907
Will the USAF need ground-based air traffic control radar	NASA and general aviation
in the year 2000? [AD-A166504] p 8 N86-29805	[NASA-SP-485] p 26 N86-30720 AIRCRAFT ENGINES
NASA and general aviation	'Smart' engine components - A micro in every blade?
[NASA-SP-485] p 26 N86-30720	p 17 A86-21896 The competitive and cooperative outlook for aircraft
AIR TRANSPORTATION Finance of international carriers p 67 A86-18539	propulsion systems
AIR WATER INTERACTIONS	[AIAA PAPER 86-1134] p 23 A86-49571 Depot maintenance of aviation components: Contractor
The overall plan: A scientific strategy Tropical Ocean Global Atmosphere (TOGA) program p 64 N86-29463	versus organic repair
AIRBORNE EQUIPMENT	[AD-A162071] p 75 N86-23556 NASA and general aviation
Geodesy: A look to the future	[NASA and general aviation [NASA-SP-485] p 26 N86-30720
(NASA-CR-176283) p 61 N86-11657 AIRBORNE SURVEILLANCE RADAR	AIRCRAFT FUELS
Air safety: Federal Aviation Administration's role in	Robotic refueling system for tactical and strategic aircraft
developing mid-air collision avoidance back-up systems [PB86-197506] p 82 N86-32418	[AD-D011980] p 92 N86-21540
AIRBORNE/SPACEBORNE COMPUTERS	AIRCRAFT HAZARDS Knowledge engineering for a flight management expert
Expert systems for Space Station automation p 28 A86-14548	system p 30 A86-28498
Spacecraft software cost estimation - Striving for	Tomorrow's weather - New accuracy in forecasting p 54 A86-32450
excellence through parametric models (A review)	NASA storm hazards research in lightning strikes to

NASA storm hazards research in lightning strikes to aircraft p 79 A86-37479

NASA's Aircraft Icing Analysis Prog		
[NASA-TM-88791]	p 82	N86-31548
AIRCRAFT INDUSTRY		
The world aircraft industry Book The factory of the future	p 17 p 23	A86-26114 N86-11228
An example of integrated logistic s		
to production testing aircraft indust		applied also
to production tooling an order indust	., p 77	N86-30898
AIRCRAFT MAINTENANCE	•	
A self-repairing aircraft? new c		
fighter stabilization	p 16	
Aviation maintenance management		
	p 72	A86-21055
Helicopter maintenance in the real		100 005 10
Developing a maintenance concept	p73 forfut	A86-30549
systems		
[AIAA PAPER 86-1145]	p 74	A86-43333
Planning for minimum overhaul time		
	p 75	A86-47616
Depot maintenance of aviation comp	onents	s: Contractor
versus organic repair		
[AD-A162071]	p 75	N86-23556
AIRCRAFT MODELS		
Large airplane derivative develop		
[AIAA PAPER 85-3043] Rapid sizing methods for airplanes	p 15	A86-10926
[AIAA PAPER 85-4031]	p 16	A86-10960
AIRCRAFT PARTS	019	,
Spare parts pricing - Impact on logi	stics si	upport
	p 74	A86-35647
AIRCRAFT PERFORMANCE		
Retrofitting avionics - Closing	the	performance
'Generation gap'		
[SAE PAPER 851813]	p 79	A86-38324
A review of unconventional aircraft	p 22	
Long endurance aircraft performance		A00-40995
Long endurance anchart performance	р 80	A86-49478
AIRCRAFT PILOTS	p 00	
Pilots of the future - Human or com	puter?	
	p 1	A86-18541
Knowledge engineering for a flight r		
system	p 30	
Will the USAF need ground-based air in the year 2000?	tranic	control rauar
AU-A1005041	n 8	N86-29805
[AD-A166504] AIRCRAFT POWER SUPPLIES	p 8	N86-29805
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications		
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION	tributic p 17	on for air and A86-24828
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated	tributic p 17	on for air and A86-24828
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing	tributic p 17 comp	on for air and A86-24828 osite aircraft
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506]	tributic p 17 comp p 17	on for air and A86-24828 osite aircraft A86-24667
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing	tributic p 17 comp p 17 p 20	on for air and A86-24828 osite aircraft A86-24667 A86-35660
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of	tributic p 17 comp p 17 p 20	on for air and A86-24828 osite aircraft A86-24667 A86-35660
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems	tributic p 17 comp p 17 p 20 putlook	on for air and A86-24828 osite aircraft A86-24667 A86-35660
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of	tributic p 17 comp p 17 p 20	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co	tributic p 17 comp p 17 p 20 putlook p 23	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques	tributic p 17 comp p 17 p 20 putlook p 23	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY	tributic p 17 comp p 17 p 20 outlook p 23 osts tl p 22	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques	tributic p 17 comp p 17 p 20 putlook p 23 osts tl p 22 ?	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced coo fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours	tributic p 17 comp p 17 p 20 outlook p 23 osts tl p 22	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY	tributic p 17 comp p 17 p 20 putlook p 23 osts tl p 22 ? p 79	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety	tributic p 17 comp p 17 p 20 outlook p 23 osts ti p 22 ? p 79 ne ma	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector	tributic p 17 comp p 17 p 20 putlook p 23 osts tl p 20 outlook	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 nagement of A86-49084
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT SAFETY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1]	tributic p 17 comp p 17 p 20 putlook p 23 vsts tl p 22 ? p 79 ne ma p 80 p 93	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 nagement of A86-49084 N86-24673
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admin	tributic p 17 comp p 17 p 20 p 23 outlook p 23 ests tl p 22 ? p 79 p 79 p 80 p 80 p 93 aistrati	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 nagement of A86-49084 N86-24673 on's role in
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidance	tributic p 17 comp p 17 p 20 outlook p 23 sts tl p 22 ? p 79 p 79 p 80 p 93 sistrati e bacl	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-24024 nagement of A86-49084 N86-24673 jon's role in <-up systems
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT SAFETY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidanc [PB86-197506]	tributic p 17 comp p 17 p 20 p 23 outlook p 23 ests tl p 22 ? p 79 p 79 p 80 p 80 p 93 aistrati	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 nrough new A86-49448 A86-22402 nagement of A86-49084 N86-24673 on's role in k-up systems
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidance	tributic p 17 comp p 20 p 20 putlook p 23 stst tl p 22 p 79 p 79 ne ma p 80 p 93 nistrati e bacl p 82	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 nagement of A86-49084 N86-24673 ion's role in k-up systems N86-32418
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT SAFETY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidand [PB86-197506] AIRCRAFT STABILITY Summary of results of NASA F- program	tributic p 17 comp p 17 p 20 putlook p 23 sts tl p 22 p 79 p 79 p 80 p 93 sistrati e bacl p 82 15 flig	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 nagement of A86-49084 N86-24673 ion's rote in N86-24673 on's rote in N86-32418
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced oc fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidance [PB86-197506] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811]	tributic p 17 comp p 20 p 20 putlook p 23 stst tl p 22 p 79 p 79 ne ma p 80 p 93 nistrati e bacl p 82	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 nagement of A86-49084 N86-24673 ion's rote in N86-24673 on's rote in N86-32418
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidance (PB86-197506] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811] AIRCRAFT STRUCTURES	tributic p 17 comp p 17 p 20 p 20 p 23 sts tf p 22 ? p 79 p 80 p 80 p 80 p 80 p 82 sts tf e baclo p 82 15 filin p 25	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49044 A86-22402 nagement of A86-49084 N86-24673 ion's role in N86-32418 ght research N86-26277
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidanco [PB86-197506] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811] AIRCRAFT STRUCTURES Next generation aircraft structure	tributic p 17 comp p 17 p 20 p 20 p 23 sts 11 p 22 p 79 p 79 p 79 p 79 p 79 p 79 p 82 sts 11 p 82 15 flig p 82 sts 15 flig p 82 sts 15 flig	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49044 A86-22402 nagement of A86-49084 N86-24673 ion's role in N86-32418 ght research N86-26277
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidance (PB86-197506] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811] AIRCRAFT STRUCTURES	tributic p 17 comp p 17 p 20 p 17 p 20 p 23 sts tl p 22 p 79 p 80 p 93 sistratic p 82 sts 15 flig p 25 sts - Til	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 nagement of A86-49084 N86-24673 ion's role in k-up systems N86-32418 ght research N86-26277 he need for
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidanc [PB86-197506] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811] AIRCRAFT STRUCTURES Next generation aircraft structure co-ordinated Canadian R & D program	tributic p 17 comp p 17 p 20 p 20 utlook p 23 sts ti p 22 p 79 p 80 p 93 sistratic e baci p 82 s 5 ti p 82 s 5 ti p 82 s 5 ti p 82 p 93 s 5 ti p 82 p 93 s 5 ti p 17 p 20 p 93 s 5 ti p 17 p 20 p 20 p 20 p 20 p 20 p 20 p 20 p 20	on for air and A86-24628 osite aircraft A86-24667 for aircraft A86-49571 hrough new A86-49571 hrough new A86-49044 A86-22402 nagement of A86-49084 N86-24673 ion's role in N86-32418 ght research N86-26277 he need for A86-39567
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced oc fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [INASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidance (PB86-197506] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811] AIRCRAFT STRUCTURES Next generation aircraft structure co-ordinated Canadian R & D program Computational structural mechanics the NASA Langley Research Center	tributic p 17 p 20 p 17 p 20 p 17 p 20 p 17 p 20 p 23 p 22 p 79 p 79 p 80 p 93 nistrati e bacl p 82 n 55 f flig p 25 ss - Ti ss p 21 p 21 p 25 ss - Ti ss - 21 p 25 p 21 p 25 p 21 p 25 p 25 p 25 p 25 p 25 p 25 p 25 p 25	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 nagement of A86-49084 N86-24673 ion's role in <-up systems N86-32418 ght research N86-26277 he need for A86-39567 ew activity at
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidance [PB86-197506] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811] AIRCRAFT STRUCTURES Next generation aircraft structure co-ordinated Canadian R & D program Computational structural mechanics the NASA Langley Research Center [NASA-TM-87612]	tributic p 17 comp p 17 p 20 p 20 utlook p 23 sts ti p 22 p 79 p 80 p 93 sistratic e baci p 82 s 5 ti p 82 s 5 ti p 82 s 5 ti p 82 p 93 s 5 ti p 82 p 93 s 5 ti p 17 p 20 p 93 s 5 ti p 17 p 20 p 20 p 20 p 20 p 20 p 20 p 20 p 20	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 nagement of A86-49084 N86-24673 ion's role in <-up systems N86-32418 ght research N86-26277 he need for A86-39567 ew activity at
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidanc [PB86-197506] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811] AIRCRAFT STRUCTURES Next generation aircraft structure co-ordinated Canadian R & D program Computational structural mechanics the NASA Langley Research Center [NASA-TM-87612] Ice detector	tributic p 17 p 20 p 17 p 20 p 23 p 22 p 29 p 29 p 30 p 40 p 40 p 40 p 40 p 40 p 40 p 40 p 4	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 nagement of A86-49084 N86-24673 on's role in N86-32418 ght research N86-26277 he need for A86-39567 ew activity at N86-11540
AiRCRAFT POWER SUPPLIES Electric power management and dis space applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [INASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidanc (PB86-197506] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811] AIRCRAFT STRUCTURES Next generation aircraft structure co-ordinated Canadian R & D program Computational structural mechanics the NASA Langley Research Center [NASA-CASE-LAR-13403-1] Ice detector [NASA-CASE-LAR-13403-1]	tributic p 17 p 20 p 17 p 20 p 17 p 20 p 17 p 20 p 23 p 22 p 79 p 79 p 80 p 93 nistrati e bacl p 82 n 55 f flig p 25 ss - Ti ss p 21 p 21 p 25 ss - Ti ss - 21 p 25 p 21 p 25 p 21 p 25 p 25 p 25 p 25 p 25 p 25 p 25 p 25	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 nagement of A86-49084 N86-24673 on's role in N86-32418 ght research N86-26277 he need for A86-39567 ew activity at N86-11540
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT PROLUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidance (PB86-197506] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811] AIRCRAFT STRUCTURES Next generation aircraft structure co-ordinated Canadian R & D program Computational structural mechanics the NASA Langley Research Center [NASA-CASE-LAR-13403-1] AIRFRAMES	tributic p 17 comp p 20 p 20 p 20 p 20 p 20 p 20 p 20 p 2	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 nagement of A86-49084 N86-24673 on's role in N86-32418 ght research N86-26277 he need for A86-39567 ew activity at N86-11540
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [INASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidance (PB86-197506] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811] AIRCRAFT STRUCTURES Next generation aircraft structure co-ordinated Canadian R & D program Computational structural mechanics the NASA Langley Research Center [NASA-CASE-LAR-13403-1] Ice detector [NASA-CASE-LAR-13403-1] AIRFRAMES CAD/CAM designer - Jack of all tra	tributic p 17 comp p 17 p 20 p 17 p 20 p 23 stst tl p 22 p 79 p 79 p 80 p 93 sistratic p 82 p 93 sistratic p 82 s 5 Tl s p 21 p 25 s 5 Tl s p 22 p 79 p 93 sistratic p 82 s 5 Tl s p 21 p 25 s 5 Tl s p 22 p 79 p 93 s 15 p 21 p 25 s 5 Tl s p 22 p 79 p 93 s 15 p 21 p 25 s 5 Tl s p 22 p 79 p 93 s 15 p 21 p 25 s 5 Tl s p 22 p 79 p 93 s 15 p 21 p 25 s 5 Tl s p 22 p 79 p 93 s 15 p 21 p 25 s 5 Tl s p 22 p 79 p 93 s 15 p 21 p 25 s 5 Tl s p 22 p 79 p 93 s 15 p 21 p 25 s 5 Tl s p 22 p 25 s 5 Tl s p 22 s 5 Tl s p 22 p 25 s 5 Tl s p 22 s 5 Tl s p 23 s 5 Tl	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 nagement of A86-49084 N86-24673 for 's role in <-up systems N86-32418 ght research N86-26277 he need for A86-39567 ew activity at N86-11540 N86-24673 A86-21895
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT PROLUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidance (PB86-197506] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811] AIRCRAFT STRUCTURES Next generation aircraft structure co-ordinated Canadian R & D program Computational structural mechanics the NASA Langley Research Center [NASA-CASE-LAR-13403-1] AIRFRAMES	tributic p 17 comp p 17 p 20 p 17 p 20 p 23 stst tl p 22 p 79 p 79 p 80 p 93 sistratic p 82 p 93 sistratic p 82 s 5 Tl s p 21 p 25 s 5 Tl s p 22 p 79 p 93 sistratic p 82 s 5 Tl s p 21 p 25 s 5 Tl s p 22 p 79 p 93 s 15 p 21 p 25 s 5 Tl s p 22 p 79 p 93 s 15 p 21 p 25 s 5 Tl s p 22 p 79 p 93 s 15 p 21 p 25 s 5 Tl s p 22 p 79 p 93 s 15 p 21 p 25 s 5 Tl s p 22 p 79 p 93 s 15 p 21 p 25 s 5 Tl s p 22 p 79 p 93 s 15 p 21 p 25 s 5 Tl s p 22 p 79 p 93 s 15 p 21 p 25 s 5 Tl s p 22 p 25 s 5 Tl s p 22 s 5 Tl s p 22 p 25 s 5 Tl s p 22 s 5 Tl s p 23 s 5 Tl	on for air and A86-24828 osite aircraft A86-24667 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 nagement of A86-49084 N86-24673 for 's role in <-up systems N86-32418 ght research N86-26277 he need for A86-39567 ew activity at N86-11540 N86-24673 A86-21895
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELABILITY Is there life after 10,000 flight hours AIRCRAFT RELABILITY The airline engineering role in th safety loc detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidance [PB86-197506] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811] AIRCRAFT STRUCTURES Next generation aircraft structure co-ordinated Canadian R & D program Computational structural mechanics the NASA Langley Research Center [NASA-TM-87612] loc detector [NASA-CASE-LAR-13403-1] AIRFRAMES CAD/CAM designer - Jack of all tra Airframe design to achieve minimur	tributic p 17 p 20 p 23 p 23 p 29 p 29 p 29 p 29 p 29 p 29 p 29 p 29	on for air and A86-24828 osite aircraft A86-24687 A86-24687 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 nagement of A86-49084 N86-24673 on's role in N86-32418 N86-26277 he need for A86-39567 ew activity at N86-11540 N86-21895 A86-21895
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidance (PB86-197506] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811] AIRCRAFT STRUCTURES Next generation aircraft structure co-ordinated Canadian R & D program Computational structural mechanics the NASA Langley Research Center [NASA-CASE-LAR-13403-1] AIRFRAMES CAD/CAM designer - Jack of all tra Airframe design to achieve minimur Manufacturers seek reduced co	tributic p 17 p 20 p 17 p 20 p 23 p 23 p 22 p 79 p 79 p 80 p 93 nistratic p 82 p 80 p 93 nistratic p 82 p 80 p 93 nistratic p 82 p 17 p 80 p 17 p 20 n p 23 n p 17 p 20 n p 17 p 20 n p 23 n p 17 p 20 n p 23 n p 23 n p 17 p 20 n p 23 n p 25 n p 23 n p 25 n p 25	on for air and A86-24828 osite aircraft A86-24687 A86-24687 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 magement of A86-49084 N86-24673 ion's role in C-up systems N86-32418 ght research N86-26277 he need for A86-39567 ew activity at N86-11540 N86-24673 A86-21895 A86-22141 hrough new
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications AIRCRAFT PRODUCTION Robotic applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidance (PB86-197506] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811] AIRCRAFT STABILITY Summary of results of NASA F- program Computational structural mechanics the NASA Langley Research Center [NASA-CASE-LAR-13403-1] Ice detector [NASA-CASE-LAR-13403-1] AIRCRAFT STABILITY Summary of results of NASA F- program Computational structural mechanics the NASA Langley Research Center [NASA-CASE-LAR-13403-1] AIRTRAMES CAD/CAM designer - Jack of all tra Airframe design to achieve minimur Manufacturers seek reduced co fabrication techniques	tributic p 17 p 20 p 17 p 20 p 23 p 23 p 22 p 79 p 79 p 80 p 93 nistratic p 82 p 80 p 93 nistratic p 82 p 80 p 93 nistratic p 82 p 17 p 80 p 17 p 20 n p 23 n p 17 p 20 n p 17 p 20 n p 23 n p 17 p 20 n p 23 n p 23 n p 17 p 20 n p 23 n p 25 n p 23 n p 25 n p 25	on for air and A86-24828 osite aircraft A86-24687 A86-24687 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 nagement of A86-49084 N86-24673 on's role in N86-32418 N86-26277 he need for A86-39567 ew activity at N86-11540 N86-21895 A86-21895
AIRCRAFT POWER SUPPLIES Electric power management and dis space applications to automated component manufacturing [SME PAPER MF85-506] Robotics in aircraft manufacturing The competitive and cooperative of propulsion systems [AIAA PAPER 86-1134] AIRCRAFT PRODUCTION COSTS Manufacturers seek reduced co fabrication techniques AIRCRAFT RELIABILITY Is there life after 10,000 flight hours AIRCRAFT SAFETY The airline engineering role in th safety Ice detector [NASA-CASE-LAR-13403-1] Air safety: Federal Aviation Admir developing mid-air collision avoidance (PB86-197506] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811] AIRCRAFT STABILITY Summary of results of NASA F- program [NASA-TM-86811] AIRCRAFT STRUCTURES Next generation aircraft structure co-ordinated Canadian R & D program Computational structural mechanics the NASA Langley Research Center [NASA-CASE-LAR-13403-1] AIRFRAMES CAD/CAM designer - Jack of all tra Airframe design to achieve minimur Manufacturers seek reduced co	tributic p 17 p 20 p 17 p 20 p 23 p 27 p 79 p 79 p 80 p 93 sistratif e bacic p 82 p 82 p 79 p 93 sistratif p 22 p 79 p 93 sistratif p 22 p 79 p 93 sistratif p 22 p 79 p 79 p 93 sistratif p 22 s 55 s - This p 21 f 17 p 20 s 55 s - This p 21 p 21 p 22 s 55 s - This p 22 s 55 s - This p 21 p 21 s 55 s - This p 21 p 23 s 55 s - This p 21 p 23 s 55 s - This p 21 s 55 s - This p 23 s - This p 24 s - This p 24 s - This p 25 s - This p 24 s - This p 25 s - This p 24 s - This p 25 s -	on for air and A86-24828 osite aircraft A86-24687 A86-24687 A86-35660 for aircraft A86-49571 hrough new A86-49448 A86-22402 magement of A86-49084 N86-24673 ion's role in C-up systems N86-32418 ght research N86-26277 he need for A86-39567 ew activity at N86-11540 N86-24673 A86-21895 A86-22141 hrough new

p 72 A86-21055

A-2

SUBJECT INDEX

Airline indemnity agreements - Will the contracts shift your risks? p 88 A86-34228
your risks? p 88 A86-34228 Aircraft ground support equipment standardization - The
pros and cons of 'functional' vs 'technical'
standardization
[SAE PAPER 851794] p 79 A86-38317 The selection and acquisition of commercial aircraft
fleets p 74 A86-44935
Planning for minimum overhaul time
p 75 A86-47616 The airline engineering role in the management of
safety p 80 A86-49084
AIRPORT PLANNING
Airports build for future traffic amid new security concern p 80 A86-48371
AIRPORT SECURITY
Airports build for future traffic amid new security
concern p 80 A86-48371 ALGORITHMS
Exploiting sequential phonetic constraints in recognizing
spoken words
[AD-A165913] p 34 N86-29120 Sensing strategies for disambiguating among multiple
Sensing strategies for disambiguating among multiple objects in known poses
[AD-A165912] p 34 N86-29220
ALLOCATIONS
Budget effects of the Challenger accident p 92 N86-20464
Technology transfer
[GPO-49-539] p 92 N86-21458
Allocation of tasks to robots for improved safety [DE86-002366] p 33 N86-22955
ANALOG SIMULATION
Computer-aided engineering
[AD-A162811] p 81 N86-24256
ANALOGIES Derivational analogy: A theory of reconstructive problem
solving and expertise acquisition
[AD-A156817] p 12 N86-10899
ANIK SATELLITES Planning for Telesat Canada's next generation
satellites
[IAF PAPER 85-354] p 10 A86-15849
Anthropology
Anthropology and the humanization of space [IAF PAPER 85-497] p 83 A86-15941
APPLICATIONS PROGRAMS (COMPUTERS)
A discuss an electron del ef Di ANIT
A discrete control model of PLANT
p 47 N86-31220
p 47 N86-31220 NASA's Aircraft Icing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS)
p 47 N86-31220 NASA's Aircraft Icing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots
p 47 N86-31220 NASA's Aircraft Icing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS)
p 47 N86-31220 NASA's Aircraft Icing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A96-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 33 N86-18736
p 47 N86-31220 NASA's Aircraft Icing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A158285] p 44 N86-25999
p 47 N86-31220 NASA's Aircraft Icing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A158285] p 44 N86-25999 Access control and privacy in large distributed
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot (AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A158285] p 44 N86-25999 Access control and privacy in large distributed systems
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A150833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A1508285] p 44 N86-25999 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot (AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A150285] p 44 N86-25999 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29588 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot (AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A158285] p 44 N86-25999 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot (AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A150285] p 44 N86-25999 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29588 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures
p 47 N86-31220 NASA's Aircraft Icing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A158285] p 44 N86-25599 Access control and privacy in large distributed systems [INASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [INASA-TM-89388] p 46 N86-29569 AILANE LAUNCH VEHICLE The economics of space launchers - Outlook for the future
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 3 N86-18736 Data Base Management: Proceedings of a conference {D-A158285] p 44 N86-25999 Access control and privacy in large distributed systems [NASA-TM-89387] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 ARIANE LAUNCH VEHICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A86-15893
p 47 N86-31220 NASA's Aircraft Icing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A150833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A1508285] p 44 N86-25999 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 ARIANE LAUNCH VEIICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A86-15893 Europe goes independent p 52 A86-21524
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A158285] p 44 N86-25999 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 ARIANE LAUNCH VEHICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A86-15893 Europe goes independent p 52 A86-21524 Ariane 5 - A new launcher for Europe [AAS 84-226] p 18 A86-28596
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A158285] p 44 N86-25999 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 ARIANE LAUNCH VEHICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A96-15993 Europe goes independent p 52 A86-21524 Ariane 5 - A new launcher for Europe [AAS 44:226] p 18 A86-28596
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot (AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A150825] p 44 N86-25999 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-25969 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-25569 ARIANE LAUNCH VEHICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A86-15893 Europ goes independent p 52 A86-21524 Ariane 5 - A new launcher for Europe [AAS 84-226] p 18 A86-28569 Ariane and Arianespace status and capability [AIAA PAPER 86-0671] p 18 A86-29688
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A158285] p 44 N86-25999 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 ARIANE LAUNCH VEHICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A96-15993 Europe goes independent p 52 A86-21524 Ariane 5 - A new launcher for Europe [AAS 44:226] p 18 A86-28596
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot (AD-A150833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A150825] p 44 N86-25999 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 ARIANE LAUNCH VENICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A86-15893 Europe goes independent p 52 A86-21524 Ariane 5 - A new launcher for Europe [AAS 84-226] p 18 A86-28566 Ariane and Arianespace status and capability [AIAA PAPER 86-0671] p 18 A86-29668 ARIAME D FORCES (FOREIGN) Transfer of high-technology to the Soviet Union. A predicament for the US
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A158285] p 44 N86-25599 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 ARIANE LAUNCH VEHICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A86-15893 Europe goes independent p 52 A86-21524 Ariane and Arianespace status and capability [AIAA PAPER 86-0671] p 18 A86-29668 ARMED FORCLS (FOREIGN) Transfer of high-technology to the Soviet Union. A predicament for the US [AD-A166469] p 96 N86-30582
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot (AD-A150833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A150825] p 44 N86-25999 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 ARIANE LAUNCH VENICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A86-15893 Europe goes independent p 52 A86-21524 Ariane 5 - A new launcher for Europe [AAS 84-226] p 18 A86-28566 Ariane and Arianespace status and capability [AIAA PAPER 86-0671] p 18 A86-29668 ARIAME D FORCES (FOREIGN) Transfer of high-technology to the Soviet Union. A predicament for the US
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A158285] p 44 N86-25599 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 ARIANE LAUNCH VEHICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A86-15893 Europe goes independent p 52 A86-21524 Ariane and Arianespace status and capability [AIAA PAPER 86-0671] p 18 A86-29668 ARMED FORCES (FOREIGN) Transfer of high-technology to the Soviet Union. A predicament for the US [AD-A166469] p 96 N86-30582 ARIMED FORCES (UNITED STATES) Guide to Canadian aerospace related industries [AD-A167794] p 26 N86-32327
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A158285] p 46 N86-25999 Access control and privacy in large distributed systems [NASA-TM-89387] p 46 N86-25688 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 ARIANE LAUNCH VEHICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A96-15893 Europe goes independent p 52 A86-21524 Ariane 5 - A new launcher for Europe [AAS 44-226] p 18 A96-28588 ARIANE LAUNCH VEHICLE Transfer of high-technology to the Soviet Union. A predicament for the US [AD-A166489] p 96 N86-30582 ARIMED FORCES (CNEIGN) Transfer of high-technology to the Soviet Union. A predicament for the US [AD-A166459] p 96 N86-30582 ARMED FORCES (UNITED STATES) Guide to Canadian aerospace related industries [AD-A167794] p 26 N86-32327
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A158285] p 44 N86-25599 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 ARIANE LAUNCH VEHICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A86-15893 Europe goes independent p 52 A86-21524 Ariane and Arianespace status and capability [AIAA PAPER 86-0671] p 18 A86-29668 ARMED FORCES (FOREIGN) Transfer of high-technology to the Soviet Union. A predicament for the US [AD-A166469] p 96 N86-30582 ARIMED FORCES (UNITED STATES) Guide to Canadian aerospace related industries [AD-A167794] p 26 N86-32327
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A158285] p 46 N86-25999 Access control and privacy in large distributed systems [NASA-TM-89387] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 ARIAME LAUNCH VEHICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A96-15893 Europe goes independent p 52 A86-21524 Ariane 5 - A new launcher for Europe [AAS 44-226] p 18 A96-28586 Ariane and Arianespace status and capability [AIAA PAPER 86-0671] p 18 A96-29568 ARIMED FORCES (FOREIGN) Transfer of high-technology to the Soviet Union. A predicament for the US [AD-A166489] p 96 N86-30582 ARMED FORCES (UNITED STATES) Guide to Canadian aerospace related industries [AD-A167794] p 26 N86-32327 ARTIFICIAL INTELLIGENCE Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A96-1948
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A158285] p 44 N86-29599 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 ARIANE LAUNCH VENICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A86-15933 Europe goes independent p 52 A86-21524 Ariane 5 - A new launcher for Europe [AAS 84-226] p 18 A86-28569 ARIANE APAPER 86-0671] p 18 A86-29668 ARMED FORCES (FOREIGN) Transfer of high-technology to the Soviet Union. A predicament for the US [AD-A166469] p 96 N86-30582 ARMED FORCES (UNITED STATES) Guide to Canadian aerospace related industries [AD-A167794] p 26 N86-32327 ARTIFICIAL INTELLIGENCE Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 The blackboard model - A farmework for integrating
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference (AD-A158285] p 44 N86-25599 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 ArlANE LAUNCH VEHICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A86-15893 Europe goes independent p 52 A86-21524 Ariane 3 - A new launcher for Europe [AAS 84-226] p 18 A86-29668 ARIMED FORCES (FOREIGN) Transfer of high-technology to the Soviet Union. A predicament for the US [AD-A168469] p 96 N86-30582 ARIMED FORCES (UNITED STATES) Guide to Canadian aerospace related industries [AD-A168469] p 36 A86-10948 The lackboard model - A framework for integrating multiple cooperating expert systems
$\begin{array}{c} p \ 47 \ \ N86-31220 \\ \ NASA's Aircraft \ ling Analysis Program \\ \ [NASA-TM-88791] p \ 82 \ \ N86-31548 \\ \hline \ ARCHITECTURE (COMPUTERS) \\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A158285] p 44 N86-25599 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 ArlaNE LAUNCH VEHICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A86-15893 Europe goes independent p 52 A86-21524 Ariane and Arianespace status and capability [AIAA PAPER 86-0671] p 18 A86-29668 ARMED FORCES (FOREIGN) Transfer of high-technology to the Soviet Union. A predicament for the US [AD-A166469] p 96 N86-30582 ARMED FORCES (INITED STATES) Guide to Canadian aerospace related industries [AD-A167794] p 26 N86-32327 ARTIFICIAL INTELLIGENCE Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-0401] p 36 A86-10948 The blackboard model - A framework for integrating multiple cooperating expert systems [AIAA PAPER 85-5045] p 27 A86-11407 Computer architecture for intelligent robots p 28 A86-13529
$p 47 \ \ N86-31220 \ \ NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 \ \ N86-31548 \ \ ARCHITECTURE (COMPUTERS) \ \ Computer architecture for intelligent robots p 28 \ \ A86-13529 \ \ System architecture for partition-tolerant distributed databases p 37 \ \ \ A86-17769 \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference (AD-A158285] p 44 N86-25599 Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 Ariane LAUNCH VEHICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A86-15893 Europe goes independent p 52 A86-21524 Ariane 3 - A new launcher for Europe [AAS 84-226] p 18 A86-29568 Ariane and Arianespace status and capability [AIAA PAPER 86-0671] p 18 A86-29668 ARMED FORCES (FOREIGN) Transfer of high-technology to the Soviet Union. A predicament for the US [AD-A166469] p 96 N86-30582 ARMED FORCES (INITED STATES) Guide to Canadian aerospace related industries [AD-A167794] p 26 N86-302327 ARTIFICIAL INTELLIGENCE Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-0401] p 36 A86-10948 The blackboard model - A framework for integrating multiple cooperating expert systems [AIAA PAPER 85-5045] p 27 A86-11407 Computer architecture for intelligent robots p 28 A86-13529 Expert systems and the 'myth' of symbolic reasoning p 28 A86-13529
p 47 N86-31220 NASA's Aircraft loing Analysis Program [NASA-TM-88791] p 82 N86-31548 ARCHITECTURE (COMPUTERS) Computer architecture for intelligent robots p 28 A86-13529 System architecture for partition-tolerant distributed databases p 37 A86-17769 A robust layered control system for a mobile robot [AD-A160833] p 33 N86-18736 Data Base Management: Proceedings of a conference [AD-A158285] p 44 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 ARIANE LAUNCH VENICLE The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A86-29569 Ariane 5 - A new launcher for Europe [AAS 84-226] p 18 A86-29568 ARIMED FORCES (FOREIGN) Transfer of high-technology to the Soviet Union. A predicament for the US [AD-A166469] p 96 N86-30582 ARIMED FORCES (UNITED STATES) Guide to Canadian aerospace related industries [AD-A166469] p 36 A86-10948 The blackboard model - A framework for integrating multiple cooperating expert systems [AIAA PAPER 85-045] p 27 A86-11007 Computer architecture for intelligent robots p 28 A86-13529 Expert systems and the 'myth' of symbolic reasoning p 28 A86-14850

Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy p 29 A86-20426 Next-generation computers --- Book p 37 A86-21317 Intelligent interfaces for human control of advanced p 29 A86-21889 automation and smart systems Assessing the artificial intelligence contribution to decision technology p 29 A86-25033 Artificial intelligence - The emerging technology p 29 A86-26070 Perspectives on artificial intelligence programming p 29 A86-27167 Expert systems for satellite stationkeeping p 30 A86-28497 The Crew Station Information Man ager - An avionics expert system D 30 A86-28515 Artificial intelligence - NASA --- robotics for Space Station p 30 A86-32538 Expert computer aided decision in supervisory control p 30 A86-33188 Artificial intelligence - New tools for aerospace project managers p 30 A86-34986 Smart robots: A handbook of intelligent robotic systems p 31 A86-37624 Artificial intelligence applications on supercomputers p 40 A86-40845 Why computers may never think like people p 31 A86-41648 State of the art in intelligent/brilliant robots p 32 A86-43884 The impact of fifth generation technology on test p 40 A86-43905 software Towards a science of expert systems p 40 A86-49488 An analysis of the application of AI to the development of intelligent aids for flight crew tasks [NASA-CR-3944] p 4 N86-12212 Knowledge-based systems: How will they affect manufacturing in the 80's [DE85-010601] p 32 N86-13027 National Aeronautics and Space Administration p 91 N86-13234 A robust layered control system for a mobile robot p 33 N86-18736 [AD-A160833] Modeling and planning robotic manufacturing [AD-A161014] p 24 Ni p 24 N86-19620 Artificial intelligence applications in manufacturing (AD-A161161) p 33 N86-20014 Artificial intelligence and its use in cost type analyses with and example in cost performance measurement p 43 N86-22168 [AD-A161817] Development experience with a simple expert system demonstrator for pilot emergency procedures [NASA-TM-85919] p.33 N86-23603 Task planning for control of a sensor-based robot p 33 N86-23954 [DE86-004225] Communication and miscommunication p 7 N86-24257 [AD-A162843] Man-machine systems of the 1990 decade: Cognitive factors and human interface issues p 7 N86-25123 [AD-A163865] Decision procedures p 34 N86-25173 [AD-A163049] Data Base Management: Proceedings of a conference [AD-A158285] p 44 N86-25999 The world brain today: Scientographic databases. What are they, how are they created and what are they used for? p 44 N86-26007 Human factors in rule-based systems [AD-A165309] p 8 N86-26840 Exploiting sequential phonetic constraints in recognizing poken words p 34 N86-29120 [AD-A165913] Sensing strategies for disambiguating among multiple objects in known poses [AD-A165912] p 34 N86-29220 Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 Parallel structures in human and computer memory p 46 N86-29535 [NASA-TM-89402] Expert assistants for design [DE86-003679] p 35 N86-29557 Design of a master lexicon p 47 N86-29721 [AD-A165999] Report on the AI trip p 35 N86-30397 [IR-82] Technology transfer and artificial intelligence [AD-A166035] p 36 N86-30581 Automated reasoning: Basic research problems

[DE86-009214] p 36 N86-31270

AUTOMATIC FLIGHT CONTROL

Evaluating space station applications of automation and robotics technologies from a human productivity point of view p 14 N86-31412
Knowledge-based load leveling and task allocation in
human-machine systems p 9 N86-32985 ARTIFICIAL SATELLITES
Countertrade - A necessary part of marketing, or an expensive diversion? p 69 A86-44537
Reliability prediction for spacecraft
[AD-A164747] p 81 N86-26359
ASCENT PROPULSION SYSTEMS Heavy lift launch vehicles for 1995 and beyond
[NASA-TM-86520] p 23 N86-11216
ASSEMBLING Economic applications of assemply robots. Economic
analysis and classification systems for robot assembly
[PB86-154465] p 34 N86-25808
ASSESSMENTS
Workload measurement in system design and evaluation p 3 A86-33787
Workload assessment - Progress during the last
decade
[SAE PAPER 851877] p 3 A86-35440 Options for operational risk assessments
[DE85-014904] p 70 N86-12390
Measuring the value of information and information
systems, services and products p 45 N86-28799 ASTRONAUT PERFORMANCE
Human roles in future space systems
[AAS PAPER 84-117] p 1 A86-17320
The roles of astronauts and machines for future space
operations [SAE PAPER 851332] p 1 A86-23521
ASTRONAUTICS
The human role in space: Technology, economics and
optimization Book p 3 A86-37037 ASTRONAUTS
Astronauts and cosmonauts biographical and statistical
data, revised June 28, 1985
[GPO-52-498] p 7 N86-21499 ASTRONOMICAL TELESCOPES
Future space telescope design concepts
p 23 N86-11107
The great observatories for space astrophysics
[NASA-CR-176754] p 63 N86-24712
ASTROPHYSICS The great observatories for space astrophysics
[NASA-CR-176754] p 63 N86-24712
ATMOSPHERIC MODELS
Support for global science: Remote sensing's challenge p 14 N86-32864
ATMOSPHERIC MOISTURE
Systematic ground-based measurements of
mesospheric water vapor p 55 A86-33544 ATTENTION
The psychophysics of workload - A second look at the
relationship between subjective measures and
performance p 3 A86-33804 AUDIO SIGNALS
Method and apparatus for operating on companded PCM
voice data
[NASA-CASE-KSC-11285-1] p 94 N86-27513 AUTOMATA THEORY
Role of robotics in solving production, social problems
p 34 N86-26062 AUTOMATIC CONTROL
Automatic control
[SAE PAPER 841534] p 37 A86-26005
Automation and robotics for Space Station in the
twenty-first century [AIAA PAPER 86-2300] p 40 A86-49552
Framework for generating expert systems to perform
Computer security risk analysis [DE85-014134] p 41 N86-10841
[DE85-014134] p 41 N86-10841 National Aeronautics and Space Administration
p 91 N86-13234
Modeling and planning robotic manufacturing [AD-A161014] p 24 N86-19620
[AD-A161014] p 24 N86-19620 Automation and the allocation of functions between
human and automatic control: General method
[AD-A161072] p 6 N86-20013 Role of robotics in solving production, social problems
p 34 N86-26062
Guide on selecting ADP (Automatic Data
Processing)backup processing alternatives [PB86-154820] p 44 N86-26241
Sensor driven robot systems testbed
[DE86-005892] p 35 N86-30412
Evaluating space station applications of automation and
Evaluating space station applications of automation and robotics technologies from a human productivity point of view p 14 N86-31412
Evaluating space station applications of automation and robotics technologies from a human productivity point of

Pilots of the future - Human or computer? p 1 A86-18541

AUTOMATIC TEST EQUIPMENT

AUTOMATIC TEST EQUIPMENT
AUTOMATIC TEST EQUIPMENT Systems modeling and DBMS application in test assets management p 74 A86-43881 Testability management through MIL-STD-2165
The impact of fifth generation technology on test
software p 40 A86-43905
Automation and robotics for the Space Station - Recommendations p 27 A86-10200
A self-repairing aircraft? new control methods for
fighter stabilization p 16 A86-14243 Expert systems for Space Station automation
p 28 A86-14548 Automation and robotics - Key to productivity in
industry and space [IAF PAPER 85-32] p 28 A86-15623
Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy
p 29 A86-20426
Automated subsystems control development for life support systems of space station
[SAE PAPER 851379] p 10 A86-23561 Robotics for the United States Space Station
p 29 A86-28073 Software automation for higher productivity
p 38 A86-28416 Logistics support economy and efficiency through
consolidation and automation p 74 A86-34956
Robotics in aircraft manufacturing p 20 A86-35660
Smart robots: A handbook of intelligent robotic systems p 31 A86-37624
ASTROS - An advanced software environment for
automated design
[AIAA PAPER 86-0856] p 39 A86-38807
Evaluating Space Station applications of automation and robotics p 31 A86-41000
USSR report: Machine tools and metalworking
equipment [JPRS-UMM-85-010] p 23 N86-11394
Alerted monitors: Human operators aided by automated
detectors [PB85-222750] p 4 N86-13906
Office automation: The administrative window into the
integrated DBMS p 41 N86-15174
Information flow and work productivity through integrated information technology p 42 N86-15183
LOGMARS (logistics applications of automated marking
and reading symbols) clearinghouse, applications directory
[AD-A162327] p 75 N86-24586 AVIATION PSYCHOLOGY
Symposium on Aviation Psychology, 3rd, Columbus, OH, April 22-25, 1985, Proceedings p 2 A86-29851
AVIONICS Implications of new aircraft avionics reliability
performance p 78 A86-22178 Digital avionics for modern aircraft - A case study into
the problems and promise of aircraft electronics
p 18 A86-28346 Software management for integrated avionics systems
p 38 A86-28425
The Crew Station Information Manager - An avionics expert system p 30 A86-28515
Aerospace and electronic systems - Advanced concepts
and pioneering perspectives; Proceedings of the Sixth Symposium, Dayton, OH, November 14, 15, 1984 p 19 A86-31253
Retrofitting avionics - Closing the performance
'Generation gap' [SAE PAPER 851813] p 79 A86-38324
Developing a maintenance concept for future electronic systems
[AIAA PAPER 86-1145] p 74 A86-43333 Expert systems development and application
[NASA-TM-86746] p 32 N86-11194
Description of an experimental expert system flight status monitor
[NASA-TM-86791] p 32 N86-11195 Heavy lift launch vehicles for 1995 and beyond
[NASA-TM-86520] p 23 N86-11216 Development experience with a simple expert system
demonstrator for pilot emergency procedures
[NASA-TM-85919] p 33 N86-23603 An engineering approach to the use of expert systems
technology in avionics applications [NASA-TM-88263] p 34 N86-24687
Langley aerospace test highlights, 1985
[NASA-TM-87703] p 81 N86-26276 NASA and general aviation
[NASA-SP-485] p.26_N86-30720

The gold and gold an analon		
[NASA-SP-485]	p 26	N86-30720

В		
BAYES THEOREM		
The group consensus problem	р7	N86-26078
[AD-A164064] BEARING (DIRECTION)	μ/	1400-20070
Sensing strategies for disambiguatin	g amo	ing multiple
ob j ects in known poses [AD-A165912]	D 34	N86-29220
BIBLIOGRAPHIES		
An annotated bibliography of litera organizational and systems theory	ature	integrating
	p 12	N86-19249
Artificial intelligence applications in m		
[AD-A161161] NASA patent abstracts bibliograp		N86-20014 continuing
bibliography. Section 2: Indexes (supp		
		N86-22444
NASA patent abstracts bibliograph bibliography. Section 1: Abstracts	iy: A	continuing
[NASA-SP-7039(29)-SECT-1]	p 94	N86-28788
NASA Patent Abstracts Bibliograp		
bibliography. Section 2: Indexes (Supple [NASA-SP-7039(29)-SECT-2]	p 94	29) N86-28789
Sonic-boom research: Selected b	ibliog	raphy with
annotation [NASA-TM-87685]	p 65	N86-30470
Scientific and technical papers prese		
by JSC authors in 1985		
[NASA-TM-58273] BIOASTRONAUTICS	p 76	N86-30568
Science requirements for Space S		
	p 52	A86-23552
Space Station - Life sciences [AIAA PAPER 86-2346]	p 60	A86-46960
BIOGRAPHY		
Astronauts and cosmonauts biographi data, revised June 28, 1985	ical an	d statistica!
[GPO-52-498]	р7	N86-21499
BIOLOGICAL EFFECTS	•	
Evaluation of the need for a large facility in space	primat	le research
[NASA-CR-179661]	p 14	N86-32111
BIOLOGICAL EVOLUTION	0	
NASA Workshop on Animal Gravity- [NASA-TM-88249]		N86-32950
BIOLOGICAL MODELS (MATHEMATICS)	
Application of a mathematical m decisionmaking for human-computer co		of human
decision making for numan-computer co	p 1	A86-25036
Development and validation of a ma		
of human decisionmaking for communication	p 2	n-computer A86-25037
Significance testing of rules in rule-	based	models of
human problem solving	p 2	A86-25038
BIOTECHNOLOGY EOS production on the Space Station -	Elec	trophoresis
Operations/Space	2.00	
	p 22	A86-46964
Marketing the use of the space en processing of biological and pharma		
[NASA-CR-176334]	p 70	N86-12243
BOEING AIRCRAFT Large airplane derivative developn	nent m	ethodology
		A86-10926
BOOMS (EQUIPMENT)		
Robotic refueling system for tactic aircraft	al an	d strategic
[AD-D011980]	p 92	N86-21540
BOOSTER ROCKET ENGINES	al hou	d
Heavy lift launch vehicles for 1995 ar [NASA-TM-86520]		N86-11216
BROADCASTING		
Global interconnectivity in the next scenario	two d	ecades - A
	p 54	A86-29581
BULKHEADS	•	
CAD/CAM designer - Jack of all trade		A86-21895
BURN-IN		
Innovative stimulus testing at the		
assembly to reduce costs and induce re		y A86-22185

С

CAMBERED WINGS Mission adaptive wing soars at NASA Facility [P86-10182] p 26 N86-31563 CANADA Government-to-government cooperation in space station development p 91 N86-15166

SUBJECT INDEX

CANADIAN SPACE PROGRAM			
The Canadian mobile satellite	servic	e and	its
socio-economic assessment [IAF PAPER 85-364]	p 66	A86-15	357
CANADIAN SPACECRAFT Planning for Telesat Canada's	next	general	
satellites [IAF PAPER 85-354] CAPACITORS	p 10	A86-158	349
Ice detector [NASA-CASE-LAR-13403-1]	p 93 .	N86-24	573
CARET WINGS Low cost access to space - A second concept		ation Shu A86-329	
CATALOGS Meteorological services of the world			
[WMO-2] CENSORED DATA (MATHEMATICS) The bootstrap method for ass	p 63	N86-23	
accuracy			
[AD-A161257] CENTRAL PROCESSING UNITS NASA supercomputer system to	p 81 becom	N86-200 le availa	
nationally			
[NASA-NEWS-RELEASE-86-92] CHALLENGER (ORBITER) Budget effects of the Challenger acc	p 44 cident	N86-286	020
Report of the Presidential Commiss	p 92	N86-204 the Spa	
Shuttle Challenger Accident, volume 1 [AD-A171402]	p 93	N86-247	
Actions to implement the recomm Presidential Commission on the Space	Shuttle	Challen	ger
Accident. Report to the President Report of the Presidential Commiss	p 94	N86-273	
Shuttle Challenger Accident, volume 2 [AD-A171403]		N86-289	
Report of the Presidential Commiss Shuttle Challenger Accident, volume 3	ion on	the Spa	ace
[AD-A171403] Report of the Presidential Commiss Shuttle Challenger Accident, volume 4		N86-289 the Spa	
[AD-A171404] Report of the Presidential Commiss	p 95 ion on	N86-289 the Spa	
Shuttle Challenger Accident, volume 5 [AD-A171404]	p 95	N86-289	
CHEMICAL PROPERTIES Standard reference data publications			
[PB86-155587] CHINESE SPACE PROGRAM		N86-264	
Chinese space and aviation indu breakthroughs [NASA-TM-87973]	p 25	N86-237	-
CHINESE SPACECRAFT Chinese space and aviation indust			
breakthroughs [NASA-TM-87973]	p 25	N86-237	
CIRCUIT BOARDS The qualification and procurement o	f two-si	ided prin	ted
circuit boards (fused tin-lead or gole European Space Agency [ESA-PSS-01-710-ISSUE-1]		d finish) N86-326	
CIVIL AVIATION A shared satellite system would sa	•		
aviation needs Aviation maintenance management	p 51	A86-209	921
_	p 72	A86-210	
The selection and acquisition of c fleets		A86-449	
High speed aeronautics [GPO-51-341] NASA and general aviation	p 91	N86-192	284
[NASA-SP-485] CLASSIFICATIONS	p 26	N86-30	720
Economic applications of assemply analysis and classification systems f	or robe	ot assem	ibly
[PB86-154465] CLEANING The factory of the future		N86-258	
CLIMATE Plan for the implementation of the			
Research Programme Central On-Line Data Directory		A86-104 N86-293	403
CLIMATOLOGY First implementation plan for th	e Wo	rld Clim	ate
Research program [WCRP-5] CLOSED ECOLOGICAL SYSTEMS	p 64	N86-29	477
Development of space technolo habitats	gyfor p63	ecolog N86-19	
COCKPITS One man and 3,000 million opera			
Preparing for the LHX cockpit Automation in the cockpit - Who's in			
[SAE PAPER 841534] 2010 - The symbionic cockpit		A86-26 A86-28	

[NASA-CR-3944]

CODING

COGNITION

of intelligent aids for flight crew tasks

An analysis of the application of AI to the development

Encryption protection for communication satellites

Aspects of cognitive complexity theory and research as

n.4 N86-12212

p 78 A86-21878

applied to a managerial decision making simulation
[AD-A161376] p 13 N86-22437
Man-machine systems of the 1990 decade: Cognitive
factors and human interface issues (AD-A1638651 p 7 N86-25123
(AD-A163865) p 7 N86-25123 Human factors in rule-based systems
[AD-A165309] p 8 N86-26840
COGNITIVE PSYCHOLOGY
Generalization in decision research - The role of formal
models p 11 A86-41385
Risk propensity, action readiness and the roles of societal and individual decision makers
[IZF-1984-27] p 12 N86-11077
COLLISION AVOIDANCE
Air safety: Federal Aviation Administration's role in
developing mid-air collision avoidance back-up systems
[PB86-197506] p 82 N86-32418 COLOR
Computer techniques for producing color maps
[AD-A161159] p 42 N86-19955
COMMAND AND CONTROL
Predicted versus experienced workload and
performance on a supervisory control task p 2 A86-29879
COMMERCE
Commercialization of the land remote sensing system:
An examination of mechanisms and issues
[E86-10008] p 24 N86-14710
Financing applied R and D in smaller companies [PB86-196987] p 71 N86-28783
A profile of selected firms awarded small business
innovation research funds
[AD-A165664] p 64 N86-28805
Semimanufactured products made of copper and copper
alloys: An analysis of production and sale in a world perspective
[EUT/BDK/15] p 71 N86-31758
COMMERCE LAB
Commerce Lab - A program of commercial flight
opportunities p 56 A86-34965
COMMERCIAL AIRCRAFT
Large airplane derivative development methodology [AIAA PAPER 85-3043] p 15 A86-10926
Is there life after 10,000 flight hours?
p 79 A86-22402
Which transport technologies will fly?
Which transport technologies will fly? p 69 A86-41037
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21876 The civilian space program A Washington perspective [AAS 84-153] p 86
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for Japan
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-43341
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21876 The civilian space program - A Washington perspective [AIAA PAPER 86-0680] p 18 A86-28779 A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 p 58 A86-43341 Insurance and commercial satellite systems
Which transport technologies will fly? p 69 A86-41037 p 69 A86-41037 p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for Japan [AIAA PAPER 86-0680] [AIAA PAPER 86-0680] p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-43341 Insurance and commercial satellite systems p 90 A86-44541
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-43311 Insurance and commercial satellite systems p 90 A86-44541 A fully reusable launch vehicle for Europe?
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-44541 Insurance and commercial satellite systems p 90 A86-44541 A fully reusable launch vehicle for Europe? p 59 A86-44543 Federal government provision of third-party liability
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-43341 Insurance and commercial satellite systems p 90 A86-44541 A fully reusable launch vehicle for Europe? p 59 A86-44543 Federal government provision of third-party liability insurance to space vehicle users
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-43341 Insurance and commercial satellite systems p 90 A86-44543 Federal government provision of third-party liability insurance to space vehicle users [NASA-CR-176346] p 90 N86-13230
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-44541 Insurance and commercial satellite systems p 90 A86-44541 A fully reusable launch vehicle for Europe? Federal government provision of third-party liability insurance to space vehicle users [NASA-CR-176346] p 90 N86-13230 Evaluation of spacecraft technology programs (effects
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites prspective [AAA PAPER 86-0680] p 78 A86-28779 A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-43341 Insurance and commercial satellite systems p 90 A86-44541 A fully reusable launch vehicle for Europe? p 59 A86-44543 Federal government provision of third-party liability insurance to space vehicle users p 90 N86-13230 Evaluation of space-creatite chenology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-176746] p 90 N86-16451
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-43341 Insurance and commercial satellite systems p 90 A86-44541 A fully reusable launch vehicle for Europe? [AASA-CR-176346] p 90 N86-13230 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174978] p 70 N86-16451 Evaluation of spacecraft technology programs (effects
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-4331 Insurance and commercial satellite systems p 90 A86-44543 Federal government provision of third-party liability insurance to space vehicle users [NASA-CR-176346] p 90 N86-13230 Evaluation of spaceraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174978] p 70 N86-16451
Which transport technologies will fly?p 69 A86-41037p 69 A86-41037The selection and acquisition of commercial aircraftfleetsp 74 A86-44935Thirty years with the jets: Commercial transport flightmanagement systems - Past, present, and future[AIAA PAPER 86-2289]p 22 A86-47402COMMERCIAL SPACECRAFTEncryption protection for communication satellitesp 78 A86-21878The civilian space program - A Washingtonperspective[AAS 84-153]p 86 A86-28779A commercial communications satellite system forJapan[AIAA PAPER 86-0680]p 18 A86-29674Contracts of and with private enterprises concerning thedevelopment, the construction, and the assembly of spacevehiclesp 58 A86-43341Insurance and commercial satellite systemsp 90 A86-44541A fully reusable launch vehicle for Europe?p 59 A86-44543Federal government provision of third-party liabilityinsurance to space vehicle users[NASA-CR-176346][NASA-CR-174978]p 90 N86-13230Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1[NASA-CR-174979]p 24 N86-16452
Which transport technologies will fly?p 69 A86-41037p 69 A86-41037The selection and acquisition of commercial transport flightmanagement systems - Past, present, and future[AIAA PAPER 86-2289]p 22 A86-47402COMMERCIAL SPACECRAFTEncryption protection for communication satellitesp 78 A86-21878The civilian space program - A Washingtonprespective[AIAA PAPER 86-0680]p 18 A86-28779A commercial communications satellite system forJapan[AIAA PAPER 86-0680]p 18 A86-29674Contracts of and with private enterprises concerning thedevelopment, the construction, and the assembly of spacey 90 A86-44541Insurance and commercial satellite systemsy 90 A86-44541A fully reusable launch vehicle for Europe?y 59 A86-44541A fully reusable launch vehicle for Europe?y 90 A86-44541A fully reusable launch vehicle of Europe?y 59 A86-44541A fully reusable launch vehicle of Europe?y 90 A86-44543Federal government provision of third-party liabilityInsurance and commercial satellite systemsy 90 N86-13230Evaluation of spacecraft technology programs (effectsA fully reusable launch vehicle party lia
Which transport technologies will fly?p 69 A86-41037p 69 A86-41037The selection and acquisition of commercial aircraftfleetsp 74 A86-44935Thirty years with the jets: Commercial transport flightmanagement systems - Past, present, and future[AIAA PAPER 86-2289]p 22 A86-47402COMMERCIAL SPACECRAFTEncryption protection for communication satellitesp 78 A86-21878The civilian space program - A Washingtonperspective[AIAA PAPER 86-0680]p 18 A86-29674Contracts of and with private enterprises concerning thedevelopment, the construction, and the assembly of spaceyeige A86-43541Insurance and commercial satellite systemsp 90 A86-44541A fully reusable launch vehicle for Europe?p 59 A86-44541A fully reusable launch vehicle for Europe?p 90 N86-13230Evaluation of space-vehicle users[NASA-CR-176346]p 90 N86-44541A fully reusable launch vehicle for Europe?p 59 A86-44543Federal government provision of third-partyl liabilityInsurance and commercial satellite systemsp 90 N86-13230Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1[NA
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial aircraft [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAA PAPER 86-0680] p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-44541 Insurance and commercial satellite systems p 90 A86-44541 A fully reusable launch vehicle for Europe? [NASA-CR-176346] p 90 N86-13230 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174978] p 70 N86-16452 Regulatory aspects of commercial, space transportation p 91 N86-17409 Contraction and effects of communication spacers vehicles p 70 N86-16452
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-43341 Insurance and commercial satellite systems p 90 A86-44541 A fully reusable launch vehicle for Europe? p 59 A86-44543 Federal government provision of third-party liability insurance to space vehicle users [NASA-CR-174978] p 70 N86-16451 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-43341 Insurance and commercial satellite systems p 90 A86-44543 Federal government provision of third-party liability insurance to space vehicle users [NASA-CR-176346] p 90 N86-13230 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174978] p 24 N86-16452 Regulatory aspects of commercial, space transportation p 91 N86-17409 Communication and miscommunication [AAA-A12979] p 24 N86-16452 Regulatory aspects of commercial, space transportation p 91 N86-17409
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-43341 Insurance and commercial satellite systems p 90 A86-44541 A fully reusable launch vehicle for Europe? p 59 A86-44543 Federal government provision of third-party liability insurance to space vehicle users [NASA-CR-174978] p 70 N86-16451 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-43341 Insurance and commercial satellite systems p 90 A86-44541 A fully reusable launch vehicle for Europe? p 59 A86-44543 Federal government provision of third-party liability insurance to space vehicle users [NASA-CR-176346] [NASA-CR-176346] p 90 N86-13230 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174979] p 24 N86-16452 Regulatory aspects of commercial, space transportation p 91 N86-17409 Contaction and miscommunication satell
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial aircraft [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT p 78 A86-21878 Encryption protection for communication satellites p 78 A86-21878 The civilian space program A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for Japan p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-44541 Insurance and commercial satellite systems p 90 A86-44541 A fully reusable launch vehicle for Europe? p 59 A86-44543 Federal government provision of third-party liability insurance to space vehicle users [NASA-CR-174978] [NASA-CR-174978] p 70 N86-13230 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174979] p 24 N86-16452 Regulatory aspects of commercial, space transportation p 91 N86-17409 Communication and miscommunication [AD-A162843] p 7 N86-24257
Which transport technologies will fly? p 69 A86-41037 The selection and acquisition of commercial aircraft fleets p 74 A86-44935 Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 COMMERCIAL SPACECRAFT Encryption protection for communication satellites p 78 A86-21878 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779 A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-43341 Insurance and commercial satellite systems p 90 A86-44541 A fully reusable launch vehicle for Europe? p 59 A86-44543 Federal government provision of third-party liability insurance to space vehicle users [NASA-CR-176346] [NASA-CR-176346] p 90 N86-13230 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174979] p 24 N86-16452 Regulatory aspects of commercial, space transportation p 91 N86-17409 Contaction and miscommunication satell

COMMUNICATION NETWORKS Inmarsat role in the future global maritime distress and system [IAF PAPER 85-339] p 78 A86-15840 Optical processing for future computer networks p 37 A86-21973 Telecommunications alternatives for federal users: Market trends and decisionmaking criteria [PB86-153764] p 13 N86-25687 Worldwide report: Telecommunications policy, research and development [JPRS-TTP-86-011] 0 5 N86-20064 COMMUNICATION SATELLITES Space WARC '85 - A look back p 82 A86-11023 Planning for Telesat Canada's next generation satellites [IAF PAPER 85-354] p 10 A86-15849 Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 The USSR and satellite communications - Competition and cooperation p 84 A86-18389 Encryption protection for communication satellite p 78 A86-21878 Satellite commuications for developing countries - From conjecture to reality p 52 A86-24672 International space law and direct broadcast satellites p 85 A86-24675 Satellite communications - A rapidly expanding arket? p 68 A86-26464 market? Hotol spaceplane is designed to slash launch costs by p 54 A86-29496 80 nercent Global interconnectivity in the next two decades - A [AIAA PAPER 86-0605] p 54 A86-29581 Improved system cost and performance ACTS using nulti-beam processing satellites [AIAA PAPER 86-0645] D 69 486-29607 Satellite system operations - A view from the trenches p 11 A86-29652 [AIAA PAPER 86-0705] A commercial communications satellite system for Janan [AIAA PAPER 86-0680] p 18 A86-29674 Satellite communications basics - A colloquium lecture p 18 A86-29680 Communications satellite business ventures - Measuring the impact of technology programmes and related policies p 69 A86-29699 A chronicle of policy and procedure - The formulation of the Reagan administration policy on international satellite telecommunications p 87 A86-30290 Advanced Communications Technology Satellite p 55 A86-32530 Contractual and related agreements required for a satellite launch p 89 A86-43342 R and D limited partnerships (possible applications in advanced communications satellite technology experiment program) [NASA-CR-176333] p 61 N86-13221 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174978] p 70 N86-16451 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 2 p 24 N86-16452 [NASA-CR-174979] Technology achievements and communication satellites of the future projections for [NASA-TM-87201] p 62 N86-17595 Worldwide report: Telecommunications policy, research and development [JPRS-TTP-86-011] p 95 N86-30064 COMMUNICATION THEORY Application of a mathematical model of human decisionmaking for human-computer communication p 1 A86-25036 Development and validation of a mathematical model human decisionmaking of for human-computer communication p 2 A86-25037 Man-machine systems of the 1990 decade: Cognitive factors and human interface issues [AD-A163865] p 7 N86-25123 COMMUNICATIONS TECHNOLOGY SATELLITE R and D limited partnerships (possible applications in advanced communications satellite technology experiment program) [NASA-CR-176333] p 61 N86-13221 COMPARISON Comparison of scientific and technical personnel trends in the United States, France, West Germany and the United Kingdom since 1970 [PB86-133030] p 7 N86-24554 COMPENSATION System architecture for partition-tolerant distributed databases p 37 A86-17769

COMPUTER DESIGN

COMPLEXITY Aspects of cognitive complexity theory and research as applied to a managerial decision making simulation p 13 N86-22437 AD-A1613761 COMPOSITE MATERIALS A rapid evaluation approach for configuration development of new aircraft 1A1AA PAPER 85-30681 p 15 A86-10932 Tough composite materials: Recent developments p 22 A86-45300 Composites in today's and tomorrow's U.S. airliners p 22 A86-47603 Manufacturers seek reduced costs through p 22 A86-49448 fabrication techniques COMPOSITE STRUCTURES Robotic applications to automated composite aircraft component manufacturing (SME PAPER MF85-506) p 17 A86-24667 Computational structural mechanics: A new activity at the NASA Langley Research Center [NASA-TM-87612] p 23 N86-11540 The application of composites to space structures: Guidelines on important aspects for the designer p 76 N86-30759 COMPUTATION Decision procedures [AD-A163049] p 34 N86-25173 Data collection via a guasi-experimental simulation technology. Part 1: Multiple measurement of performance in complex and uncertain managerial tasks excellenc [AD-A167949] D 9 N86-32969 COMPUTER AIDED DESIGN Large airplane derivative development methodology [AIAA PAPER 85-3043] p 15 A86-10926 p 15 A86-10926 A rapid evaluation approach configuration for development of new aircraft [AIAA PAPER 85-3068] n 15 A86-10932 Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 Expert systems and their use in augmenting design ontimization [AIAA PAPER 85-3095] p 28 A86-14434 CAD/CAM designer - Jack of all trades p 29 A86-21895 SADDLE - A computer-aided structural analysis and dynamic design language. I - Design system. II - Database management system p.37 A86-25999 Development of a knowledge base for an expert system p 20 A86-36853 for design of structural parts ASTROS - An advanced software environment for automated design [AIAA PAPER 86-0856] p 39 A86-38807 Integrated structural analysis for rapid design support p 39 A86-38868 [AIAA PAPER 86-1010] On a microcomputer integrated system for structural p 21 A86-39794 engineering practices Computational structural mechanics: the NASA Langley Research Center A new activity at [NASA-TM-87612] p 23 N86-11540 Knowledge-based systems: How will they affect manufacturing in the 80's [DE85-010601] p 32 N86-13027 Expert assistants for design [DE86-003679] p 35 N86-29557 Intelligent N/C controllers [DE86-003132] p 35 N86-30387 In-house CAD training: A realistic approach p 8 N86-31251 [DE86-008926] COMPUTER AIDED MANUFACTURING CAD/CAM designer - Jack of all trades p 29 A86-21895 A study on robot path planning from a solid model p 32 A86-43061 Manufacturers seek reduced costs through new p 22 A86-49448 fabrication techniques Knowledge-based systems: How will they affect manufacturing in the 80's [DE85-010601] p 32 N86-13027 Implementation of computer-aided production systems p 32 N86-14611 detailed Artificial intelligence applications in manufacturing p 33 N86-20014 [AD-A161161] Intelligent N/C controllers [DE86-003132] p 35 N86-30387 Robotic simulation p 35 N86-30390 [DE86-006517] In-house CAD training: A realistic approach p8 N86-31251 [DE86-008926] A comparison of a manual and computer-integrated production process in terms of process control decision-making p 14 N86-32750 [AD-A168037] COMPUTER DESIGN

Next-generation computers --- Book p 37 A86-21317

COMPUTER GRAPHICS

Fifth generation computers: Concepts, implementations p 41 A86-50280 and uses --- Book White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures p 46 N86-29569 [NASA-TM-89388] COMPUTER GRAPHICS Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] n 36 A86-10948 New maintainability prediction technique p 73 A86-22379 COMPUTER INFORMATION SECURITY Encryption protection for communication satellites p 78 A86-21878 Framework for generating expert systems to perform computer security risk analysis p 41 N86-10841 [DE85-014134] COMPUTER NETWORKS Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 Optical processing for future computer networks Computer networking for scientists p 37 A86-21973 PASSCAL Field Date Mark PASSCAL Field Data Management Plan (PFDMP) p 43 N86-24285 [DE86-003192] Access control and privacy in large distributed systems [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures p 46 N86-29569 [NASA-TM-89388] COMPUTER PROGRAM INTEGRITY Using automated tools to reduce software costs and insure system integrity [AIAA PAPER 85-6013] p 36 A86-11445 Establishing software QA - An exercise in frustration p 39 A86-35657 Quality Assurance p 40 A86-45470 Advances in software inspections COMPUTER PROGRAMMING Perspectives on artificial intelligence programming p 29 A86-27167 Ada instructional techniques for managers and programmers p 38 A86-28409 Expert systems development and application p 32 N86-11194 [NASA-TM-86746] National Aeronautics and Space Administration p 91 N86-13234 Quantitative evaluation of software methodology [NASA-CR-1765221 PASSCAL Field Data Management Plan (PFDMP) p 43 N86-24285 [DE86-003192] User systems guidelines for software projects p 48 N86-33048 [DE86-010490] COMPUTER PROGRAMS The discipline of software acquisition [AIAA PAPER 85-5056] p 36 A86-11412 Software quality and software productivity p 38 A86-28415 Software automation --- for higher productivity p 38 A86-28416 The engineering data management and analysis system (EDMAS) p 39 A86-28482 Spacecraft software cost estimation - Striving for excellence through parametric models (A review) [SAE PAPER 851907] p 31 A80 p 31 A86-38556 Quantitative evaluation of software methodology NASA-CR-176522] p 42 N86-19022 [NASA-CR-176522] Robot software: Current state-of-the-art, and future p 42 N86-19630 challenges Software verification and testing [NASA-TM-88587] p 43 N86-19966 The bootstrap method for assessing statistical accuracy [AD-A161257] p 81 N86-20047 Artificial intelligence and its use in cost type analyses with and example in cost performance measurement p 43 N86-22168 [AD-A161817] Space station: The role of software p 43 N86-23315 Managing the data analysis progress p 44 N86-26005 Ada (trademark) training curriculum: Software ngineering for managers M101 teacher's guide AD-A165123] p 8 N86-27941 [AD-A165123] Automated reasoning: Basic research problems p 36 N86-31270 [DE86-009214] Computing Services Software Library [DE86-009491] p 48 N86-32340 COMPUTER STORAGE DEVICES A cost analyst's guide to satellite autonomy and fault-tolerant computing p 71 N86-23630 [AD-A161853] COMPUTER SYSTEMS DESIGN Towards a science of expert systems

p 40 A86-49488

p 82 N86-31548

p 9 N86-32969

p 23 N86-11228

p 37 A86-17769

p 28 A86-15278

p 68 A86-26451

Fifth generation computers: Concepts, implementations and uses --- Book p 41 A86-50280 Access control and privacy in large distributed

p 46 N86-29568 [NASA-TM-89397] White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures p 46 N86-29569 [NASA-TM-893881

COMPUTER SYSTEMS PERFORMANCE Application of a mathematical model of human

evetome

decisionmaking for human-computer communication p 1 A86-25036

Development and validation of a mathematical model of human decisionmaking for human-computer communication p 2 A86-25037 A comparison of software verification techniques

p 43 N86-19965 [NASA-TM-88585] COMPUTER SYSTEMS PROGRAMS

Software quality and software productivity p 38 A86-28415

- ASTROS An advanced software environment for automated design
- [AIAA PAPER 86-0856] p 39 A86-38807 The impact of fifth generation technology on test p 40 A86-43905 software Cost uncertainty assessment methodology: A critical

overview p 71 N86-24575 [AD-A161920]

Computing Services Software Library [DE86-009491] p 48 N86-32340

Legislation for software rights protection at last p 96 N86-32343 [SNIAS-861-422-114]

User systems guidelines for software projects p 48 N86-33048 DE86.0104901 COMPUTER SYSTEMS SIMULATION

White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures p 46 N86-29569 [NASA-TM-89388] COMPUTER TECHNIQUES

Artificial intelligence - The emerging technology p 29 A86-26070

pervisory control Expert computer aided decision in s p 30 A86-33188

Why computers may never think like people p 31 A86-41648 p 33 N86-19634 Applications of expert systems Computer techniques for producing color maps p 42 N86-19955 [AD-A161159] Aspects of cognitive complexity theory and research as

applied to a managerial decision making simulation p 13 N86-22437 [AD-A161376] A cost analyst's guide to satellite autonomy and fault-tolerant computing

p 71 N86-23630 [AD-A161853] Computer-aided engineering

p 81 N86-24256 [AD-A162811] Man-machine systems of the 1990 decade: Cognitive factors and human interface issues

p 7 N86-25123 (AD-A163865) USSR report: Cybernetics, computers and automation

technology [JPRS-UCC-86-004] p 45 N86-28694 Numerical analysis and the scientific method p 47 N86-29591 [DE86-005404] Report on the AI trip

p 35 N86-30397 [IR-82] COMPUTER VISION Applications of artificial intelligence; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984 p 28 A86-15278 (SPIE-485) COMPUTERIZED SIMULATION The engineering data management and analysis system p 39 A86-28482 (EDMAS)

Computer simulation and modeling - A tool for inventory p 74 A86-35646 management Framework for generating expert systems to perform computer security risk analysis

[DE85-014134] n 41 N86-10841 Problem solving under time-constraints p6 N86-15957 [AD-A1589211 Expert systems for design and simulation [DE85-017565] p 32

p 32 N86-18053 Risk assessment preprocessor (RAPP) p 43 N86-24278 [AD-A161914] A computer modeling methodology and tool for

assessing design concepts for the Space Station Data Management System p 43 N86-24737 [NASA-TM-87647]

NASA supercomputer system to become available nationally [NASA-NEWS-RELEASE-86-92] p 44 N86-28628 Expert assistants for design [DE86-003679] p 35 N86-29557 Robotic simulation p 35 N86-30390 [DE86-006517]

p 2 A86-29851 April 22-25, 1985, Proceedings Aerospace and electronic systems - Advanced concepts and pioneering perspectives; Proceedings of the Sixth Symposium, Dayton, OH, November 14, 15, 1984 p 19 A86-31253 Man's permanent presence in space; Proceedings of the Third Annual Aerospace Technology Symposium, University of New Orleans, LA, November 7, 8, 1985 p 55 A86-32904

NASA's Aircraft Icing Analysis Program

Data collection via a quasi-experimental simulation

Productivity enhancement planning using participative anagement concepts p 6 N86-15202

System architecture for partition-tolerant distributed

Applications of artificial intelligence; Proceedings of the

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Symposium on Aviation Psychology, 3rd, Columbus, OH,

the International Business Strategy Conference, London,

technology. Part 1: Multiple measurement of performance

excellence in complex and uncertain managerial tasks

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[AD-A167949]

The factory of the future

CONCURRENT PROCESSING

Meeting, Arlington, VA, May 3, 4, 1984 [SPIE-485]

England, October 31, November 1, 1984

management concepts

COMPUTERS

databases

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Space - Technology and opportunity; Proceedings of the Conference, Geneva, Switzerland, May 28-30, 1985 p 58 A86-44526 Tough composite materials: Recent developments ---

p 22 A86-45300 Book R and D Productivity: New Challenges for the US Space Program

[NASA-TM-87520] p 61 N86-15157 Data Base Management: Proceedings of a conference p 44 N86-25999 [AD-A158285]

The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes [AGARD-CP-385] p 45 N86-28793 Space teleoperation research. American Nuclear

Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in other hostile environments p 35 N86-29513 [NASA-TM-89234]

Proceedings of the 2nd Annual Conference on

NASA/University Advanced Space Design Program p 64 N86-29888

[NASA-TM-89399] Scientific and technical papers presented or published by JSC authors in 1985

p 76 N86-30568 INASA-TM-582731

CONFIGURATION MANAGEMENT Reconfigurable work station for a video display unit and kevboard

[NASA-CASE-MES-26009-1SB] p 92 N86-22114 CONGRESSIONAL REPORTS High speed aeronautics p 91 N86-19284 [GPO-51-341] LANDSAT Authorizing appropriations commercialization [H-REPT-99-177] p 91 N86-20174 Technology transfer [GPO-49-539] p 92 N86-20177 Technology transfer [GPO-49-539] p 92 N86-21458 NASA's long range plans p 93 N86-22435 [GPO-55-035] Landsat Authorizing appropriations for commercialization p 93 N86-22448 [HR-REPT-99-177] National Aeronautics and Space Administration p 96 N86-31450 CONSISTENCY Human factors in rule-based systems p 8 N86-26840 [AD-A165309]

CONSTRAINTS Research and competition: Best partners p 76 N86-25321 [NASA-TM-87313] CONSTRUCTION INDUSTRY Use of broker organizations in technology transfer and

research utilization for the buildings industry p 25 N86-26262 [DE86-004674] CONSUMABLES (SPACECREW SUPPLIES)

NASA Facts: Space Shuttle food systems p 9 N86-32102 [NF-150/1-86]

SUBJECT INDEX
CONTAINERLESS MELTS
Space Processing Applications Rocket (SPAR) project: SPAR 10
[NASA-TM-86548] p 76 N86-28972 CONTAINMENT
Cost containment and KSC Shuttle facilities or cost
containment and aerospace construction p 19 A86-34989
CONTRACT INCENTIVES Motivational contracting in space programs -
Government and industry prospectives
An application of cost risk in incentive contracts
[AD-A165177] p 71 N86-27115 CONTRACT MANAGEMENT
The discipline of software acquisition
[AIAA PAPER 85-5056] p 36 A86-11412 Depot maintenance of aviation components: Contractor
versus organic repair [AD-A162071] p 75 N86-23556
Aids in validating a contractor's cost estimate
[AD-A161871] p 71 N86-24574 Cost and schedule control systems criteria for contract
performance measurement. Data analysis guide [DE86-010796] p 15 N86-33198
CONTRACT NEGOTIATION
A technique for lowering risks during contract negotiations p 57 A86-40999
CONTRACTORS An application of cost risk in incentive contracts
[AD-A165177] p 71 N86-27115
Cost and schedule control systems criteria for contract performance measurement. Data analysis guide
[DE86-010796] p 15 N86-33198
CONTRACTS Airline indemnity agreements - Will the contracts shift
your risks? p 88 A86-34228 Contracts of and with private enterprises concerning the
development, the construction, and the assembly of space
vehicles p 58 A86-43341 Contractual and related agreements required for a
satellite launch p 89 A86-43342
modernization incentives program
[AD-A162968] p 25 N86-24589 An application of cost risk in incentive contracts
[AD-A165177] p 71 N86-27115
A profile of selected firms awarded small business innovation research funds
[AD-A165664] p 64 N86-28805 Cost and schedule control systems criteria for contract
performance measurement. Data analysis guide [DE86-010796] p 15 N86-33198
CONTROL
Future directions in mobile teleoperation [DE85-014308] p 61 N86-12976
CONTROL CONFIGURED VEHICLES Optimum wing - For all flight conditions?
p 16 A86-11961
A self-repairing aircraft? new control methods for fighter stabilization p 16 A86-14243
Construction and control of large space structures p 21 A86-37060
CONTROL SIMULATION
Predicted versus experienced workload and performance on a supervisory control task
CONTROL SYSTEMS DESIGN
Automated subsystems control development for life
support systems of space station [SAE PAPER 851379] p 10 A86-23561
A study on robot path planning from a solid model p 32 A86-43061
Description of an experimental expert system flight
status monitor [NASA-TM-86791] p 32 N86-11195
Variable structure model following control design for robotics applications
[DE86-008136] p 35 N86-29234
A discrete control model of PLANT p 47 N86-31220
The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332
CONTROL THEORY
Aerospace guidance and control in the university - Anticipated trends
[AAS PAPER 85-001A] p 19 A86-31777 Leader-follower strategies under modeling and
information uncertainties
[DE86-000203] p 13 N86-27950 Structuring the production control problem in a repair
shop [THE/BDK/KBS/84-16] p 27 N86-32334
CONTROLLED ATMOSPHERES
Development of space technology for ecological

Development of space technology for ecological p 63 N86-19943 habitats

CONTROLLERS

- A robust layered control system for a mobile robot [AD-A160833] p.33 N86-18736 Reconfigurable work station for a video display unit and keyboard [NASA-CASE-MFS-26009-1SB] p 92 N86-22114 Intelligent N/C controllers [DE86-003132] p 35 N86-30387 COPPER Semimanufactured products made of copper and copper alloys: An analysis of production and sale in a world perspective (EUT/BDK/15) p 71 N86-31758 COPPER ALLOYS Semimanufactured products made of copper and copper alloys: An analysis of production and sale in a world
- perspective EUT/BDK/151 p 71 N86-31758 COSMIC RAYS
- Extragalactic astronomy p 65 N86-31489 COSMONALITS Astronauts and cosmonauts biographical and statistical
- data, revised June 28, 1985 p 7 N86-21499 [GPO-52-4981
- COST ANALYSIS Decision making in product assurance
 - p 78 A86-22394 Cost in space - The price of government control
 - p 68 A86-27885 Productivity impacts of software automation p 68 A86-28418
 - Helicopter maintenance in the real world p 73 A86-30549
- Cost containment and KSC Shuttle facilities or cost containment and aerospace construction
- p 19 A86-34989 Space Station design-to-cost - A massive engineering challenge
- [SAWE PAPER 1673] p 20 A86-35216 Spare parts pricing - Impact on logistics support
- p 74 A86-35647 Options for operational risk assessments
- p 70 N86-12390 [DE85-014904] Artificial intelligence and its use in cost type analyses
- with and example in cost performance measurement p 43 N86-22168 [AD-A161817] A cost analyst's guide to satellite autonomy and
- fault-tolerant computing [AD-A161853] p 71 N86-23630
- Aids in validating a contractor's cost estimate
- p 71 N86-24574 [AD-A161871] Cost uncertainty assessment methodology: A critical overview
- p 71 N86-24575 [AD-A161920] Discounted cash flow model for the industrial modernization incentives program
- (AD-A162968) p 25 N86-24589 An application of cost risk in incentive contracts [AD-A165177] p 71 N86-27115
- COST EFFECTIVENESS Assessing cost-effective weight saving in aircraft
 - operations p 16 A86-20039 Expert systems for satellite stationkeeping
 - p 30 A86-28497 Improved system cost and performance ACTS using multi-beam processing satellites
 - p 69 A86-29607 [AIAA PAPER 86-0645] Software productivity improvement through software ngineering technology p 42 N86-15180 engineering technology Space crew productivity: A driving factor in space station
- design p.5 N86-15187 White collar productivity improvement: Sponsored
- action research 1983 1985 [NASA-CR-176366] p6 N86-21419
- COST ESTIMATES Spacecraft software cost estimation - Striving for
- excellence through parametric models (A review) [SAE PAPER 851907] p 31 A86 p 31 A86-38556 Aids in validating a contractor's cost estimate
- p 71 N86-24574 [AD-A161871] An application of cost risk in incentive contracts [AD-A165177] p 71 N86 p 71 N86-27115
- COST INCENTIVES An application of cost risk in incentive contracts
- p 71 N86-27115 [AD-A165177] COST REDUCTION
 - Using automated tools to reduce software costs and insure system intearity p 36 A86-11445
- [AIAA PAPER 85-6013] Space Station operations [IAE PAPER 85-45] p 72 A86-15632
- Airframe design to achieve minimum cost p 17 A86-22141
- Innovative stimulus testing at the lowest level of assembly to reduce costs and induce reliability
 - p 78 A86-22185

development project p 38 A86-28422 Manufacturers seek reduced costs through new p 22 A86-49448 fabrication techniques Streamlining: Reducing costs and increasing STS operations effectiveness p 5 N86-15194 Developments in quality control

p 81 N86-19638 [REPT-186] COSTS

Planning for cost/schedule control in a software

- Budget effects of the Challenger accident p 92 N86-20464
- The costs of not having refined information p 45 N86-28798
- CRAY COMPUTERS Artificial intelligence applications on supercomputers
- p 40 A86-40845 NASA supercomputer system to become available
- nationally [NASA-NEWS-RELEASE-86-92] p 44 N86-28628 CREATIVITY
- Creativity in Science a symposium [DE86-003289] p 63 N86-27109
- CREW WORKSTATIONS The Crew Station Information Manager - An avionics
- p 30 A86-28515 expert system CRITERIA
- The functional age profile An objective decision criterion for the assessment of pilot performance capacities and p 3 A86-31823 capabilities
- CRYOGENIC WIND TUNNELS. Cryogenic wind tunnels for high Reynolds number
- testing [NASA-TM-87743] p 26 N86-29872 CRYPTOGRAPHY
- Encryption protection for communication satellites p 78 A86-21878
- CRYSTAL GROWTH Automation requirements derived from space p 11 A86-40526 manufacturing
- Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 Á86-46963 CYBERNETICS
- Artificial intelligence The emerging technology p 29 A86-26070 CYCLES
- Man-machine systems of the 1990 decade: Cognitive factors and human interface issues
- [AD-A163865] p 7 N86-25123

D

- DATA ACQUISITION
 - ENVIROSAT-2000 report: Federal agency satellite requirements
 - [NASA-TM-88752] p 63 N86-26355 Los Alamos software development tools
 - [DE86-0060241 p 48 N86-31248 Data collection via a quasi-experimental simulation technology. Part 1: Multiple measurement of performance
 - excellence in complex and uncertain managerial tasks DATA BASE MANAGEMENT SYSTEMS Office automatica.
 - integrated DBMS p 41 N86-15174 Implementation of artificial intelligence rules in a data base management system
 - p 33 N86-21220 [NASA-CR-178048] Data Base Management: Proceedings of a conference
 - [AD-A158285] p 44 N86-25999 Managing the data analysis progress
 - p 44 N86-26005 Linking science, technology and economics data
 - p 44 N86-26006 The world brain today: Scientographic databases. What they, how are they control and the science of the science
 - are they, how are they created and what are they used for? p 44 N86-26007
 - The design and analysis of a network interface for the multi-lingual database system p 44 N86-27121 [AD-A164756]
 - A relational database environment for software development
 - p 47 N86-30398 [IR-86] Database capacity planning and management p 48 N86-32338
 - [DE86-009076] DATA BASES System architecture for partition-tolerant distributed
 - p 37 A86-17769 databases Shuttle environment database
 - p 39 A86-28578 [AAS 85-103] Trades and Analyses Management System (TRAMS) p 21 A86-40514
 - Systems modeling and DBMS application in test assets p 74 A86-43881
 - management Data Base Management: Proceedings of a conference p 44 N86-25999 [AD-A158285]

DATA BASES

DATA FLOW ANALYSIS

DATA FLOW ANALYSIS
Linking science, technology and economics data
p 44 N86-26006 Standard reference data publications, 1964-1984
[PB86-155587] p 81 N86-26409 USSR report: Cybernetics, computers and automation technology
[JPRS-UCC-86-004] p 45 N86-28694
Measuring the value of information and information systems, services and products p 45 N86-28799
Information resources management in the R and D environment p 46 N86-28803
DATA FLOW ANALYSIS The engineering data management and analysis system
(EDMAS) p 39 A86-28482 DATA LINKS
Linking science, technology and economics data p 44 N86-26006 DATA MANAGEMENT
The engineering data management and analysis system (EDMAS) p 39 A86-28482
PASSCAL Field Data Management Plan (PFDMP)
[DE86-003192] p 43 N86-24285 A computer modeling methodology and tool for
assessing design concepts for the Space Station Data Management System
[NASĂ-TM-87647] p 43 N86-24737 Los Alamos software development tools
[DE86-006024] p 48 N86-31248 DATA PROCESSING
The right stuff software system development for Earth
Radiation Budget Experiment satellite p 41 A86-49872
Implementation of computer-aided production systems detailed p 32 N86-14611
Computer systems measures p 41 N86-15173
Computer techniques for producing color maps [AD-A161159] p 42 N86-19955
Man-machine systems of the 1990 decade: Cognitive factors and human interface issues
[AD-A163865] p 7 N86-25123 Guide on selecting ADP (Automatic Data
Processing)backup processing alternatives [PB86-154820] p 44 N86-26241
Ada (trademark) training curriculum: Software
engineering for managers M101 teacher's guide [AD-A165123] p 8 N86-27941
Numerical analysis and the scientific method [DE86-005404] p 47 N86-29591
Los Alamos software development tools [DE86-006024] p 48 N86-31248
Database capacity planning and management
[DE86-009076] p 48 N86-32338 Cost and schedule control systems criteria for contract
performance measurement. Data analysis guide [DE86-010796] p 15 N86-33198
Organizations as information processing systems: Environmental characteristics, company performance and
chief executive scanning, an empirical study [AD-A168035] p 15 N86-33201
DATA SYSTEMS
An Operations Management System for the Space Station
[AIAA PAPER 86-2329] p 40 A86-46952 The right stuff software system development for Earth Radiation Budget Experiment satellite
Central On-Line Data Directory p 41 A86-49872 DATA TRANSMISSION
Encryption protection for communication satellites
p 78 A86-21878 DECISION MAKING Decision making in product assurance
p 78 A86-22394 Assessing the artificial intelligence contribution to
decision technology p 29 A86-25033
Application of a mathematical model of human decisionmaking for human-computer communication
p 1 A86-25036 Development and validation of a mathematical model
of human decisionmaking for human-computer communication p 2 A86-25037
Automation in the cockpit - Who's in charge?
[SAE PAPER 841534] p 37 A86-26005 The functional age profile - An objective decision criterion
for the assessment of pilot performance capacities and capabilities p 3 A86-31823
Expert computer aided decision in supervisory control
p 30 A86-33188 Computer simulation and modeling - A tool for inventory
management p 74 A86-35646 Generalization in decision research - The role of formal
models p 11 A86-41385
Derivational analogy: A theory of reconstructive problem solving and expertise acquisition
[AD-A156817] p 12 N86-10899

Risk propensity, action readiness	
societal and individual decision maker [IZF-1984-27] Alerted monitors: Human operators	p 12 N86-11077
detectors	-
[PB85-222750] Socio-technical integration of the w	p 4 N86-13906 orkplace
-	p 5 N86-15182
Space crew productivity: A driving fa design	p 5 N86-15187
Aspects of cognitive complexity the	ory and research as
applied to a managerial decision maki [AD-A161376]	p 13 N86-22437
Depot maintenance of aviation comp	oonents: Contractor
versus organic repair {AD-A162071}	p 75 N86-23556
Decision procedures [AD-A163049]	p 34 N86-25173
Evaluating R and D and new pr	oduct development
ventures: An overview of assessment n A01	nethods \$12.00/MF
[PB86-110806]	p 13 N86-25289
Telecommunications alternatives Market trends and decisionmaking crit	
[PB86-153764]	p 13 N86-25687
Schema-based theory of information distributed decision making	
[AD-A163150]	p 13 N86-25992
The group consensus problem [AD-A164064]	p7 N86-26078
A theoretically based review of the judgment and decision making	ory and research in
[AD-A164914]	p 13 N86-27113
Leader-follower strategies unde information uncertainties	er modeling and
[DE86-000203]	p 13 N86-27950
The policy maker looks at information	on p 45 N86-28794
Technology transfer and artificial int	telligence
[AD-A166035] A discrete control model of PLANT	p 36 N86-30581
	p 47 N86-31220
A comparison of a manual and o production process in terms of	
decision-making [AD-A168037]	p 14 N86-32750
Data collection via a quasi-experi	•
technology. Part 1: Multiple measurem excellence in complex and uncertai	
[AD-A167949]	p 9 N86-32969
ECISION THEORY Evaluating Space Station application	is of automation and
robotics	p 31 A86-41000
Generalization in decision research models	- The role of formal p 11 A86-41385
Options for operational risk assess	nents
[DE85-014904] Schema-based theory of informatic	p 70 N86-12390 on presentation for
distributed decision making	
[AD-A163150] A theoretically based review of the	p 13 N86-25992 ory and research in
judgment and decision making [AD-A164914]	p 13 N86-27113
EFENSE COMMUNICATIONS SATEL	LITE SYSTEM
Expert systems for satellite stationk	eeping p 30 A86-28497
EFENSE PROGRAM	,
An application of cost risk in incenti [AD-A165177]	p 71 N86-27115
EICERS NASA's Aircraft Icing Analysis Prog	ram
[NASA-TM-88791]	p 82 N86-31548
ESCENT TRAJECTORIES Space shuttle descent design: Fro	om development to
operations ESIGN ANALYSIS	p 24 N86-15197
A rapid evaluation approach	for configuration
development of new aircraft [AIAA PAPER 85-3068]	p 15 A86-10932
Can we develop the 1.5 million	pound aerospace
plane? Construction and control of large sp	p 55 A86-34195 bace structures
Integrated structural analysis for ra	p 21 A86-37060
[AIAA PAPER 86-1010]	p 39 A86-38868

[AIAA PAPER 86-1010] p 39 A86-38868 Which transport technologies will fly?

An updated model for a Space Station Health Maintenance Facility [AIAA PAPER 86-2303] p 59 A86-46029 Economic applications of

 Maintenance Facility
 p 59
 A86-46938

 [AIAA PAPER 86-2303]
 p 59
 A86-46938

 Economic applications of assemply robots.
 Economic analysis and classification systems for robot assembly

 [PB86-154465]
 p 34
 N86-25808

Marine-related research at MIT (Mas of Technology): A directory of 1985-1986	
[PB86-158102] The design and analysis of a netwo multi-lingual database system	p 63 N86-26249 ork interface for the
[AD-A164756] Suggestions for designers of navy el	p 44 N86-27121 ectronic equipment.
Revision A. 1985 edition [AD-A165697] DESIGN TO COST	p 25 N86-28326
Airframe design to achieve minimur	p17 A86-22141
Space Station design-to-cost - A m challenge [SAWE PAPER 1673]	p 20 A86-35216
DETECTION Power sensing device	- 04 - NOC 00500
[AD-D012171] DEVELOPING NATIONS The participation of developing c	p 94 N86-26529 ountries in space
research The needs of developing countries	p 84 A86-18392 s in the application
of satellite technology for disaster ma	p 84 A86-21123
Satellite commuications for developi	•
conjecture to reality	p 52 A86-24672
Satellite communications planni manufacturing in Latin America	p 19 A86-30187
Information for the developing world	: NTIS's (National
Technical Information Services's) r	ole in information
transfer to developing countries [PB85-243269] DICTIONARIES	p92 N86-21434
Design of a master lexicon {AD-A165999} DIGITAL COMPUTERS	p 47 N86-29721
Optical processing for future compu	
Fifth concretion computers: Concon	p 37 A86-21973
Fifth generation computers: Concep and uses Book	p 41 A86-50280
Numerical analysis and the scientifi	
[DE86-005404] DIGITAL SYSTEMS	p 47 N86-29591
Digital avionics for modern aircraft	
the problems and promise of aircraft e	
DIGITAL TO ANALOG CONVERTERS	p 18 A86-28346
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating of	p 18 A86-28346
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating of voice data [NASA-CASE-KSC-11285-1] DIRECTORIES	p 18 A86-28346 on companded PCM p 94 N86-27513
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating of voice data [NASA-CASE-KSC-11285-1]	p 18 A86-28346
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating ovoice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating ovoice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating of voice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inte management The view from the U	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 rmational disaster J.S. Department of
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating of voice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inte management The view from the U State	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 rmational disaster J.S. Department of p 85 A86-21126
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating of voice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inter management The view from the U State How NASA prepared to cope with o	p 18 A86-28346 on companded PCM p 94 N86-27513 p 94 N86-29294 sin the application nagement p 84 A86-21123 strational disaster J.S. Department of p 95 A86-21126 strational disaster J.S. Department of p 95 A86-21126 strational
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating ovoice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inte management The view from the U State How NASA prepared to cope with o DISTRIBUTED PARAMETER SYSTEMS Access control and privacy in	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 irrational disaster J.S. Department of p 85 A86-21126 disaster p 79 A86-25866 S
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating of voice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inte management The view from the U State How NASA prepared to cope with of DISTRIBUTED PARAMETER SYSTEMS	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 irrational disaster J.S. Department of p 85 A86-21126 disaster p 79 A86-25866 S
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating of voice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inter management The view from the U State How NASA prepared to cope with of DISTRIBUTED PARAMETER SYSTEMS Access control and privacy in systems [NASA-TM-89397]] DISTRIBUTED PROCESSING	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 rmational disaster J.S. Department of p 85 A86-21126 disaster p 79 A86-25866 S large distributed p 46 N86-29568
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating ovoice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inte management The view from the U State How NASA prepared to cope with of DISTRIBUTED PARAMETER SYSTEMS Access control and privacy in systems [NASA-TM-89397] DISTRIBUTED PROCESSING The blackboard model - A framew multiple cooperating expert systems	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 irrational disaster J.S. Department of p 85 A86-21126 lisaster p 79 A86-25866 S large distributed p 46 N86-29568 work for integrating
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating o voice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inte management The view from the U State How NASA prepared to cope with o DISTRIBUTED PARAMETER SYSTEM Access control and privacy in systems [NASA-TM-89397] DISTRIBUTED PROCESSING The blackboard model - A framew multiple cooperating expert systems [AIAA PAPER 85-5045]	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 rmational disaster J.S. Department of p 85 A86-21126 disaster p 79 A86-25866 S large distributed p 46 N86-29568 vork for integrating p 27 A86-11407
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating ovoice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inte management The view from the U State How NASA prepared to cope with of DISTRIBUTED PARAMETER SYSTEMS Access control and privacy in systems [NASA-TM-89397] DISTRIBUTED PROCESSING The blackboard model - A framew multiple cooperating expert systems [AIAA PAPER 85-045] System architecture for partition	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 mational disaster J.S. Department of p 85 A86-21126 disaster p 79 A86-25866 s large distributed p 46 N86-29568 work for integrating p 27 A86-11407 tolerant distributed
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating o voice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inte management The view from the U State How NASA prepared to cope with o DISTRIBUTED PARAMETER SYSTEM Access control and privacy in systems [NASA-TM-89397] DISTRIBUTED PROCESSING The blackboard model - A framew multiple cooperating expert systems [AIAA PAPER 85-5045]	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 mational disaster J.S. Department of p 85 A86-21126 disaster p 79 A86-25866 S large distributed p 46 N86-29568 vork for integrating p 27 A86-11407 tolerant distributed p 37 A86-17769
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating of voice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inter management The view from the U State How NASA prepared to cope with of DISTRIBUTED PARAMETER SYSTEM Access control and privacy in systems [NASA-TM-89397] DISTRIBUTED PROCESSING The blackboard model - A framew multiple cooperating expert systems [AIAA PAPER 85-5045] System architecture for partition- databases	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 mational disaster J.S. Department of p 85 A86-21126 disaster p 79 A86-25866 S large distributed p 46 N86-29568 vork for integrating p 27 A86-11407 tolerant distributed p 37 A86-17769
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating ovoice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inte management The view from the U State How NASA prepared to cope with of DISTRIBUTED PARAMETER SYSTEMS Access control and privacy in systems [NASA-TM-89397] DISTRIBUTED PARAMETER SYSTEMS Access control and privacy in systems [AIAA PAPER 85-5045] System architecture for partition- databases Data Base Management: Proceedir [AD-A158285] DOCUMENTATION Scientific and technical papers pres	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 mational disaster J.S. Department of p 85 A86-21126 disaster p 79 A86-25866 s large distributed p 46 N86-29568 work for integrating p 27 A86-11407 ctolerant distributed p 37 A86-17769 rgs of a conference p 44 N86-25999
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating ovoice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inte management The view from the U State How NASA prepared to cope with of DISTRIBUTED PARAMETER SYSTEMS Access control and privacy in systems [NASA-TM-89397] DISTRIBUTED PARCESSING The blackboard model - A framew multiple cooperating expert systems [AIAA PAPER 85-045] System architecture for partition- databases Data Base Management: Proceedir [AD-A158285] DOCUMENTATION Scientific and technical papers pres by JSC authors in 1985 [NASA-TM-58273]	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 rmational disaster J.S. Department of p 85 A86-21126 disaster p 79 A86-25866 s large distributed p 46 N86-29568 work for integrating p 27 A86-11407 etolerant distributed p 37 A86-17769 rogs of a conference p 44 N86-25999 sented or published p 76 N86-30568
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating of voice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inter management The view from the U State How NASA prepared to cope with of DISTRIBUTED PARAMETER SYSTEMS Access control and privacy in systems [NASA-TM-89397] DISTRIBUTED PARAMETER SYSTEMS (AIAS A-TM-89397] DISTRIBUTED PROCESSING The blackboard model - A framew multiple cooperating expert systems [AIAA PAPER 85-5045] System architecture for partition- databases Data Base Management: Proceedir [AD-A158285] DOCUMENTATION Scientific and technical papers pres by JSC authors in 1985 [NASA-TM-58273] DOMESTIC SATELLITE COMMUNIC	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 mational disaster J.S. Department of p 85 A86-21126 disaster p 79 A86-25866 S large distributed p 46 N86-29568 vork for integrating p 27 A86-11407 tolerant distributed p 37 A86-17769 rgs of a conference p 44 N86-25999 sented or published p 76 N86-30568 ATIONS SYSTEMS
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating ovoice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inte management The view from the U State How NASA prepared to cope with of DISTRIBUTED PARAMETER SYSTEMS Access control and privacy in systems [NASA-TM-89397] DISTRIBUTED PARCESSING The blackboard model - A framew multiple cooperating expert systems [AIAA PAPER 85-045] System architecture for partition- databases Data Base Management: Proceedir [AD-A158285] DOCUMENTATION Scientific and technical papers pres by JSC authors in 1985 [NASA-TM-58273]	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 rmational disaster J.S. Department of p 85 A86-21126 disaster p 79 A86-25866 S large distributed p 46 N86-29568 vork for integrating p 27 A86-11407 tolerant distributed p 37 A86-17769 gs of a conference p 44 N86-25999 sented or published p 76 N86-30568 ATIONS SYSTEMS olicies - Impacts on
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating of voice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inter management The view from the U State How NASA prepared to cope with of DISTRIBUTED PARAMETER SYSTEMS Access control and privacy in systems [NASA-TM-89397] DISTRIBUTED PARCESSING The blackboard model - A framew multiple cooperating expert systems [AIAA PAPER 85-5045] System architecture for partition- databases Data Base Management: Proceedir [AD-A158285] DOCUMENTATION Scientific and technical papers pres by JSC authors in 1985 [NASA-TM-58273] DOMESTIC SATELLITE COMMUNIC Technology programs and related p communications satellite business ver [IAF PAPER 85-433]	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 mational disaster J.S. Department of p 85 A86-21126 disaster p 79 A86-25866 S large distributed p 46 N86-29568 work for integrating p 27 A86-11407 tolerant distributed p 37 A86-17769 rgs of a conference p 44 N86-25999 sented or published p 76 N86-30568 ATIONS SYSTEMS olicies - Impacts on htures p 82 A86-15903
 DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating ovoice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in intel management The view from the U State How NASA prepared to cope with of State DISTRIBUTED PARAMETER SYSTEMS Access control and privacy in systems [NASA-TM-89397] DISTRIBUTED PARAMETER SYSTEMS (ALAA PAPER 85-5045] System architecture for partition databases Data Base Management: Proceedir (AD-A158285] DOCUMENTATION Scientific and technical papers pre- by JSC authors in 1985 [NASA-TM-58273] DOMESTIC SATELLITE COMMUNIC Technology programs and related p communications satelilite business ver (IAF PAPER 85-343) A commercial communications sateline 	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 mational disaster J.S. Department of p 85 A86-21126 disaster p 79 A86-25866 S large distributed p 46 N86-29568 work for integrating p 27 A86-11407 tolerant distributed p 37 A86-17769 rgs of a conference p 44 N86-25999 sented or published p 76 N86-30568 ATIONS SYSTEMS olicies - Impacts on htures p 82 A86-15903
 DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating of voice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inte management The view from the U State How NASA prepared to cope with of DISTRIBUTED PARAMETER SYSTEMS Access control and privacy in systems [NASA-TM-89397] DISTRIBUTED PARAMETER SYSTEMS (AIA PAPER 85-5045] System architecture for partition databases Data Base Management: Proceedir (AD-A158285] DOCUMENTATION Scientific and technical papers pres by JSC authors in 1985 [NASA-TM-58273] DOMESTIC SATELLITE COMMUNIC Technology programs and related p communications satellife business ver [IAF PAPER 85-433] A commercial communications sat Japan [AIAA PAPER 86-0680] 	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 mational disaster J.S. Department of p 85 A86-21126 disaster p 79 A86-25866 S large distributed p 46 N86-29568 work for integrating p 27 A86-11407 clolerant distributed p 37 A86-17769 regs of a conference p 44 N86-25999 sented or published p 76 N86-30568 ATIONS SYSTEMS olicies - Impacts on tures p 82 A86-15903 atellite system for p 18 A86-29674
DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating o voice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inte management The view from the U State How NASA prepared to cope with o DISTRIBUTED PARAMETER SYSTEMS Access control and privacy in systems [NASA-TM-89397] DISTRIBUTED PARAMETER SYSTEMS (ALAA PAPER 85-5045] System architecture for partition databases Data Base Management: Proceedir (AD-A158285) DOCUMENTATION Scientific and technical papers pres by JSC authors in 1985 [NASA-TM-58273] DOMESTIC SATELLITE COMMUNIC Technology programs and related p communications satellite business ver [AFP PAPER 86-0680] Satellite communications planni	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 rmational disaster J.S. Department of p 85 A86-21126 disaster p 79 A86-25866 S large distributed p 46 N86-29568 vork for integrating p 27 A86-11407 tolerant distributed p 37 A86-17769 gs of a conference p 44 N86-25999 sented or published p 76 N86-30568 ATIONS SYSTEMS olicies - Impacts on tures p 82 A86-15903 atellite system for p 18 A86-29674 ing and equipment
 DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating of voice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inte management The view from the U State How NASA prepared to cope with of DISTRIBUTED PARAMETER SYSTEMS Access control and privacy in systems [NASA-TM-89397] DISTRIBUTED PARAMETER SYSTEMS (AIA PAPER 85-5045] System architecture for partition databases Data Base Management: Proceedir (AD-A158285] DOCUMENTATION Scientific and technical papers pres by JSC authors in 1985 [NASA-TM-58273] DOMESTIC SATELLITE COMMUNIC Technology programs and related p communications satellife business ver [IAF PAPER 85-433] A commercial communications sat Japan [AIAA PAPER 86-0680] 	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 mational disaster J.S. Department of p 85 A86-21126 disaster p 79 A86-25866 S large distributed p 46 N86-29568 work for integrating p 27 A86-11407 clolerant distributed p 37 A86-17769 regs of a conference p 44 N86-25999 sented or published p 76 N86-30568 ATIONS SYSTEMS olicies - Impacts on tures p 82 A86-15903 atellite system for p 18 A86-29674
 DIGITAL TO ANALOG CONVERTERS Method and apparatus for operating ovoice data [NASA-CASE-KSC-11285-1] DIRECTORIES Central On-Line Data Directory DISASTERS The needs of developing countries of satellite technology for disaster ma Use of satellite data in inte management The view from the U State How NASA prepared to cope with of DISTRIBUTED PARAMETER SYSTEMS Access control and privacy in systems [NASA-TM-89397] DISTRIBUTED PARAMETER SYSTEMS (ACAS-TM-89397] DISTRIBUTED PROCESSING The blackboard model - A framew multiple cooperating expert systems [AIAA PAPER 85-5045] System architecture for partition- databases Data Base Management: Proceedir [AD-A158285] DOCUMENTATION Scientific and technical papers pres by JSC authors in 1985 [NASA-TM-58273] DMESTIC SATELLITE COMMUNIC Technology programs and related p communications satellite business ver [IAF PAPER 85-0360] Satellite communications planni manufacturing in Latin America 	p 18 A86-28346 on companded PCM p 94 N86-27513 p 46 N86-27513 p 46 N86-29294 s in the application nagement p 84 A86-21123 rmational disaster J.S. Department of p 85 A86-21126 disaster p 79 A86-25866 S large distributed p 46 N86-29568 vork for integrating p 27 A86-11407 tolerant distributed p 37 A86-17769 gs of a conference p 44 N86-25999 sented or published p 76 N86-30568 ATIONS SYSTEMS olicies - Impacts on tures p 82 A86-15903 atellite system for p 18 A86-29674 ing and equipment

Long endurance aircraft performance p 80 A86-49478 SUBJECT INDEX F EARTH (PLANET) Research and competition: Best partners p 76 N86-25321 [NASA-TM-87313] EARTH OBSERVATIONS (FROM SPACE) The Space Station Polar Platforms - Integrating research and operational missions [AIAA PAPER 85-3000] p 49 A86-12935 Earth observation satellites - From technology push to p 68 A86-26465 market pull Space remote sensing systems: An introduction ---Book p 73 A86-26525 Space technology and resource management p 58 A86-41981 The earth observing system --- instrument package planning for atmosphere, ocean and land studies p 58 A86-43229 [AAS PAPER 85-397] NASA plans for spaceborne lidar - The Earth Observing p 59 A86-46763 System Geodesy: A look to the future p 61 N86-11657 [NASA-CR-176283] Space station: ESA views on requirements for experimental and operational Earth observation missions p 62 N86-18379 ESA and its Earth observation programs p 66 N86-32849 EARTH OBSERVING SYSTEM (EOS) The earth observing system --- instrument package planning for atmosphere, ocean and land studies [AAS PAPER 85-397] p 58 A86-43229 NASA plans for spaceborne lidar - The Earth Observing System o 59 A86-46763 EARTH RADIATION BUDGET EXPERIMENT The right stuff --- software system development for Earth Radiation Budget Experiment satellite p 41 A86-49872 EARTH-MARS TRAJECTORIES Concepts for the early realization of a manned mission to Mars [AAS 84-170] p 53 A86-28796 FARTHOUAKE DAMAGE Geodesy: A look to the future [NASA-CR-176283] p 61 N86-11657 ECONOMIC ANALYSIS The Canadian mobile satellite service and its socio-economic assessment p 66 A86-15857 [IAF PAPER 85-364] The economics of space launchers - Outlook for the future [IAF PAPER 85-420] p 66 A86-15893 The world aircraft industry --- Book p 17 A86-26114 Private funds will bolster tax dollars in the job of financing p 69 A86-29494 the station Communications satellite business ventures - Measuring the impact of technology programmes and related policies p 69 A86-29699 Insurance - Forms of coverage and current market situation --- for spacecraft and space operations p 89 A86-43344 Economic aspects of space industrialization p 70 A86-45636 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174978] p 70 N86-16451 Economic applications of assemply robots. Economic analysis and classification systems for robot assembly [PB86-154465] p 34 N86-25808 Financing applied R and D in smaller companies [PB86-196987] p 71 N86p 71 N86-28783 ECONOMIC FACTORS The National Aeronautics and Space Administration (NASA) Tracking and Data Relay Satellite System (TDRSS) Economic and programmatic, considerations program [IAF PAPER 85-422] p 67 A86-15895 Economic equity and international cooperation - The example of E.S.A p 83 A86-15943 [IAF PAPER 85-499] Economic considerations of space manufacturing p 67 A86-21886 The human role in space: Technology, economics and optimization --- Book p 3 A86-37037 An economics perspective of the 21st century Space Station [AIAA PAPER 86-2348] p 70 A86-46961 New technology implementation: Technical, economic p 24 N86-15172 and political factors ECONOMIC IMPACT processing in space

More precious than gold - The economics of materials p 70 A86-44549 USSR report: Machine tools and metalworking equipment [JPRS-UMM-85-013] p 24 N86-13745

ECONOMICS R and D limited partnerships (possible applications in advanced communications satellite technology experiment [NASA-CR-176333] p.61 N86-13221 USSR report: Machine tools and metalworking equipment [JPBS-UMM-85-014] o 24 N86-13742 Linking science, technology and economics data p 44 N86-26006 EDUCATION Satellite commuications for developing countries - From p 52 A86-24672 conjecture to reality Ada instructional techniques for managers and A86-28409 programmers D 38 Aerospace guidance and control in the university -Anticipated trends [AAS PAPER 85-001A] p 19 A86-31777 An annotated bibliography of literature integrating organizational and systems theory [AD-A160912] p 12 N86-19249 Comparison of scientific and technical personnel trends in the United States, France, West Germany and the United Kingdom since 1970 p 7 N86-24554 [PB86-1330301 Creativity in Science - a symposium p 63 N86-27109 [DE86-003289] Ada (trademark) training curriculum: Software engineering for managers M101 teacher's guide [AD-A165123] p 8 N86-27941 University funding. Assessing mechanisms for university research federal funding [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 EFFECTIVENESS Management behavior, group climate and performance appraisal at NASA p 4 N86-15163 EFFICIENCY Aeronautical technology 2000: A projection of advanced vehicle concepts [NASA-CR-176322] p 23 N86-13235 Maintenance planning for the 1990's (initial planning) p 75 N86-22065 [PB86-106010] Computer-aided engineering [AD-A162811] o 81 N86-24256 ELECTRIC POWER SUPPLIES Power sensing device [AD-D012171] p 94 N86-26529 ELECTRIC TERMINALS Productivity enhancement planning using participative anagement concepts рŐ N86-15202 FLECTRICAL PROPERTIES Power sensing device [AD-D012171] p 94 N86-26529 FLECTRICITY Technical activities 1983, Center for Basic Standards [PB86-140043] ELECTROMAGNETIC MEASUREMENT p 81 N86-26239 Nondestructive techniques characterizing fo mechanical properties of structural materials: overview [NASA-TM-87203] p 80 N86-19636 ELECTRON BEAM WELDING In-process inspection of the parameters of the electron beam in electron beam welding p 19 A86-34124 ELECTRONIC EQUIPMENT Developing a maintenance concept for future electronic systems p 74 A86-43333 [AIAA PAPER 86-1145] Growth of electronic materials in microgravity p 75 Á86-46963 [AIAA PAPER 86-2356] USSR report: Machine tools and metalworking equipment p 24 N86-13745 [JPRS-UMM-85-013] Suggestions for designers of navy electronic equipment. Revision A. 1985 edition [AD-A165697] p 25 N86-28326 ELECTRONIC EQUIPMENT TESTS Innovative stimulus testing at the lowest level of assembly to reduce costs and induce reliability p 78 A86-22185 Testability management through MIL-STD-2165 p 80 A86-43901 The impact of fifth generation technology on test p 40 A86-43905 software ELECTRONIC MODULES A robust layered control system for a mobile robot p 33 N86-18736 [AD-A1608331 ELECTRONICS Aerospace and electronic systems - Advanced concepts and pioneering perspectives; Proceedings of the Sixth Symposium, Dayton, OH, November 14, 15, 1984 p 19 A86-31253

ELECTROPHORESIS Electrophoresis operations in space - A promising new p 59 A86-44548 commercial venture EOS production on the Space Station --- Electrophoresis Operations/Space [AIAA PAPER 86-2358] p 22 A86-46964 EMBEDDED COMPUTER SYSTEMS Spacecraft software cost estimation - Striving for excellence through parametric models (A review) p 31 A86-38556 [SAE PAPER 851907] EMERGENCIES Development experience with a simple expert system demonstrator for pilot emergency procedures p 33 N86-23603 [NASA-TM-85919] EMPLOYEE RELATIONS Socio-technical integration of the workplace p 5 N86-15182 Quality circles: Organizational adaptations, improvements and results p 5 N86-15201 Productivity enhancement planning using participative p 6 N86-15202 management concepts Results of innovative communication processes on productivity gains in a high technology environment p 6 N86-15203 ENERGY CONSERVATION Use of broker organizations in technology transfer and research utilization for the buildings industry p 25 N86-26262 [DE86-0046741 ENERGY STORAGE Electric power management and distribution for air and p 17 A86-24828 space applications ENERGY TRANSFER Tether applications for space station p 76 N86-28418 ENGINE CONTROL 'Smart' engine components - A micro in every blade? p 17 A86-21896 ENGINE DESIGN 'Smart' engine components - A micro in every blade? p 17 A86-21896 The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] p 23 A86-49571 Aeropropulsion opportunities for the 21st century p 26 N86-31585 [NASA-TM-88817] ENGINE PARTS 'Smart' engine components - A micro in every blade? p 17 A86-21896 ENGINEERING Productivity improvement in engineering Rocketdyne p 5 N86-15178 productivity through interactive Improved p 12 N86-15181 mmunicatio ENGINEERING MANAGEMENT The engineering data management and analysis system (EDMAS) p 39 A86-28482 Evaluating Space Station applications of automation and robotics p 31 A86-41000 Keys to engineering management reducing the risks of p 21 A86-41155 R&D start-ups planning Socio-technical integration of the workplace p 5 N86-15182 Academic science/engineering: R and D funds, fiscal year 1983 (detailed statistical tables) p 25 N86-23482 [PB86-120706] Guide to programs, fiscal year 1986: Guide describing National Science Foundation Programs and Activities p 93 N86-23484 [PB86-125184] Suggestions for designers of navy electronic equipment. Revision A. 1985 edition p 25 N86-28326 [AD-A165697] The structuring of production control systems

p 26 N86-32332 [THE/BDK/ORS/84/10] Due-date reliability in a repair shop: Implications for organizational and work design

HE/BDK/KBS/84-14] p 27 N86-32333 ENGINES Institutional supporting research and development.

1985 [DE86-0085801

[DE86-008580]	p 65	N86-30583
ENVIRONMENT MANAGEMENT		
Environmental management o	t payload	processing
facilities		
[AIAA PAPER 85-6067]	p 78	A86-17602
Management of outer space	p 84	A86-19261

ENVIRONMENTAL MONITORING

Space technology and resource management 58 A86-41981

ENVIRONMENTAL RESEARCH SATELLITES ENVIROSAT-2000 report: Federal agency satellite

requirements		
[NASA-TM-88752]	p 63	N86-26355
ENVIRONMENTAL TESTS		

Implications	of	new	aircraft	avionics	reliability
performance				p 78	A86-22178

A-9

EQUIPMENT SPECIFICATIONS

Innovative stimulus testing at the lowest level of assembly to reduce costs and induce reliability p 78 A86-22185

EQUIPMENT SPECIFICATIONS Aircraft ground support equipment standardization - The pros and cons of 'functional' vs 'technical' standardization

[SAE PAPER 851794] p 79 A86-38317 ERROR DETECTION CODES

A comparison of software verification techniques [NASA-TM-88585] p 43 N86-19965 ERROR SIGNALS

Satellite communications basics - A colloquium lecture p 18 A86-29680 ERRORS

EHHORS

LOGMARS (logistics applications of automated marking and reading symbols) clearinghouse, applications directory [AD-A162327] p 75 N86-24586

ERS-1 (ESA SATELLITE) ERS-1 - Mission objectives and system description

- p 49 A86-13823 The ERS-1 program and its future applications
- p 50 A86-14095 ERS-1 - Our new window on the oceans for the 1990s
- p 57 A86-38718
- Estimating The input into good project planning p 67 A86-17673 ETHICS

Human development and the conquest of space p 83 A86-18381

- EUROPEAN SPACE AGENCY Economic equity and international cooperation - The
- example of E.S.A [IAF PAPER 85-499] p 83 A86-15943
- The evolution of the agency's patent policy p 85 A86-24598
- [AAS 85-113] p 86 A86-28582 Space - Technology and opportunity; Proceedings of the Conference, Geneva, Switzerland, May 28-30, 1985
- p 58 A86-44526 Status of ESA's planning for the Space Station
- p 59 A86-44530 Government-to-government cooperation in space
- station development p 91 N86-15166 The qualification and procurement of two-sided printed circuit boards (fused tin-lead or gold plated finish) ---
- European Space Agency [ESA-PSS-01-710-ISSUE-1] p 82 N86-32660
- ESA and its Earth observation programs p 66 N86-32849

EUROPEAN SPACE PROGRAMS

- ERS-1 Mission objectives and system description p 49 A86-13823 The ERS-1 program and its future applications p 50 A86-14095 p 52 A86-21524 Europe goes independent Europe - Towards a new long-term programme p 85 A86-22242 space ESA Space Station planning [AAS 85-113] p 86 A86-28582 Ariane 5 - A new launcher for Europe p 18 [AAS 84-226] A86-28596 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Ariane and Arianespace status and capability [AIAA PAPER 86-0671] A86-29668 p 18 Europe aims for space independence p 88 A86-35562 Developing the final frontier: International cooperation in the peaceful uses of outer space --- Book p 88 A86-42236 Space - Technology and opportunity; Proceedings of the Conference, Geneva, Switzerland, May 28-30, 1985 p 58 A86-44526 Status of ESA's planning for the Space Station p 59 A86-44530 A fully reusable launch vehicle for Europe? p 59 A86-44543 Horizon 2000 and its relation to the Columbus p 59 A86-45643 Programme Missions to Mars D 60 A86-48100 ESA views on requirements for Space station:
- experimental and operational Earth observation missions p 62 N86-18379 ESA and its Earth observation programs p 66 N86-32849
- EVALUATION
- Quantitative evaluation of software methodology [NASA-CR-176522] p 42 N86-19022 Nondestructive techniques for characterizing mechanical properties of structural materials: An overview [NASA-TM-87203] p 80 N86-19636

EXOBIOLOGY

- Space Station life sciences guidelines for nonhuman experiment accommodation
- [SAE PAPER 851370] p 52 A86-23553 EXPENDABLE STAGES (SPACECRAFT)
- US space commercialization Effects on space law and domestic law p 84 A86-18384 EXPERT SYSTEMS
- The blackboard model A framework for integrating multiple cooperating expert systems
- [AIAA PAPER 85-5045] p 27 A86-11407 Expert systems and their use in augmenting design optimization
- [AIAA PAPER 85-3095] p 28 A86-14434 Expert systems for Space Station automation
- p 28 A86-14548 Enhanced maintenance and explanation of expert
- systems through explicit models of their development p 28 A86-14847 Expert systems and the 'myth' of symbolic reasoning
- p 28 A86-14850 Applications of artificial intelligence; Proceedings of the
- Meeting, Arlington, VA, May 3, 4, 1984 [SPIE-485] p 28 A86-15278
- Expert systems for satellite stationkeeping p 30 A86-28497 Knowledge engineering for a flight management expert system p 30 A86-28498
- The Crew Station Information Manager An avionics expert system p 30 A86-28515 Expert computer aided decision in supervisory control
- p 30 A86-33188 Development of a knowledge base for an expert system
- for design of structural parts p 20 A86-36853 Automation requirements derived from space manufacturing p 11 A86-40526
- State of the art in intelligent/brilliant robots p 32 A86-43884 Towards a science of expert systems
- p 40 A86-49488 Framework for generating expert systems to perform
- computer security risk analysis [DE85-014134] p 41 N86-10841 Expert systems development and application
- [NASA-TM-86746] p 32 N86-11194 Description of an experimental expert system flight
- status monitor [NASA-TM-86791] p 32 N86-11195
- Knowledge-based systems: How will they affect manufacturing in the 80's [DE85-010601] p 32 N86-13027
- National Aeronautics and Space Administration p 91 N86-13234
- Expert systems for design and simulation

 [DE85-017565]
 p 32
 N86-18053

 Applications of expert systems
 p 33
 N86-19634
- Implementation of artificial intelligence rules in a data base management system [NASA-CR-178048] p 33 N86-21220
- Development experience with a simple expert system demonstrator for pilot emergency procedures [NASA-TM-85919] p 33 N86-23603 An engineering approach to the use of expert systems
- technology in avionics applications [NASA-TM-88263] p 34 N86-24687 Mental models and problem solving with a
- knowledge-based expert system [AD-A165398] p 8 N86-26843 Expert assistants for design
- [DE86-003679] p 35 N86-29557 DEASEL: An expert system for software engineering
- p 47 N86-30361 Report on the Al trip
- [IR-92] p 35 N86-30397 Real-time production system for intelligent robot control
- [DE86-008501] p 36 N86-31271 Evaluating space station applications of automation and robotics technologies from a human productivity point of
- view p 14 N86-31412 EXPLORATION Exploration for strategic materials
- [PB86-126463] p 75 N86-24005 EXTRAGALACTIC RADIO SOURCES
- Extragalactic astronomy p 65 N86-31489 EXTRATERRESTRIAL ENVIRONMENTS Anthropology and the humanization of space
- Anthropology and the humanization of space [IAF PAPER 85-497] p 83 A86-15941 EXTRATERRESTRIAL RESOURCES
- Enabling technologies for transition to utilization of space-based resources and operations p 56 A86-34992
- EXTRAVEHICULAR ACTIVITY The roles of astronauts and machines for future space operations
 - [SAE PAPER 851332] p 1 A86-23521

EXTREMELY HIGH FREQUENCIES

A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 F-106 AIRCRAFT NASA storm hazards research in lightning strikes to p 79 A86-37479 F-111 AIRCRAFT Mission adaptive wing soars at NASA Facility [P86-10182] N86-31563 p 26 F-15 AIRCRAFT CAD/CAM designer - Jack of all trades p 29 A86-21895 Summary of results of NASA F-15 flight research program [NASA-TM-86811] p 25 N86-26277 F-16 AIRCRAFT Knowledge engineering for a flight management expert p 30 A86-28498 FACILITIES An updated model for a Space Station Health Maintenance Facility [AIAA PAPER 86-2303] p 59 A86-46938 FAILURE ANALYSIS Failures and successes of quantitative methods in management [ARW-03-THE-BDK/ORS/83-06] p 12 N86-11076 Reliability prediction for spacecraft [AD-A164747] p 81 N86-26359 Survey of Soviet work in reliability p 82 N86-32766 AD-A1676071 FATIGUE (BIOLOGY) Influence of complexity of control task on level of activation of operators physiological functions when working with waiting p 7 N86-23260 FATIGUE TESTS Is there life after 10,000 flight hours? p 79 A86-22402 FAULT TOLERANCE A cost analyst's guide to satellite autonomy and fault-tolerant computing AD-A1618531 71 N86-23630 p FEASIBILITY ANALYSIS Technology achievements and communication satellites of the future and projections for p 62 N86-17595 [NASA-TM-87201] FEDERAL BUDGETS Authorizing appropriations LANDSAT commercialization [H-REPT-99-177] p 91 N86-20174 Budget effects of the Challenger accid p 92 N86-20464 Authorizing appropriations for Landsat commercialization (HB-REPT-99-177) p 93 N86-22448 Academic science/engineering: R and D funds, fiscal ear 1983 (detailed statistical tables) [PB86-120706] p 25 N86-23482 National Aeronautics and Space Administration p 96 N86-31450 FEEDBACK Leader-follower strategies under modeling and information uncertainties [DE86-000203] p 13 N86-27950 FEEDBACK CONTROL Sharpening the senses of industrial robots p 31 A86-40831 National Aeronautics and Space Administration p 91 N86-13234 A robust lavered control system for a mobile robot [AD-A160833] p 33 N86-18736 FIBER OPTICS Worldwide report: Telecommunications policy, research and development [JPBS-TTP-86-011] p 95 N86-30064 FIGHTER AIRCRAFT A self-repairing aircraft? --- new control methods for p 16 A86-14243 fighter stabilization FILE MAINTENANCE (COMPUTERS) Database capacity planning and management [DF86-009076] p 48 N86-32338 FINANCE Underwriters worldwide incurred \$600 million in unexpected losses, signifying changes ahead in space p 85 A86-24122 insurance Insurance in space risk management p 68 A86-26453 The broker's role in space insurance p 90 A86-44540 Insurance and commercial satellite systems p 90 A86-44541

Financing applied R and D in smalle	
[PB86-196987] University funding. Assessing	p 71 N86-28783 federal funding
mechanisms for university research	local landing
[AD-A165721]	p 95 N86-28806
FINANCIAL MANAGEMENT Technology programs and related p	olicies - Impacts on
communications satellite business ver	
[IAF PAPER 85-433]	p 82 A86-15903
Finance of international carriers	p 67 A86-18539
Entrepreneurial spirit combines business sense	p 10 A86-24116
Private funds will bolster tax dollars in	the job of financing
the station	p 69 A86-29494
Space insurance - A resource for activities	p 87 A86-32562
Financial structure for participation	in industrial space
projects	p 69 A86-44538
Space Station overall managem operations	ient approach for
[AIAA PAPER 86-2322]	p 11 A86-49558
NASA's FIA (National Aerona	
Administration's Financial Integrity Act progress in implementing Financial	
progress in implementing Financ requirements	da integrity Act
[PB86-135100]	p 94 N86-25288
Cost and schedule control systems	
performance measurement. Data anal [DE86-010796]	p 15 N86-33198
FISHERIES	P · • · · • · • · • · • · • · • · • · •
Marine-related research at MIT (Mas	
of Technology): A directory of 1 1985-1986	research projects,
[PB86-158102]	p 63 N86-26249
FLIGHT CONTROL	
A rapid evaluation approach	for configuration
development of new aircraft [AIAA PAPER 85-3068]	p 15 A86-10932
Expert systems development and a	pplication
[NASA-TM-86746]	p 32 N86-11194
Description of an experimental ex status monitor	pert system inght
[NASA-TM-86791]	p 32 N86-11195
Development experience with a sir	
demonstrator for pilot emergency prov [NASA-TM-85919]	p 33 N86-23603
Mission adaptive wing soars at NAS	SA Facility
Mission adaptive wing soars at NAS [P86-10182]	5A Facility p 26 N86-31563
[P86-10182] FLIGHT CREWS	p 26 N86-31563
[P86-10182] FLIGHT CREWS An analysis of the application of Al	p 26 N86-31563
[P86-10182] FLIGHT CREWS An analysis of the application of AI of intelligent aids for flight crew tasks [NASA-CR-3944]	p 26 N86-31563
[P86-10182] FLIGHT CREWS An analysis of the application of AI of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS	p 26 N86-31563 to the development p 4 N86-12212
[P86-10182] FLIGHT CREWS An analysis of the application of AI of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight r	p 26 N86-31563 to the development p 4 N86-12212 nanagement expert
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight r system The Crew Station Information Man	p 26 N86-31563 to the development p 4 N86-12212 nanagement expert p 30 A86-28498 ager - An avionics
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight r system The Crew Station Information Man expert system	p 26 N86-31563 to the development p 4 N86-12212 nanagement expert p 30 A86-28498 lager - An avionics p 30 A86-28515
[P86-10182] FLIGHT CREWS An analysis of the application of AI of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight r system The Crew Station Information Man expert system An Operations Management Sys	p 26 N86-31563 to the development p 4 N86-12212 nanagement expert p 30 A86-28498 lager - An avionics p 30 A86-28515
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight r system The Crew Station Information Man expert system	p 26 N86-31563 to the development p 4 N86-12212 nanagement expert p 30 A86-28498 lager - An avionics p 30 A86-28515
[P86-10182] FLIGHT CREWS An analysis of the application of AI of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight r system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Comment	p 26 N86-31563 to the development p 4 N86-12212 management expert p 30 A86-28498 ager - An avionics p 30 A86-28515 tem for the Space p 40 A86-46952 rcial transport flight
[P86-10182] FLIGHT CREWS An analysis of the application of AI of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight r system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 66-2329] Thirty years with the jets: Commen management systems - Past, present	p 26 N86-31563 to the development p 4 N86-12212 management expert p 30 A86-28498 lager - An avionics p 30 A86-28515 tem for the Space p 40 A86-46952 rcial transport flight , and future
[P86-10182] FLIGHT CREWS An analysis of the application of AI of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight r system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Comment	p 26 N86-31563 to the development p 4 N86-12212 management expert p 30 A86-28498 ager - An avionics p 30 A86-28515 tem for the Space p 40 A86-46952 rcial transport flight
[P86-10182] FLIGHT CREWS An analysis of the application of AI of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 66-2329] Thirty years with the jets: Commen management systems - Past, present. [AIAA PAPER 86-2289] FLIGHT SIMULATION Engineering flight simulation - A re	p 26 N86-31563 to the development p 4 N86-12212 management expert p 30 A86-28498 ager - An avionics p 30 A86-28515 tem for the Space p 40 A86-46952 rcial transport flight , and future p 22 A86-47402 evolution of change
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Comment management systems - Past, present, [AIAA PAPER 86-2289] FLIGHT SIMULATION Engineering flight simulation - A ref [SAE PAPER 851901]	p 26 N86-31563 to the development p 4 N86-12212 management expert p 30 A86-28498 ager - An avionics p 30 A86-28515 tem for the Space p 40 A86-46952 rcial transport flight , and future p 22 A86-47402
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commen management systems - Past, present. [AIAA PAPER 86-2329] FLIGHT SIMULATION Engineering flight simulation - A ref [SAE PAPER 851901] FLIGHT SIMULATORS	p 26 N86-31563 to the development p 4 N86-12212 management expert p 30 A86-28498 lager - An avionics p 30 A86-28515 tem for the Space p 40 A86-46952 rcial transport flight and future p 22 A86-47402 avolution of change p 20 A86-36941
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commen management systems - Past, present, [AIAA PAPER 86-2289] FLIGHT SIMULATION Engineering flight simulation - A ref [SAE PAPER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, [NASA-TM-87703]	p 26 N86-31563 to the development p 4 N86-12212 management expert p 30 A86-28498 lager - An avionics p 30 A86-28515 tem for the Space p 40 A86-46952 rcial transport flight and future p 22 A86-47402 avolution of change p 20 A86-36941
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commen management systems - Past, present. [AIAA PAPER 86-2289] FLIGHT SIMULATION Engineering flight simulation - A ref [SAE PAFER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, " [NASA-TM-87703] FLIGHT TESTS	p 26 N86-31563 to the development p 4 N86-12212 management expert p 30 A86-28498 lager - An avionics p 30 A86-28515 tem for the Space p 40 A86-46952 rcial transport flight and future p 22 A86-47402 avolution of change p 20 A86-36941 1985 p 81 N86-26276
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commen management systems - Past, present, [AIAA PAPER 86-2289] FLIGHT SIMULATION Engineering flight simulation - A ref [SAE PAPER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, [NASA-TM-87703]	p 26 N86-31563 to the development p 4 N86-12212 management expert p 30 A86-28498 lager - An avionics p 30 A86-28515 tem for the Space p 40 A86-46952 rcial transport flight and future p 22 A86-47402 avolution of change p 20 A86-36941 1985 p 81 N86-26276 pplication
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commen management systems - Past, present, [AIAA PAPER 86-2329] FLIGHT SIMULATION Engineering flight simulation - A ref [SAE PAPER 851001] FLIGHT SIMULATORS Langley aerospace test highlights, [NASA-TM-87703] FLIGHT TESTS Expert systems development and a [NASA-TM-8776] Description of an experimental ex	p 26 N86-31563 to the development p 4 p 4 N86-12212 nanagement expert p 30 p 30 A86-28498 avger - An avionics p 30 avger - An avionics p 30 p 40 A86-28515 tem for the Space p 40 p 40 A86-46952 rcial transport flight; and future p 22 A86-47402 avolution of change p 20 p 81 N86-26276 pplication p 32 p 32 N86-11194
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight r system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commen management systems - Past, present. [AIAA PAPER 86-2289] FLIGHT SIMULATION Engineering flight simulation - A re [SAE PAPER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, ' [NASA-TM-87703] FLIGHT TESTS Expert systems development and a [NASA-TM-86746] Description of an experimental ex status monitor	p 26 N86-31563 to the development p 4 N86-12212 management expert p 30 A86-28498 uager - An avionics p 30 A86-28515 tem for the Space p 40 A86-46952 rcial transport flight and future p 22 A86-47402 avolution of change p 20 A86-36941 1985 p 81 N86-26276 pplication p 32 N86-11194 pert system flight
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commen management systems - Past, present, [AIAA PAPER 86-2289] FLIGHT SIMULATION Engineering flight simulation - A ref [SAE PAPER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, [NASA-TM-87746] Description of an experimental ex- status monitor [NASA-TM-87791]	p 26 N86-31563 to the development p 4 p 4 N86-12212 nanagement expert p 30 p 30 A86-28498 aager - An avionics p 30 ase-28498 ager - An avionics p 30 A86-28515 tem for the Space p 40 p 40 A86-46952 crial transport flight; and future p 22 A86-47402 avolution of change p 20 p 81 N86-26276 pplication p 32 p 32 N86-11194 pert system flight p 32
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight r system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commen management systems - Past, present. [AIAA PAPER 86-2289] FLIGHT SIMULATION Engineering flight simulation - A re [SAE PAPER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, ' [NASA-TM-87703] FLIGHT TESTS Expert systems development and a [NASA-TM-86746] Description of an experimental ex status monitor	p 26 N86-31563 to the development p 4 N86-12212 nanagement expert p 30 A86-28498 lager - An avionics p 30 A86-28515 tem for the Space p 40 A86-46952 ricial transport flight , and future p 22 A86-47402 evolution of change p 20 A86-36941 1985 p 81 N86-26276 pplication p 32 N86-11194 pert system flight p 32 N86-11195 -15 flight research
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commen management systems - Past, present, [AIAA PAPER 86-2289] FLIGHT SIMULATION Engineering flight simulation - A ref [SAE PAPER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, * [NASA-TM-87703] FLIGHT TESTS Expert systems development and a [NASA-TM-86746] Description of an experimental ex- status monitor [NASA-TM-86791] Summary of results of NASA F program	p 26 N86-31563 to the development p 4 p 4 N86-12212 nanagement expert p 30 p 30 A86-28515 stem for the Space p 40 p 40 A86-46952 rcial transport flight, and future p 22 p 20 A86-47402 avolution of change p 20 p 81 N86-26276 pplication p 32 p 32 N86-11194 p 42 N86-11195 -15 flight research p 32 p 81 N86-26276
 [P86-10182] FLIGHT CREWS An analysis of the application of AI of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS 	p 26 N86-31563 to the development p 4 p 4 N86-12212 nanagement expert p 30 p 30 A86-28498 ager - An avionics p 30 ager - An avionics p 30 p 40 A86-28515 tem for the Space p 40 p 40 A86-46952 crial transport flight and future p 22 A86-47402 avolution of change p 20 p 81 N86-26276 pplication p 32 p 32 N86-11194 pert system flight p 32 15 flight research p 25 p 25 N86-26277 SA Facility Sacility
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commen management systems - Past, present, [AIAA PAPER 86-2289] FLIGHT SIMULATION Engineering flight simulation - A ref [SAE PAPER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, * [NASA-TM-87703] FLIGHT TESTS Expert systems development and a [NASA-TM-86746] Description of an experimental ex- status monitor [NASA-TM-86791] Summary of results of NASA F program [NASA-TM-86811] Mission adaptive wing soars at NAS [P86-10182] FLUID MANAGEMENT	p 26 N86-31563 to the development p 4 p 4 N86-12212 nanagement expert p 30 p 30 A86-28515 sager - An avionics p 30 p 30 A86-28515 stem for the Space p 40 p 40 A86-46952 crial transport flight and future p 22 A86-47402 avolution of change p 20 p 81 N86-26276 pplication p 32 p 32 N86-11194 p rt system flight p 32 -15 flight research p 25 p 25 N86-26277 SA Facility p 26
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commen management systems - Past, present, [AIAA PAPER 86-2329] FLIGHT SIMULATION Engineering flight simulation - A ref [SAE PAPER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, T [NASA-TM-87703] FLIGHT TESTS Expert systems development and a [NASA-TM-86746] Description of an experimental ex- status monitor [NASA-TM-86791] Summary of results of NASA F program [NASA-TM-8671] Mission adaptive wing soars at NAS [P86-10182] FLUID MANAGEMENT A design for fluid management in s	p 26 N86-31563 to the development p 4 p 4 N86-12212 nanagement expert p 30 p 30 A86-28498 avger - An avionics p 30 avger - An avionics p 30 p 30 A86-28515 tem for the Space p 40 p 40 A86-46952 criail transport flight and future p 22 A86-47402 avolution of change p 20 p 81 N86-26276 pplication p 32 p 32 N86-11194 pert system flight p 32 r 32 N86-11195 r 15 flight research p 25 p 26 N86-26277 SA Facility p 26 p 26 N86-31563 pace
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 66-2329] Thirty years with the jets: Commen management systems - Past, present [AIAA PAPER 66-2289] FLIGHT SIMULATION Engineering flight simulation - A re [SAE PAPER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, ' [NASA-TM-87703] FLIGHT TESTS Expert systems development and a [NASA-TM-86746] Description of an experimental ex status monitor [NASA-TM-86791] Summary of results of NASA F program [NASA-TM-86111] Mission adaptive wing soars at NAS [P86-10182] FLUID MANAGEMENT A design for fluid management in s [IAF PAPER ST-85-04]	p 26 N86-31563 to the development p 4 p 4 N86-12212 nanagement expert p 30 p 30 A86-28515 sager - An avionics p 30 p 30 A86-28515 stem for the Space p 40 p 40 A86-46952 crial transport flight and future p 22 A86-47402 avolution of change p 20 p 81 N86-26276 pplication p 32 p 32 N86-11194 p rt system flight p 32 -15 flight research p 25 p 25 N86-26277 SA Facility p 26
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commen management systems - Past, present, [AIAA PAPER 86-2329] FLIGHT SIMULATION Engineering flight simulation - A ref [SAE PAPER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, T [NASA-TM-87703] FLIGHT TESTS Expert systems development and a [NASA-TM-86746] Description of an experimental ex- status monitor [NASA-TM-86791] Summary of results of NASA F program [NASA-TM-8671] Mission adaptive wing soars at NAS [P86-10182] FLUID MANAGEMENT A design for fluid management in s	p 26 N86-31563 to the development p 4 p 4 N86-12212 nanagement expert p 30 p 30 A86-28498 aager - An avionics p 30 p 30 A86-28515 tem for the Space p 40 p 40 A86-46952 crial transport flight and future p 22 A86-47402 avolution of change p 20 p 81 N86-26276 pplication p 32 p 32 N86-11194 p 42 N86-26276 pplication p 32 p 32 N86-11194 p 43 N86-26276 psolication p 32 p 32 N86-11194 p 43 N86-26276 p 43 N86-26277 SA Facility p 26 p 26 N86-31563 pace p 50
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 66-2329] Thirty years with the jets: Commen management systems - Past, present. [AIAA PAPER 66-2289] FLIGHT SIMULATION Engineering flight simulation - A re [SAE PAPER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, ' [NASA-TM-87703] FLIGHT TESTS Expert systems development and a [NASA-TM-86746] Description of an experimental ex status monitor [NASA-TM-86791] Summary of results of NASA F program [NASA-TM-86111] Mission adaptive wing soars at NAS [P86-10182] FLUID MANAGEMENT A design for fluid management in s [IAF PAPER ST-85-04] FOLDING STRUCTURES Shuttle-launch triangular space stat [NASA-CASE-MSC-20676-1]	p 26 N86-31563 to the development p 4 p 4 N86-12212 nanagement expert p 30 p 30 A86-28498 aager - An avionics p 30 p 30 A86-28515 tem for the Space p 40 p 40 A86-46952 crial transport flight and future p 22 A86-47402 avolution of change p 20 p 81 N86-26276 pplication p 32 p 32 N86-11194 p 42 N86-26276 pplication p 32 p 32 N86-11194 p 43 N86-26276 psolication p 32 p 32 N86-11194 p 43 N86-26276 p 43 N86-26277 SA Facility p 26 p 26 N86-31563 pace p 50
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commen management systems - Past, present [AIAA PAPER 86-2289] FLIGHT SIMULATION Engineering flight simulation - A ref [SAE PAPER 851901] FLIGHT SIMULATIONS Langley aerospace test highlights, * [NASA-TM-87703] FLIGHT TESTS Expert systems development and a [NASA-TM-86746] Description of an experimental ex- status monitor [NASA-TM-86791] Summary of results of NASA F program [NASA-TM-86811] Mission adaptive wing soars at NAS [P6E-10182] FLUID MANAGEMENT A design for fluid management in s [IAF PAPER ST-85-04] FOLDING STRUCTURES Shuttle-launch triangular space stat [NASA-CSE-MSC-20676-1] FORMALISM	p 26 N86-31563 to the development p 4 p 4 N86-12212 nanagement expert p 30 p 30 A86-28498 aager - An avionics p 30 aager - An avionics p 30 p 40 A86-28515 tem for the Space p 40 p 40 A86-46952 crial transport flight and future p 22 A86-47402 avolution of change p 20 p 81 N86-26276 pplication p 32 p 32 N86-11194 p 42 N86-26276 pplication p 32 p 32 N86-11194 p 43 N86-26276 p 25 N86-26277 SA Facility p 26 p 25 N86-31563 pace p 50 p 50 A86-15949 tion p 93
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 66-2329] Thirty years with the jets: Commen management systems - Past, present. [AIAA PAPER 66-2289] FLIGHT SIMULATION Engineering flight simulation - A re [SAE PAPER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, ' [NASA-TM-87703] FLIGHT TESTS Expert systems development and a [NASA-TM-86746] Description of an experimental ex status monitor [NASA-TM-86791] Summary of results of NASA F program [NASA-TM-86111] Mission adaptive wing soars at NAS [P86-10182] FLUID MANAGEMENT A design for fluid management in s [IAF PAPER ST-85-04] FOLDING STRUCTURES Shuttle-launch triangular space stat [NASA-CASE-MSC-20676-1]	p 26 N86-31563 to the development p 4 p 4 N86-12212 nanagement expert p 30 p 30 A86-28498 aager - An avionics p 30 aager - An avionics p 30 p 40 A86-28515 tem for the Space p 40 p 40 A86-46952 crial transport flight and future p 22 A86-47402 avolution of change p 20 p 81 N86-26276 pplication p 32 p 32 N86-11194 p 42 N86-26276 pplication p 32 p 32 N86-11194 p 43 N86-26276 p 25 N86-26277 SA Facility p 26 p 25 N86-31563 pace p 50 p 50 A86-15949 tion p 93
 [P86-10182] FLIGHT CREWS An analysis of the application of AI of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commer management systems - Past, present. [AIAA PAPER 86-2289] FLIGHT SIMULATION Engineering flight simulation - A ref [SAE PAPER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, "[NASA-TM-87703] FLIGHT TESTS Expert systems development and at [NASA-TM-86746] Description of an experimental ex status monitor [NASA-TM-86791] Summary of results of NASA F program [NASA-TM-86811] Mission adaptive wing soars at NAS (P86-10182) FLUID MANAGEMENT A design for fluid management in s [IAF PAPER ST-85-04] FOLDING STRUCTURES Shuttle-launch triangular space stat [NASA-CASE-MSC-20676-1] FORMALISM	p 26 N86-31563 to the development p 4 p 4 N86-12212 nanagement expert p 30 p 30 A86-28498 aager - An avionics p 30 p 30 A86-28515 tem for the Space p 40 p 40 A86-28515 tem for the Space p 40 p 40 A86-46952 rcial transport flight and future p 22 A86-47402 avolution of change p 20 p 81 N86-26276 pplication p 32 p 32 N86-11194 p 42 N86-26276 p21 N86-26276 p21 N86-26277 SA Facility p 26 p 26 N86-31563 pace p 50 p 50 A86-15949 tion p 33 p 93 N86-24729 - The role of formal p 11
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commen management systems - Past, present. [AIAA PAPER 86-2289] FLIGHT SIMULATION Engineering flight simulation - A ref [SAE PAPER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, T [INASA-TM-87703] FLIGHT TESTS Expert systems development and a [NASA-TM-86791] Summary of results of NASA F program [NASA-TM-86811] Mission adaptive wing soars at NAS [P46-10182] FLUID MAAGEMENT A design for fluid management in s [IAF PAPER 87-85-04] FOLDING STRUCTURES Shuttle-launch triangular space stat [NASA-CASE-MSC-20676-1] FORMALISM Generalization in decision research models FORMING TECHNIQUES USSR report: Machine tools	p 26 N86-31563 to the development p 4 p 4 N86-12212 nanagement expert p 30 p 30 A86-28498 aager - An avionics p 30 adde-28498 aager - An avionics p 30 A86-28515 tem for the Space p 40 p 40 A86-46952 rcial transport flight and future p 22 A86-47402 avolution of change p 20 p 20 A86-36941 1985 p 81 p 81 N86-26276 pplication p 32 p 32 N86-11194 p 42 N86-26277 SA Facility p 26 p 25 N86-31563 pace p 50 p 50 A86-15949 tion p 93 v86-24729 - The role of formal p 11 A86-41385
 [P86-10182] FLIGHT CREWS An analysis of the application of AI of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commer management systems - Past, present. [AIAA PAPER 86-2289] FLIGHT SIMULATION Engineering flight simulation - A ref [SAE PAPER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, "[NASA-TM-87703] FLIGHT TESTS Expert systems development and at [NASA-TM-86746] Description of an experimental ex status monitor [NASA-TM-86791] Summary of results of NASA F program [NASA-TM-86811] Mission adaptive wing soars at NAS (P86-10182) FLUID MANAGEMENT A design for fluid management in s [IAF PAPER ST-85-04] FOLDING STRUCTURES Shuttle-launch triangular space stat [NASA-CASE-MSC-20676-1] FORMALISM	p 26 N86-31563 to the development p 4 N86-12212 nanagement expert p 30 A86-28498 ager - An avionics p 30 A86-28515 tem for the Space p 40 A86-46952 ricial transport flight , and future p 22 A86-47402 avolution of change p 20 A86-36941 1985 p 81 N86-26276 pplication p 32 N86-11194 pert system flight p 32 N86-11195 -15 flight research p 25 N86-26277 SA Facility p 25 N86-31563 pace p 50 A86-15949 tion p 93 N86-24729 - The role of formal p 11 A86-41385 and metalworking
[P86-10182] FLIGHT CREWS An analysis of the application of Al of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commen management systems - Past, present [AIAA PAPER 86-2289] FLIGHT SIMULATION Engineering flight simulation - A ref [SAE PAPER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, " [INASA-TM-87703] FLIGHT TESTS Expert systems development and at [NASA-TM-8671] Summary of results of NASA F program [NASA-TM-86811] Mission adaptive wing soars at NAS [P6-10182] FLUID MANAGEMENT A design for fluid management in s [IAF PAPER 85-04] FOLDING STRUCTURES Shuttle-launch triangular space stat [NASA-CASE-MSC-20676-1] FORMALISM Generalization in decision research models FORMING TECHNIQUES USSR report: Machine tools equipment [JPSR report: Machine tools	p 26 N86-31563 to the development p 4 p 4 N86-12212 nanagement expert p 30 p 30 A86-28498 aager - An avionics p 30 p 40 A86-28515 tem for the Space p 40 p 40 A86-46952 criai transport flight and future p 22 A86-47402 avolution of change p 20 p 81 N86-26276 pplication p 32 p 32 N86-11194 p 40 S6-26276 pplication p 32 p 32 N86-11194 p 40 N86-26276 p 25 N86-26276 p 25 N86-26277 SA Facility p 26 p 25 N86-31563 pace p 50 p 50 A86-15949 tion p 93 p 93 N86-24729 - The role of formal p 11 A86-41385 and
 [P86-10182] FLIGHT CREWS An analysis of the application of AI of intelligent aids for flight crew tasks [NASA-CR-3944] FLIGHT MANAGEMENT SYSTEMS Knowledge engineering for a flight of system The Crew Station Information Man expert system An Operations Management Sys Station [AIAA PAPER 86-2329] Thirty years with the jets: Commer management systems - Past, present. [AIAA PAPER 86-2289] FLIGHT SIMULATION Engineering flight simulation - A ref [SAE PAPER 851901] FLIGHT SIMULATORS Langley aerospace test highlights, * [NASA-TM-87703] FLIGHT TESTS Expert systems development and at [NASA-TM-86746] Description of an experimental exstatus monitor [NASA-TM-86791] Summary of results of NASA F program [NASA-TM-86811] Mission adaptive wing soars at NAS [P86-10182] FLUID MANAGEMENT A design for fluid management in s [IAF PAPER ST-85-04] FOLDING STRUCTURES Shuttle-launch triangular space stat [NASA-CASE-MSC-20676-1] FORMALISM Generalization in decision research models FORMING TECHNIQUES USSR report: Machine tools equipment [JPRS-UMM-85-014]	p 26 N86-31563 to the development p 4 p 4 N86-12212 nanagement expert p 30 p 30 A86-28498 aager - An avionics p 30 p 30 A86-28515 tem for the Space p 40 p 40 A86-46952 rcial transport flight and future p 22 A86-47402 avolution of change p 20 p 81 N86-26276 pplication p 32 p 32 N86-11194 p 40 N86-26276 pplication p 32 p 32 N86-26276 p 25 N86-26277 SA Facility p 26 p 26 N86-31563 pace p 50 p 30 N86-24729 tion p 33 p 30 N86-24729 -The role of formal p 11 p 11 A86-41385 and metalworking p 24

FORTRAN The engineering data management	t and analysis system	
(EDMAS)	p 39 A86-28482	
FRANCE Comparison of scientific and techn in the United States, France, West Ge		
Kingdom since 1970 [PB86-133030]	p7 N86-24554	
Legislation for software rights prot [SNIAS-861-422-114]		
FREQUENCIES		
Technical activities 1983, Center [PB86-140043]	for Basic Standards p 81 N86-26239	
	,	
G		
GALACTIC NUCLEI		
Extragalactic astronomy	p 65 N86-31489	
GAS TURBINE ENGINES 'Smart' engine components - A m	icro in every blade?	
GEODESY	p 17 A86-21896	
Geodesy: A look to the future		
[NASA-CR-176283] GEODETIC ACCURACY	p61 N86-11657	
Geodesy: A look to the future		
[NASA-CR-176283] GEODETIC SATELLITES	p 61 N86-11657	
Geodesy: A look to the future		
[NASA-CR-176283] GEOGRAPHIC INFORMATION SYST	p61 N86-11657 TEMS	
Planning design and implementa	tion of a statewide	
geographic information system GEOLOGICAL SURVEYS	p 40 A86-46104	
Exploration for strategic materials		
[PB86-126463] GEOLOGY	p 75 N86-24005	
Institutional supporting researce 1985	ch and development,	
[DE86-008580]	p 65 N86-30583	
State of the art of geoscience libr services	raries and information	
[DE86-011188]	p 49 N86-33207	
GEOPHYSICS Institutional supporting research	and development.	
1985		
[DE86-008580] State of the art of geoscience libr	p 65 N86-30583 raries and information	
services [DE86-011188]	p 49 N86-33207	
GEOSYNCHRONOUS ORBITS	•	
Space WARC '85 - A look back Space law in the United Nations -	p 82 A86-11023	
	p 85 A86-26546	
GLOBAL ATMOSPHERIC RESEARC The overall plan: A scientific strate		
Global Atmosphere (TOGA) program GLOBAL POSITIONING SYSTEM		
Will the USAF need ground-based	air traffic control radar	
in the year 2000? [AD-A166504]	p 8 N86-29805	
GOALS		
Support for global science: challenge	Remote sensing's p 14 N86-32864	
GOLD COATINGS The qualification and procuremen	t of two-sided printed	
circuit boards (fused tin-lead or		
European Space Agency [ESA-PSS-01-710-ISSUE-1]	p 82 N86-32660	
GOVERNMENT PROCUREMENT		
Motivational contracting in Government and industry prospection		
Treads in industrial D and D an	p 55 A86-34963	
Trends in industrial R and D ac States, Europe and Japan, 1963-83		
[PB86-141371] Guide to Canadian aerospace rel	p 63 N86-25290	
[AD-A167794]	p 26 N86-32327	
GOVERNMENT/INDUSTRY RELATIO		
Commercialization of space - approach		
[IAF PAPER 85-431] Commercialization of space	p 50 A86-15902 - The investment	
Commercialization of space opportunities	p 67 A86-18385	
Have factory, will launch	p 16 A86-20591	
Washington broadens its efforts t	p 67 A86-24102	
Shuttle launches of satellites	are making space a p 67 A86-24104	
bottomline business Future space goals - National con		
options for the 21st century	p 85 A86-24127	
The world aircraft industry Boo Four important issues in the civil		
F	p 68 A86-27886	

GUIDANCE (MOTION)

· · · · · · · · · · · · · · · · · · ·
Learning from the past - Bringing Adam Smith into
orbit p 10 A86-27887
A 3M/NASA basic research program in space p 52 A86-27896
Communications satellite business ventures - Measuring
the impact of technology programmes and related
policies p 69 A86-29699 Motivational contracting in space programs -
Motivational contracting in space programs - Government and industry prospectives
p 55 A86-34963
The field representative 'front line actioneer'
helicopter manufacturer field service representative responsibilities p 20 A86-35645
Commerical use of space - Status and prospects
p 58 A86-41154
R and D limited partnerships (possible applications in advanced communications satellite technology experiment
program)
[NASA-CR-176333] p 61 N86-13221
Federal government provision of third-party liability
insurance to space vehicle users [NASA-CR-176346] p 90 N86-13230
Evaluation of spacecraft technology programs (effects
on communication satellite business ventures), volume 1 [NASA-CR-174978] p 70 N86-16451
Technology transfer
[GPO-49-539] p 92 N86-21458
Aids in validating a contractor's cost estimate
[AD-A161871] p 71 N86-24574 Trends in industrial R and D activities in the United
States, Europe and Japan, 1963-83
[PB86-141371] p 63 N86-25290
GOVERNMENTS Federal agencies' policies and practices are in
accordance with patent and trademark amendments of
1980 [B-207939] p 91 N86-20175
Guide to programs, fiscal year 1986: Guide describing
National Science Foundation Programs and Activities
[PB86-125184] p 93 N86-23484 Managing federal information resources: Report under
the Paperwork Reduction Act of 1980
[PB86-247682] p 13 N86-25299
GRAMMARS Design of a master lexicon
GRAMMARS Design of a master lexicon [AD-A165999] p 47 N86-29721
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS
Design of a master lexicon [AD-A165999] p 47 N86-29721
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research p 95 N86-28806 University funding: Federal funding mechanisms in support of university research p 66 N86-33212 GRAVIRECEPTORS p 66 N86-33212
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research p 95 N86-28806 [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS FFECTS FFECTS FFECTS FFECTS
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-87313] p 76 N86-25321
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 76 N86-25321 NASA-Workshop on Animal Gravity-Sensing Systems [NASA-TM-87313] p 76 N86-25321 NASA-TM-88249] p 66 N86-32950
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-87313] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL FIELDS
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-25321 NASA-Workshop on Animal Gravity-Sensing Systems [NASA-TM-87313] p 76 N86-25321 NASA-TM-88249] p 66 N86-32950
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-88249] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL FIELDS Geodesy: A look to the future [NASA-CR-176283] p 61 N86-11657 GROUND BASED CONTROL
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-87313] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL FIFECTS Geodesy: A look to the future [NASA-CR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-88249] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL FIELDS Geodesy: A look to the future [NASA-CR-176283] p 61 N86-11657 GROUND BASED CONTROL
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-87313] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL FIFECTS Geodesy: A look to the future [NASA-CR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar in the year 2000? [AD-A166504] p 8 N86-29805 GROUND HANDLING
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-88249] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL FIFECTS Geodesy: A look to the future [NASA-CR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar in the year 2000? [AD-A166504] p 8 N86-29805 GROUND HANDLING Airports build for future traffic amid new security
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-87313] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-87313] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-8249] p 66 N86-32950 GRAVITATIONAL FIELDS Geodesy: A look to the future [NASA-CR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar in the year 2000? [AD-A166504] p 8 N86-29805 GROUND HANDLING Airports build for future traffic amid new security concern p 80 A86-48371 GROUND SUPPORT EQUIPMENT
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-87313] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL FIFECTS Geodesy: A look to the future [NASA-CR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar in the year 2000? [AD-A166504] p 8 N86-29805 GROUND HANDLING Airports build for future traffic amid new security concern p 80 A86-48371 GROUND SUPPORT EQUIPMENT Aircraft ground support equipment standardization - The
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-87313] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-87313] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-8249] p 66 N86-32950 GRAVITATIONAL FIELDS Geodesy: A look to the future [NASA-CR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar in the year 2000? [AD-A166504] p 8 N86-29805 GROUND HANDLING Airports build for future traffic amid new security concern p 80 A86-48371 GROUND SUPPORT EQUIPMENT
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-87313] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL FIFECTS Geodesy: A look to the future [NASA-CR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar in the year 2000? [AD-A166504] p 8 N86-29805 GROUND HANDLING Airports build for future traffic amid new security concern p 80 A86-48371 GROUND SUPPORT EQUIPMENT Aircraft ground support equipment standardization - The pros and cons of 'functional' vs 'technical' standardization [SAE PAPER 851794] p 79 A86-38317
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL FIELDS Geodesy: A look to the future [NASA-CR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar in the year 2000? [AD-A166504] p 8 N86-29805 GROUND HANDLING Airports build for future traffic amid new security concern p 80 A86-48371 GROUND SUPPORT EQUIPMENT Aircraft ground support equipment standardization - The pros and cons of 'functional' vs 'technical' standardization [SAE PAPER 851794] p 79 A86-38317 GROUND PYNAMICS
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-87313] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL FIFECTS Geodesy: A look to the future [NASA-CR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar in the year 2000? [AD-A166504] p 8 N86-29805 GROUND HANDLING Airports build for future traffic amid new security concern p 80 A86-48371 GROUND SUPPORT EQUIPMENT Aircraft ground support equipment standardization - The pros and cons of 'functional' vs 'technical' standardization [SAE PAPER 851794] p 79 A86-38317
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-88249] p 66 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-25321 MASA-CR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar in the year 2000? [AD-A166504] p 8 N86-29805 GROUND HANDLING Airports build for future traffic amid new security concern p 80 A86-48371 GROUND SUPPORT EQUIPMENT Aircraft ground support equipment standardization - The pros and cons of 'functional' vs 'technical' standardization [SAE PAPER 851794] p 79 A86-38317 GROUP DYNAMICS Management behavior, group climate and performance appraisal at NASA p 4 N86-15163 An annotated bibliography of literature integrating
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-88249] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL FIELDS Geodesy: A look to the future [NASA-GR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar in the year 2000? [AD-A166504] p 8 N86-29805 GROUND HANDLING Airports build for future traffic amid new security concern p 80 A86-48371 GROUND SUPPORT EQUIPMENT Aircraft ground support equipment standardization - The pros and cons of 'functional' vs 'technical' standardization [SAE PAPER 851794] p 79 A86-38317 GROUP DYNAMICS Management behavior, group climate and performance appraisal at NASA p 4 N86-15163 An annotated bibliography of literature integrating organizational and systems theory
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-88249] p 66 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-25321 MASA-CR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar in the year 2000? [AD-A166504] p 8 N86-29805 GROUND HANDLING Airports build for future traffic amid new security concern p 80 A86-48371 GROUND SUPPORT EQUIPMENT Aircraft ground support equipment standardization - The pros and cons of 'functional' vs 'technical' standardization [SAE PAPER 851794] p 79 A86-38317 GROUP DYNAMICS Management behavior, group climate and performance appraisal at NASA p 4 N86-15163 An annotated bibliography of literature integrating
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS university funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms for university research [AD-A168023] p 96 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL FIELDS Geodesy: A look to the future [NASA-CR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar in the year 2000? [AD-A166504] p 8 N86-29805 GROUND HANDLING Airports build for future traffic amid new security concern p 80 A86-48371 GROUND SUPPORT EQUIPMENT Aircraft ground support equipment standardization - The pros and cons of 'functional' vs 'technical' standardization p 79 A86-38317 GROUND PYNAMICS Management behavior, group climate and performance appraisal at NASA
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-88249] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 76 N86-32950 GRAVITATIONAL FIELDS Geodesy: A look to the future [NASA-GR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar in the year 2000? [AD-A166504] p 8 N86-29805 GROUND HANDLING Airports build for future traffic amid new security concern p 80 A86-48371 GROUND SUPPORT EQUIPMENT Aircraft ground support equipment standardization - The pros and cons of 'functional' vs 'technical' standardization [SAE PAPER 851794] p 79 A86-38317 GROUP DYNAMICS Management behavior, group climate and performance appraisal at NASA p 4 N86-15163 An annotated bibliography of literature integrating organizational and systems theory [AD-A164064] p 7 N86-26078 GROUP THEORY
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS university funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms for university research [AD-A168023] p 96 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVIRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL FIELDS Geodesy: A look to the future [NASA-CR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar in the year 2000? [AD-A166504] p 8 N86-29805 GROUND HANDLING Airports build for future traffic amid new security concern p 80 A86-48371 GROUND SUPPORT EQUIPMENT Aircraft ground support equipment standardization - The pros and cons of 'functional' vs 'technical' standardization p 79 A86-38317 GROUND PYNAMICS Management behavior, group climate and performance appraisal at NASA
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVITRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-88249] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL FIELDS Geodesy: A look to the future [NASA-GR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar in the year 2000? [AD-A166504] p 8 N86-29805 GROUND HANDLING Airports build for future traffic amid new security concern p 80 A86-48371 GROUND SUPPORT EQUIPMENT Aircraft ground support equipment standardization - The pros and cons of 'functional' vs 'technical' standardization [SAE PAPER 851794] p 79 A86-38317 GROUP DYNAMICS Management behavior, group climate and performance appraisal at NASA p 4 N86-15163 An annotated bibliography of literature integrating organizational and systems theory [AD-A164084] p 7 N86-26078 GROUP THEORY Group Structure and group process for effective space station astronaut teams p 5 N86-15166 GUIDANCE (MOTION)
Design of a master lexicon [AD.A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms for university research [AD-A168023] p 66 N86-33212 GRAVITECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-88249] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-88249] p 66 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL FIELDS Geodesy: A look to the future [NASA-CR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar in the year 2000? [AD-A166504] p 8 N86-29805 GROUND SUPPORT EQUIPMENT Airoraft ground support equipment standardization - The pros and cons of 'functional' vs 'technical' standardization The group consensus problem </td
Design of a master lexicon [AD-A165999] p 47 N86-29721 GRANTS University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212 GRAVITRECEPTORS NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL EFFECTS Research and competition: Best partners [NASA-TM-88249] p 76 N86-25321 NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 GRAVITATIONAL FIELDS Geodesy: A look to the future [NASA-GR-176283] p 61 N86-11657 GROUND BASED CONTROL Will the USAF need ground-based air traffic control radar in the year 2000? [AD-A166504] p 8 N86-29805 GROUND HANDLING Airports build for future traffic amid new security concern p 80 A86-48371 GROUND SUPPORT EQUIPMENT Aircraft ground support equipment standardization - The pros and cons of 'functional' vs 'technical' standardization [SAE PAPER 851794] p 79 A86-38317 GROUP DYNAMICS Management behavior, group climate and performance appraisal at NASA p 4 N86-15163 An annotated bibliography of literature integrating organizational and systems theory [AD-A164084] p 7 N86-26078 GROUP THEORY Group Structure and group process for effective space station astronaut teams p 5 N86-15166 GUIDANCE (MOTION)

HABITABILITY

н

HABITABILITY	b		
The quantitative modelling of habitability	hum	ian	spatial
[NASA-CR-179716] HARDWARE	p 9	N86	-33210
USSR report: Cybernetics, compute technology			
[JPRS-UCC-86-004] HEALTH PHYSICS	p 45		-28694
An updated model for a Space Maintenance Facility			Health
(AIAA PAPER 86-2303) HEAT			-46938
Institutional supporting research a 1985 [DE86-008580]	p 65		-30583
HELICOPTER DESIGN Logistics supportability considerations			
and preliminary design of aircraft			
[AIAA PAPER 85-3052] One man and 3,000 million oper Preparing for the LHX cockpit	p 72 ations p 17	a se	-10928 cond - -24988
HELICOPTER PERFORMANCE Helicopter maintenance in the real w	vorid p 73	486	-30549
HELICOPTERS	•		
Helicopter customer support - Are great it can be	weaw p20		of how
Robotics in aircraft manufacturing HERMES MANNED SPACEPLANE	p 20		35660
The economics of space launchers future	- Outl	look i	for the
[IAF PAPER 85-420] HIERARCHIES	p 66	A86	15893
Leader-follower strategies under information uncertainties	mod	deling	and
[DE86-000203] Design of a master lexicon	p 13	N86-	27950
(AD-A165999) HIGH ALTITUDE	p 47	N86-	29721
Aeronautical technology 2000: A proje vehicle concepts	ection	ofadv	anced
[NASA-CR-176322] HIGH LEVEL LANGUAGES	p 23	N86-	13235
Task planning for control of a sensor [DE86-004225]	r-based p 33		ot 23954
HISTORIES History of British space science B	ook p87	486	33604
The heavens and the earth: A polit	-	story	of the
space age Book Historical data and analysis for the	p 87 first fr		34134 ars of
KSC STS payload processing [NASA-TM-83105]	p 77	N86-	32471
HOLOGRAPHY Nondestructive techniques for			erizing
mechanical properties of structural overview			An
[NASA-TM-87203] HORIZONTAL SPACECRAFT LANDING			19636
Hotol spaceplane is designed to slas 80 percent HUBBLE SPACE TELESCOPE	p 54		sts by 29496
Systems engineering - Space Telesc			19525
The role of scientists in developin			
Telescope HUMAN BEHAVIOR			19526
A review of the psychological aspect	p 2	A86-	29090
Management behavior, group climate appraisal at NASA	p 4		mance 15163
Communication and miscommunicati [AD-A162843]		N86-	24257
HUMAN BEINGS Why computers may never think like			
Man-machine systems of the 1990			41648 anitive
factors and human interface issues [AD-A163865]			25123
The quantitative modelling of habitability	huma		spatial
[NASA-CR-179716] HUMAN FACTORS ENGINEERING	p 9	N86-	33210
Workload measurement in syste evaluation	əm d p3		and 33787
Workload assessment - Progress decade	durin		e last
[SAE PAPER 851877] An analysis of the application of AI to			35440 oment
of intelligent aids for flight crew tasks [NASA-CR-3944]			12212
· · · · · · · · · · · · · · · · · · ·			

SUBJECT INDEX

p 81 N86-26409

p 47 N86-29720

Standard reference data publications, 1964-1984

NASA Thesaurus supplement: A 4-part cumulative supplement to the 1985 edition of the NASA Thesaurus

[PB86-155587]

[NASA-SP-7053(SUPP-1)]

Alerted monitors: Human operators aided by automated
detectors [PB85-222750] p 4 N86-13906
Automation and the allocation of functions between
human and automatic control: General method
[AD-A161072] p 6 N86-20013 Langley aerospace test highlights, 1985
[NASA-TM-87703] p 81 N86-26276
Human factors in rule-based systems [AD-A165309] p 8 N86-26840
Mental models and problem solving with a
knowledge-based expert system [AD-A165398] p 8 N86-26843
Creativity in Science - a symposium
[DE86-003289] p 63 N86-27109 A discrete control model of PLANT
p 47 N86-31220 Basic human factors considerations
[DE86-008181] p 8 N86-31223
Human factors management [DE86-008184] p 8 N86-31226
Evaluating space station applications of automation and robotics technologies from a human productivity point of
view p 14 N86-31412
Human Factors Review Plan [DE86-010561] p 9 N86-33023
HUMAN PERFORMANCE
Application of a mathematical model of human decisionmaking for human-computer communication
p 1 A86-25036
Development and validation of a mathematical model of human decisionmaking for human-computer
communication p 2 A86-25037
Significance testing of rules in rule-based models of human problem solving p 2 A86-25038
A review of the psychological aspects of space flight
p 2 A86-29090 Results of innovative communication processes on
productivity gains in a high technology environment
p 6 N86-15203 Basic human factors considerations
[DE86-008181] p 8 N86-31223
Human factors management [DE86-008184] p 8 N86-31226
HUMAN RESOURCES
R and D Productivity: New Challenges for the US Space Program
[NASA-TM-87520] p 61 N86-15157
Implementing quality/productivity improvement initiatives in an engineering environment
p 80 N86-15158
Self-renewal: A strategy for quality and productivity improvement p 80 N86-15160
Management behavior, group climate and performance
appraisal at NASA p 4 N86-15163 Mentoring as a communication channel: Implications
for innovation and productivity p 4 N86-15164
A case study in R and D productivity: Helping the program manager cope with job stress and improve
communication effectiveness p 4 N86-15170
University funding: Federal funding mechanisms in support of university research
[AD-A168023] p 66 N86-33212 HYDROGEN OXYGEN ENGINES
Hotol spaceplane is designed to slash launch costs by
80 percent p 54 A86-29496 HYGIENE
NASA Facts: Space Shuttle food systems
[NF-150/1-86] p 9 N86-32102 HYPERSONIC AIRCRAFT
Can we develop the 1.5 million pound aerospace
High speed aeronautics
[GPO-51-341] p 91 N86-19284 HYPERSONIC FLIGHT
Low cost access to space - A second-generation Shuttle concept p 55 A86-32913
I
ICE FORMATION
lce detector [NASA-CASE-LAR-13403-1] p 93 N86-24673
NASA's Aircraft Icing Analysis Program
[NASA-TM-88791] p 82 N86-31548

[AD-A162968]

INCENTIVES

NASA's Aircraft Icing Analysis Program [NASA-TM-88791] p

modernization incentives program

INDEXES (DOCUMENTATION)

Discounted cash flow model for the industrial

Index to NASA news releases and speeches, 1984 [NASA-TM-87514] p 41 N86-13224

p 82 N86-31548

p 25 N86-24589

information technology

INDUSTRIAL MANAGEMENT In-process inspection of the parameters of the electron beam in electron beam welding p 19 A86-34124 USSR report: Machine tools and metalworking quipment p 24 N86-13742 [JPRS-UMM-85-014] Commercialization of the land remote sensing system: An examination of mechanisms and issues p 24 N86-14710 [E86-10008] Quality circles: al adaptations, p 5 N86-15201 Organizational improvements and results INDUSTRIAL PLANTS The factory of the future p 23 N86-11228 INDUSTRIES p 51 A86-17672 Identifying technical innovations Assessment of US industry's technology trends and new technology requirements [NASA-CR-176479] p 24 N86-17227 White collar productivity improvement: Sponsored action research 1983 - 1985 [NASA-CR-176366] p 6 N86-21419 Discounted cash flow model for the industrial modernization incentives program [AD-A162968] n 25 N86-24589 Trends in industrial R and D activities in the United States, Europe and Japan, 1963-83 [PB86-141371] p 63 N86-25290 University funding. Assessing federal funding mechanisms for university research [AD-A165721] p 95 N86-28806 Spinoff 1985 [NASA-TM-89240] p 65 N86-31451 INFERENCE Applications of expert systems p 33 N86-19634 INFORMATION Technology transfer is opportunity transfer [DE85-016622] p 62 N86-17230 A programme manager's needs for information p 45 N86-28795 The information needs of scientists and engineers in aerospace p 45 N86-28796 INFORMATION DISSEMINATION The role of technical information in US competitiveness with Japan [GPO-51-564] p 91 N86-16152 Information for the developing world: NTIS's (National Technical Information Services's) role in information transfer to developing countries [PB85-243269] p 92 N86-21434 Managing federal information resources: Report under the Paperwork Reduction Act of 1980 [PB86-247682] p 13 N86-25299 Public laws of the 98th Congress relating to information policy [CRS-TK-7885-F] p 94 N86-27130 The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes p 45 N86-28793 [AGARD-CP-385] International information exchange programmes are ecessary p 95 N86-28800 necessarv Freedom of Information Act: Noncompliance with affirmative disclosure provisions [AD-A168589] p 96 N86-33204 **INFORMATION FLOW** Information flow and work productivity through integrated formation technology p 42 N86-15183 information technology The role of technical information in US competitiveness with Japan p 91 N86-16152 [GPO-51-564] Managing federal information resources: Report under the Paperwork Reduction Act of 1980 p 13 N86-25299 [PB86-247682] The policy maker looks at information p 45 N86-28794 A discrete control model of PLANT p 47 N86-31220 INFORMATION MANAGEMENT Subjective workload and individual differences in information processing abilities [SAE PAPER 841491] p 2 A86-26011 Shuttle environment database [AAS 85-103] p 39 A86-28578 Technical and management information system: The tool for professional productivity on the space station program p 41 N86-15171 p 41 N86-15173 Computer systems measures Office automation: The administrative window into the integrated DBMS p 41 N86-15174 Information flow and work productivity through integrated p 42 N86-15183

Software verification and testing p 43 N86-19966 [NASA-TM-885871 Managing federal information resources: Report under the Paperwork Reduction Act of 1980 p 13 N86-25299 (PB86-2476821 Telecommunications alternatives for federal users: Market trends and decisionmaking criteria p 13 N86-25687 [PB86-153764] Data Base Management: Proceedings of a conference p 44 N86-25999 [AD-A158285] The design and analysis of a network interface for the multi-lingual database system [AD-A164756] n 44 N86-27121 Public laws of the 98th Congress relating to information policy p 94 N86-27130 [CRS-TK-7885-F] The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes p 45 N86-28793 [AGARD-CP-385] Information resources management in the R and D p 46 N86-28803 environment INFORMATION RETRIEVAL Central On-Line Data Directory p 46 N86-29294 NASA Thesaurus supplement: A 4-part cumulative supplement to the 1985 edition of the NASA Thesaurus [NASA-SP-7053(SUPP-1)] p 47 N86-29720 Freedom of Information Act: Noncompliance with affirmative disclosure provisions p 96 N86-33204 [AD-A168589] INFORMATION SYSTEMS p 39 A86-34981 Information systems in space n 41 N86-15173 Computer systems measures Information flow and work productivity through integrated information technology p Information Systems development aids p 42 N86-15183 p 42 N86-18246 [DE85-018161] Managing federal information resources: Report under the Paperwork Reduction Act of 1980 [PB86-247682] p 13 N86-25299 Schema-based theory of information presentation for distributed decision making [AD-A163150] p 13 N86-25992 The world brain today: Scientographic databases. What are they, how are they created and what are they used p 44 N86-26007 for? Role of robotics in solving production, social problems p 34 N86-26062 Public laws of the 98th Congress relating to information policy [CRS-TK-7885-F] p 94 N86-27130 USSR report: Cybernetics, computers and automation technology [JPRS-UCC-86-004] p 45 N86-28694 A programme manager's needs for information p 45 N86-28795 The costs of not having refined information p 45 N86-28798 Measuring the value of information and information systems, services and products p 45 N86-28799 Information resources management in the R and D environment p 46 N86-28803 Organization as information processing systems: Toward a model of the research factors associated with significant research outcomes p 48 N86-33200 [AD-A168018] Organizations as information processing systems: Environmental characteristics, company performance and chief executive scanning, an empirical study [AD-A168035] p 15 N86-33201 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 State of the art of geoscience libraries and information services [DE86-011188] p 49 N86-33207 INFORMATION TRANSFER Public laws of the 98th Congress relating to information policy [CRS-TK-7885-F] p 94 N86-27130 The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes [AGARD-CP-385] p 45 N86-28793 The costs of not having refined information p 45 N86-28798 International information exchange programmes are necessarv p 95 N86-28800 INFRARED ASTRONOMY SATELLITE Science operations management --- with Infrared Astronomy Satellite project p 72 A86-19524 INSPECTION In-process inspection of the parameters of the electron beam in electron beam welding p 19 A86-34124 INSTRUMENT PACKAGES The earth observing system --- instrument package planning for atmosphere, ocean and land studies [AAS PAPER 85-397] p 58 A86-43229

INTELSAT SATELLITES Intelsat and the challenge of competitive systems p 84 A86-18394 INTERACTIVE CONTROL Intelligent interfaces for human control of advanced automation and smart systems INTERCOSMOS SATELLITES p 29 A86-21889 The USSR and satellite communications - Competition and cooperation p 84 A86-18389 INTERFACES Design of a master lexicon [AD-A165999] p 47 N86-29721 INTERNATIONAL COOPERATION Space WARC '85 - A look back p 82 A86-11023 Development and implementation of the Future Global Maritime Distress and Safety System (FGMDSS) [IAF PAPER 85-338] p 77 A86-15839 Inmarsat role in the future global maritime distress and safety system [IAF PAPER 85-339] p 78 A86-15840 Economic equity and international cooperation - The example of E.S.A [IAF PAPER 85-4991 p 83 A86-15943 International cooperation and competition in civilian space activities p 83 A86-17743 Space law challenged . p 83 A86-18368 The USSR and satellite communications - Competition and cooperation p 84 A86-18389 The participation of developing countries in space research p 84 A86-18392 Intelsat and the challenge of competitive systems p 84 A86-18394 p 84 A86-19261 Management of outer space National and international cooperation in remote sensing and applications [AIAA PAPER 86-0412] p 84 A86-19861 Use of satellite data in international disaster management The view from the U.S. Department of p 85 A86-21126 State Europe - Towards a new long-term programme --- in n 85 A86-22242 space International involvement in the US space station programme p 85 A86-22244 Japanese policy on participation in the Space Station program [AAS 85-114] p 86 A86-28583 The Mars base - International cooperation [AAS 84-154] p 87 A86-28780 US-Soviet intergovernmental agreement on cooperative space activities - Should it be re-established? p 87 A86-29698 A chronicle of policy and procedure - The formulation of the Reagan administration policy on international satellite telecommunications p 87 A86-30290 Internationalization of the Space Station p 56 A86-34974 Developing the final frontier: International cooperation in the peaceful uses of outer space --- Book p 88 A86-42236 Space stations: Legal aspects of scientific and commercial use in a framework of transatlantic cooperation; Proceedings of the International Colloquium, Hamburg, West Germany, October 3, 4, 1984 p 88 A86-43335 Possible models for specific space agreements p 88 A86-43339 Agreements between states and with international organizations --- on Space Station construction, transport p 88 A86-43340 and orbital assembly The U.S. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July 22, 23, 1986 --- Book p 60 A86-47648 The search for common ground --- with joint Mars expedition by U.S. and U.S.S.R. p 90 Å86-49454 US space programs: Cooperation and competition from Europe [BPA-CP-695] p 90 N86-12163 Report on active and planned spacecraft and experiments p 61 N86-13343 [NASA-TM-874991 Government-to-government cooperation in space station development p 91 N86-15166 The role of technical information in US competitiveness with Japan [GPO-51-564] p 91 N86-16152 Information for the developing world: NTIS's (National Technical Information Services's) role in information transfer to developing countries p 92 N86-21434 (PB85-243269) Significant NASA inventions available for licensing in foreign countries [NAŠA-SP-7038(08)] p 94 N86-26243 The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes

[AGARD-CP-385]

p 45 N86-28793

p 14 N86-32864 challenge INTERNATIONAL LAW US space commercialization - Effects on space law and domestic law p 84 A86-18384 International space law and direct broadcast satellites p 85 A86-24675 INTERNATIONAL RELATIONS The heavens and the earth: A political history of the pace age --- Book p 87 A86-34134 space age --- Book Transfer of high-technology to the Soviet Union. A predicament for the US (AD-A1664691 p 96 N86-30582 INTERNATIONAL TRADE Transfer of high-technology to the Soviet Union. A redicament for the US AD-A1664691 p 96 N86-30582 INTERPLANETARY FLIGHT Space Station - The first step [AAS 84-160] p 87 A86-28786 Concepts for the early realization of a manned mission to Mars [AAS 84-170] p 53 A86-28796 The search for common ground --- with joint Mars expedition by U.S. and U.S.S.R. p 90 A86-49454 INTERPLANETARY SPACECRAFT Mission strategy and spacecraft design for a Mars base program AAS 84-1691 p 53 A86-28795 INVENTIONS Power sensing device [AD-D012171] p 94 N86-26529 INVENTORY CONTROLS p 23 N86-11228 The factory of the future Production and inventory control with the base stock system p 77 N86-32328 (ÉUT/BDK/12) Balancing production level variations and inventory variations in complex production systems THE/BDK/841 p 77 N86-32329 INVENTORY MANAGEMENT Computer simulation and modeling - A tool for inventory management p 74 A86-35646 INVESTMENTS The investment p 67 A86-18385 Commercialization of space opportunities Shuttle launches of satellites are making space a bottomline business p 67 A86-24104 Insurance in space risk management p 68 A86-26453 R and D limited partnerships (possible applications in advanced communications satellite technology experiment program) [NASA-CR-176333] p 61 N86-13221 Financing applied R and D in smaller companies [PB86-196987] p 71 N86-3 p 71 N86-28783 J JAPAN Government-to-government cooperation in space station development p 91 N86-15166 The role of technical information in US competitiveness with Japan [GPO-51-564] p 91 N86-16152 JAPANESE SPACE PROGRAM Japanese policy on participation in the Space Station program [AAS 85-114] p 86 A86-28583 The flowering of Japan's space program p 60 A86-49453 JAPANESE SPACECRAFT A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 JET AIRCRAFT

Thirty years with the jets: Commercial transport flight management systems - Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402 JET AIRCRAFT NOISE

Sonic-boom research: Selected bibliography with annotation

[NASA-TM-87685] p 65 N86-30470 JET PROPULSION

Aeropropulsion opportunities for the 21st century [NASA-TM-88817] p 26 N86-31585 JUDGMENTS

Recent developments in aviation case law

p 84 A86-18848 A theoretically based review of theory and research in udgment and decision making [AD-A164914]

p 13 N86-27113

JUDGMENTS

p 95 N86-28800

International information exchange programmes are

Support for global science: Remote sensing's

necessary

KEYING Reconfigurable work station for a video display unit and keyboard p 92 N86-22114 [NASA-CASE-MES-26009-1SB]

Κ

KINESTH	FSIA					
	quantitative	modelling	of	huma	an	spatial
habitab	ility	-				
[NASA-	CB-1797161			p 9	N86	5-33210

179716] KNOWLEDGE The effects of type of knowledge upon human problem p 1 A86-17771 solving in a process control task The world brain today: Scientographic databases. What are they, how are they created and what are they used p 44 N86-26007 for?

White collar productivity improvem	Sponsored	
action research 1983 - 1985		
[NASA-CR-176366]	р6	N86-21419
LAND MOBILE SATELLITE SERVICE		

- A shared satellite system would satisfy many future aviation needs p 51 A86-20921 LANDSAT SATELLITES
- US space commercialization Effects on space law and p 84 A86-18384 domestic law Commercial marketing of Landsat data begins p 68 A86-24123

Commercialization of the land remote sensing system: An examination of mochanisms and issues

p 24	N86-14710
tions for	LANDSAT
p 91	N86-20174
ations for	Landsat
	p 24 tions for p 91

[HR-REPT-99-177]	p 93	N86-22448
LARGE SPACE STRUCTURES		
Requirements, development and pa	arametric	analysis for

space systems division [AIAA PAPER 85-3078] p 16 A86-10936

Structures in space - Contractors adapt earth-based construction methods to microgravity p 17 A86-24106 Construction and control of large space structures p 21 A86-37060

LASER APPLICATIONS

The role of laser technology in materials processing and nondestructive testing in the 21st century p 75 A86-47139

- LAUNCH VEHICLE CONFIGURATIONS p 52 A86-21524 Europe goes independent Hotol spaceplane is designed to slash launch costs by 80 percent p 54 A86-29496 Integrated structural analysis for rapid design support [AIAA PAPER 86-1010] p 39 A86-38868
- LAUNCH VEHICLES The economics of space launchers - Outlook for the future
- [IAF PAPER 85-420] p 66 A86-15893 Heavy lift launch vehicles for 1995 and beyond p 23 N86-11216 [NASA-TM-865201 Regulatory aspects of commercial space
- p 91 N86-17409 transportation LAUNCHING BASES

Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989

LAUNCHING SITES

Proceedings of the 2nd Annual Conference on NASA/University Advanced Space Design Program [NASA-TM-89399] p 64 N86-29888

LEAD COMPOUNDS

The qualification and procurement of two-sided printed circuit boards (fused tin-lead or gold plated finish) ---European Space Agency [ESA-PSS-01-710-ISSUE-1]

- p 82 N86-32660 LEADERSHIP Results of innovative communication processes on
- productivity gains in a high technology environment p 6 N86-15203

LEARNING THEORY

Man-machine systems of the 1990 decade: Cognitive factors and human interface issues [AD-A163865] p 7 N86-25123

LEASING Satellite leasing - Cheap access to space

- p 72 A86-22267 LECTURES
- Index to NASA news releases and speeches, 1984 [NASA-TM-87514] p 41 N86-13224

LEGAL LIABILITY

Insurance	for	space	venture

- [IAF PAPER 85-435] p 83 A86-15905 Airline indemnity agreements - Will the contracts shift vour risks? p 88 A86-34228 The broker's role in space insurance p 90 A86-44540 Insurance and commercial satellite systems p 90 A86-44541 Something has to change p 90 A86-46375 Federal government provision of third-party liability insurance to space vehicle users p 90 N86-13230 [NASA-CR-176346]
- A study of factors related to commercial space platform services [NASA-CR-176881] p 96 N86-30744
- LIBRARIES
- Measuring the value of information and information p 45 N86-28799 systems, services and products Computing Services Software Library [DE86-009491] 048 N86-32340
- State of the art of geoscience libraries and information services
- (DE86-011188) p 49 N86-33207 LICENSING Regulatory commercial, aspects of space
- p 91 N86-17409 transportation LIFE (DURABILITY)
- Ada (trademark) training curriculum: Software engineering for managers M101 teacher's guide p 8 N86-27941 [AD-A165123]
- LIFE CYCLE COSTS Software quality and software productivity p 38 A86-28415
- Primer on operating and support (O and S) costs for space systems [AD-A162381]
- p 71 N86-24588 LIFE SCIENCES
- Science requirements for Space Station Laboratory [SAE PAPER 851368] p 52 A86-23552 Space Station life sciences guidelines for nonhuman experiment accommodation
- [SAE PAPER 851370] p 52 A86-23553 Space Station - Life sciences
- [AIAA PAPER 86-2346] p 60 A86-46960 Life Sciences Space Station planning document: A reference payload for the Life Sciences Research
- Facility [NASA-TM-89188] p 64 N86-30302 Institutional supporting research and development,
- 1985 [DE86-0085801 p 65 N86-30583
- LIFE SUPPORT SYSTEMS Automated subsystems control development --- for life
- support systems of space station (SAE PAPER 851379) p 10 A86-23561 Toward a permanent lunar settlement in the coming
- decade: the Columbus Project p 14 N86-29874 (DE86-006709)
- LIGHT AIRCRAFT One man and 3,000 million operations a second -Preparing for the LHX cockpit p 17 A86-24988 LIGHTNING
- NASA storm hazards research in lightning strikes to aircraft p 79 A86-37479 LINGUISTICS
- Communication and miscommunication
- [AD-A162843] p 7 N86-24257 Design of a master lexicon (AD-A165999) p 47 N86-29721
- LOGIC CIRCUITS

Automated reasoning: Basic research problems [DE86-009214] p 36 N86-31270 LOGIC DESIGN

- Applications of expert systems p 33 N86-19634 The world brain today: Scientographic databases. What are they, how are they created and what are they used for? p 44 N86-26007
- LOGISTICS
- Maintenance planning for the 1990's (initial planning) [PB86-106010] p 75 N86-22065 LOGISTICS MANAGEMENT
- Logistics supportability considerations during conceptual and preliminary design --- of aircraft [AIAA PAPER 85-3052]
- n 72 A86-10928 Spare parts pricing - Impact on logistics support p 74 A86-35647
- Developing a maintenance concept for future electronic p 74 A86-43333 [AIAA PAPER 86-1145]
- Space Station overall management approach for , rations p 11 A86-49558 [AIAA PAPER 86-23221]

LOGMARS (logistics applications of automated marking and reading symbols) clearinghouse, applications directory [AD-A162327] n 75 N86-24586 An example of integrated logistic support applied also to production testing --- aircraft industry D 77 N86-30898 LONG DURATION SPACE FLIGHT Evaluation of the need for a large primate research facility in space [NASA-CR-179661] p 14 N86-32111 LOSSES Federal government provision of third-party liability insurance to space vehicle users [NASA-CR-176346] p 90 N86-13230 LOW COST Low cost access to space - A second-generation Shuttle p 55 A86-32913 concept Spacelab Hitchhiker, for rapid, low cost orbital resources p 56 A86-34991 LOW GRAVITY MANUFACTURING Prescription for profits p 56 A86-35526 Space Processing Applications Rocket (SPAR) project: SPAR 10 [NASA-TM-86548] p 76 N86-28972 LUNAR BASES Toward a permanent lunar settlement in the coming decade: the Columbus Project [DE86-006709] p 14 N86-29874 LUNAR LOGISTICS Toward a permanent lunar settlement in the coming decade: the Columbus Project (DE86-0067091 p 14 N86-29874 LUNAR SURFACE Proceedings of the 2nd Annual Conference on NASA/University Advanced Space Design Program

[NASA-TM-89399] p 64 N86-29888

М

MACHINE TOOLS USSR report: Machine tools and metalworking equipment [JPRS-UMM-85-010] p 23 N86-11394 USSR report: Machine tools and metalworking equipment [JPRS-UMM-85-014] p 24 N86-13742 Machine tools USSR report: and metalworking equipment [JPRS-UMM-85-013] p 24 N86-13745 MACHINING p 23 N86-11228 The factory of the future USSR report: Machine tools and metalworking equipment [JPRS-UMM-85-010] p 23 N86-11394 MÀINTAINABILITY New maintainability prediction technique p 73 A86-22379 Maintainability planning for the Space Station p 73 A86-32095 [AIAA PAPER 86-9754] LOGMARS (logistics applications of automated marking and reading symbols) clearinghouse applications directory [AD-A162327] p 75 N86-24586 MAINTENANCE Enhanced maintenance and explanation of expert systems through explicit models of their development p 28 A86 14847 Systems modeling and DBMS application in test assets p 74 A86-43881 management Maintenance planning for the 1990's (initial planning) [PB86-106010] p 75 N86-22065 Due-date reliability in a repair shop: Implications for organizational and work design p 27 N86-32333 [THE/BDK/KBS/84-14] Structuring the production control problem in a repair shop [THE/BDK/KBS/84-16] p 27 N86-32334 MAN ENVIRONMENT INTERACTIONS Plan for the implementation of the World Climate Research Programme p 49 A86-10403 MAN MACHINE SYSTEMS The effects of type of knowledge upon human problem p 1 A86-17771 solving in a process control task Pilots of the future - Human or computer? p1 A86-18541 Intelligent interfaces for human control of advanced automation and smart systems p 29 A86-21889 The roles of astronauts and machines for future space operations [SAE PAPER 851332] p 1 A86-23521 Application of a mathematical model of human decisionmaking for human-computer communication p 1 A86-25036

Development and validation of a mathematical model of human decisionmaking for human-computer communication p 2 A86-25037
Automation in the cockpit - Who's in charge? [SAE PAPER 841534] p 37 A86-26005
2010 - The symbionic cockpit p 18 A86-28455
The Crew Station Information Manager - An avionics expert system p 30 A86-28515
Symposium on Aviation Psychology, 3rd, Columbus, OH,
April 22-25, 1985, Proceedings p 2 A86-29851
Predicted versus experienced workload and performance on a supervisory control task
p 2 A86-29879
Expert computer aided decision in supervisory control p 30 A86-33188
The human role in space: Technology, economics and
optimization Book p 3 A86-37037 Future directions in mobile teleoperation
[DE85-014308] p 61 N86-12976 Robot software: Current state-of-the-art, and future
challenges p 42 N86-19630
Applications of expert systems p 33 N86-19634 Man-machine systems of the 1990 decade: Cognitive
factors and human interface issues
[AD-A163865] p 7 N86-25123 Human factors in rule-based systems
[AD-A165309] p 8 N86-26840
Mental models and problem solving with a knowledge-based expert system
[AD-A165398] p 8 N86-26843 A discrete control model of PLANT
p 47 N86-31220 Knowledge-based load leveling and task allocation in
human-machine systems p 9 N86-32985
MAN-COMPUTER INTERFACE Application of a mathematical model of human
decisionmaking for human-computer communication
p 1 A86-25036
Development and validation of a mathematical model of human decisionmaking for human-computer
communication p 2 A86-25037 MANAGEMENT
New job for NASA is marketing management
p 69 A86-41681
Mentoring as a communication channel: Implications for innovation and productivity p 4 N86-15164
Organizations as information processing systems: Environmental characteristics, company performance and
chief executive scanning, an empirical study
[AD-A168035] p 15 N86-33201
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS)
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference.
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072 Software verification and testing [NASA-TM-88587] p 43
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072 Software verification and testing
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072 Software verification and testing [NASA-TM-88587] p 43 N86-19966 MANAGEMENT INFORMATION SYSTEMS Technical and management information system: The tool for professional productivity on the space station
[AD-A188035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072 Software verification and testing [NASA-TM-88587] p 43 MANAGEMENT INFORMATION SYSTEMS Technical and management information system: The tool for professional productivity on the space station program
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-CS-85-0003-H2] p 12 N86-19966 MANAGEMENT INFORMATION SYSTEMS Technical and management information system: The tool for professional productivity on the space station program p 41 N86-15171 Establishing a successful management information system for project management
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 NASA-TM-88587] p 43 MANAGEMENT INFORMATION SYSTEMS Technical and management information system: The tool for professional productivity on the space station program p 41 N86-15171 Establishing a successful management information
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS p 21 A86-40514 Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-003-H2] p 12 N86-11072 Software verification and testing [NASA-TM-88587] p 43 N86-19966 MANAGEMENT INFORMATION SYSTEMS Technical and management information system: The tool for professional productivity on the space station program p 41 N86-15171 Establishing a successful management [DE85-018543] p 42 N86-19251 DEASEL: An expert system for software engineering p 47 N86-30361
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072 Software verification and testing [NASA-TM-88587] p 43 MANAGEMENT INFORMATION SYSTEMS Technical and management information system: The tool for professional productivity on the space station program p 41 N86-15171 Establishing a successful management information system for project management [DE85-018543] p 42 DEASEL: An expert system for software engineering p 47 N86-30201 MANAGEMENT INFERDOS Aviation maintenance management Book
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 NASA-TM-88587] p 43 MANAGEMENT INFORMATION SYSTEMS Technical and management information system: The tool for professional productivity on the space station program p 41 N86-19261 DEASEL: An expert system for software engineering p 47 DEASEL: An expert system for software engineering p 47 MANAGEMENT INFERDINGS
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072 Software verification and testing [NASA-TM-88587] p 43 N86-19966 MANAGEMENT INFORMATION SYSTEMS Technical and management information system: The tool for professional productivity on the space station program p 41 N86-15171 Establishing a successful management information system for project management [DE85-018543] p 42 N86-19251 DEASEL: An expert system for software engineering p 47 N86-30361 MANAGEMENT METHODS Aviation maintenance management Book p 72 A86-21055 Concurrent and sequential networks - Implications for project management p 52 A86-21055
[AD-A188035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072 Software verification and testing [NASA-TM-88587] p 43 N86-19966 MANAGEMENT INFORMATION SYSTEMS Technical and management information system: The tool for professional productivity on the space station program p 41 N86-15171 Establishing a successful management information system for project management [DEASEL: An expert system for software engineering p 47 N86-30361 MANAGEMENT INFERDOS Aviation maintenance management Book p 72 A86-21055 Concurrent and sequential networks - Implications for project management p 52 A86-28055 Aviation maintenance management Book p 72 A86-21055 Concurrent and sequential networks - Implications for project management p 52 A86-28055
$\begin{tabular}{ c c c c c c } \hline P 15 & N86-33201 \\ \hline \textbf{MANAGEMENT ANALYSIS} \\ \hline Trades and Analyses Management System (TRAMS) $$$$ p 21 & A86-40514 $$$$ Management of organizational operations in dynamic environments. Towards a frame of reference. $$$$ [FOA-C5-85-0003-H2] $$$ p 12 & N86-11072 $$$$$ Software verification and testing $$$$ [NASA-TM-88587] $$$ p 43 & N86-19966 $$$$$$$$$$$$$$$$$ MANAGEMENT INFORMATION SYSTEMS $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
[AD-A188035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072 Software verification and testing [NASA-TM-88587] p 43 N86-19966 MANAGEMENT INFORMATION SYSTEMS Technical and management information system: The tool for professional productivity on the space station program p 41 N86-19261 DEASEL: An expert system for software engineering p 42 N86-19251 DEASEL: An expert system for software engineering p 47 N86-30361 MANAGEMENT INFERDOS Aviation maintenance management Book p 72 A86-21055 Concurrent and sequential networks - Implications for project management p 52 A86-28423 A new perspective on software management p 38 A86-28423 A new perspective on software management p 38 A86-28424 Software management for integrated avionics systems p 38 A86-28424
$\begin{tabular}{ c c c c c c } \hline P 15 & N86-33201 \\ \hline \textbf{MANAGEMENT ANALYSIS} \\ \hline Trades and Analyses Management System (TRAMS) $$$$ p 21 & A86-40514 $$$$ Management of organizational operations in dynamic environments. Towards a frame of reference. $$$$ [FOA-C5-85-0003-H2] $$$ p 12 & N86-11072 $$$$ Software verification and testing $$$$ [NASA-TM-88587] $$$$ p 43 & N86-19966 $$$$$$$$$$$$$$$$$ MANAGEMENT INFORMATION SYSTEMS $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072 Software verification and testing [NASA-TM-86587] p 43 N86-19966 MANAGEMENT INFORMATION SYSTEMS Technical and management information system: The tool for professional productivity on the space station program p 41 N86-19261 JEAS-018543] p 42 N86-19251 DEASEL: An expert system for software engineering p 47 N86-30361 MANAGEMENT METHODS Aviation maintenance management
$\begin{tabular}{ c c c c c } \hline P 15 N86-33201 \\ \hline \textbf{MANAGEMENT ANALYSIS} \\ \hline Trades and Analyses Management System (TRAMS) $$$ p 21 A86-40514 $$$ Management of organizational operations in dynamic environments. Towards a frame of reference. $$$ [FOA-C5-85-0003-H2] $$ p 12 N86-11072 $$$ Software verification and testing $$$ [NASA-TM-88587] $$ p 43 N86-19966 $$$$$$$$$ MANAGEMENT INFORMATION SYSTEMS $$$ Technical and management information system: The tool for professional productivity on the space station program $$ p 41 N86-15171 $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072 Software verification and testing [NASA-TM-88587] p 43 N86-19966 MANAGEMENT INFORMATION SYSTEMS Technical and management information system: The tool for professional productivity on the space station program p 41 N86-15171 Establishing a successful management [DE85-018543] p 42 N86-19251 DEASEL: An expert system for software engineering p 47 N86-30361 MANAGEMENT METHODS p 72 A86-21055 Concurrent and sequential networks - Implications for project management p 38 A86-28423 A new perspective on software management p 38 p 38 A86-28423 A new perspective on software management p 38 p 38 A86-28425 A proven software project audit methodology p 39 A86-28427 Artificial intelligence - New tools for aerospace project
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072 Software verification and testing [NASA-TM-88587] p 43 N86-19966 MANAGEMENT INFORMATION SYSTEMS Technical and management information system: The tool for professional productivity on the space station program p 41 N86-15171 Establishing a successful management information system for project management [DE85-018543] p 42 N86-19966 MANAGEMENT METHODS p 42 N86-19251 DEASEL: An expert system for software engineering p 47 N86-30361 MANAGEMENT METHODS Aviation maintenance management Book p 72 A86-21055 Concurrent and sequential networks - Implications for project management tool p 38 A86-28425 A new perspective on software management p 38 A86-28425 A proven software project audit methodology p 39 A86-34986 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072 Failures and successes of quantitative methods in management p 30 A
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072 Software verification and testing [NASA-TM-88587] p 43 N86-19966 MANAGEMENT INFORMATION SYSTEMS Technical and management information system: The tool for professional productivity on the space station program p 41 N86-15171 Establishing a successful management information system for project management p 42 N86-19251 DEASEL: An expert system for software engineering p 47 N86-30361 MANAGEMENT METHODS Aviation maintenance management p 52 A86-21055 Concurrent and sequential networks - Implications for project management tool p 38 A86-28423 A new perspective on software management p 38 A86-284242 A proven software project audit methodology p 39 A86-34986 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072 Failures and successes of quantitative methods in management p 12 N86-11072 Failures and successes of quantitative methods in management
[AD-A168035]p 15N86-33201MANAGEMENT ANALYSISTrades and Analyses Management System (TRAMS) p 21A86-40514Management of organizational operations in dynamic environments. Towards a frame of reference.[FOA-C5-85-0003-H2]p 12N86-11072 Software verification and testing [NASA-TM-88587]p 43N86-19966MANAGEMENT INFORMATION SYSTEMSTechnical and management information system: The tool for professional productivity on the space station programp 41N86-15171Establishing a successful management information system for project management [DE85-018543]p 42N86-19966MANAGEMENT METHODSp 42N86-30361MANAGEMENT METHODSp 47N86-30361MANAGEMENT METHODSp 42N86-21055Concurrent and sequential networks - Implications for project management project management toolp 38A86-28425A new perspective on software management p 38A86-28424Software management for integrated avionics systems p 38A86-28425A proven software project audit methodology p 39A86-34986Management of organizational operations in dynamic environments. Towards a frame of reference.[FOA-C5-85-0003-H2]p 12N86-11072Failures and successes of quantitative methods in managementp 12N86-15181Socio-technical integration of the workplace p 12p 5N86-15182Training managers for high productivity: Guidelines and a case historyp 5N86-15184
[AD-A168035] p 15 N86-33201 MANAGEMENT ANALYSIS Trades and Analyses Management System (TRAMS) p 21 A86-40514 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072 Software verification and testing [NASA-TM-88587] p 43 N86-19966 MANAGEMENT INFORMATION SYSTEMS Technical and management information system: The tool for professional productivity on the space station program p 41 N86-15171 Establishing a successful management information system for project management p 42 N86-19251 DEASEL: An expert system for software engineering p 47 N86-30361 MANAGEMENT METHODS Aviation maintenance management p 52 A86-21055 Concurrent and sequential networks - Implications for project management tool p 38 A86-28423 A new perspective on software management p 38 A86-284242 A proven software project audit methodology p 39 A86-34986 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072 Failures and successes of quantitative methods in management p 12 N86-11072 Failures and successes of quantitative methods in management

Results of innovative communication processes on productivity gains in a high technology environment p 6 N86-15203 White collar productivity improvement: Sponsored action research 1983 - 1985 [NASA-CR-176366] p 6 N86-21419

Computer-aided engineering [AD-A162811] p 81 N86-24256 NASA's FIA (National Aeronautics and Space Administration's Financial Integrity Act) Program: NASA's progress in implementing Financial Integrity Act

requirements [PB86-135100] p 94 N86-25288 Evaluating R and D and new product development ventures: An overview of assessment methods \$12.00/MF

A01 [PB86-110806] p 13 N86-25289 Production and inventory control with the base stock system

[EUT/BDK/12] p 77 N86-32328 MANAGEMENT PLANNING

Keys to engineering management reducing the risks of R&D start-ups planning p 21 A86-41155 Planning for minimum overhaul time p 75 A86-47616

Space Station overall management approach for operations

[AIAA PAPER 86-2322] p 11 A86-49558 Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072 On the structure of manpower planning, a contribution

of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution

of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 Improved productivity through interactive communication p 12 N86-15181 Socio-technical integration of the workplace

p 5 N86-15182 Training managers for high productivity: Guidelines and a case history p 5 N86-15184 Productivity enhancement planning using participative

management concepts p 6 N86-15202 NASA: 1986 long-range program plan [NASA-TM-87560] p 63 N86-21420

PASSCAL Field Data Management Plan (PFDMP) [DE86-003192] p 43 N86-24285 Schema-based theory of information presentation for distributed decision making

[AD-A163150] p 13 N86-25992 Guide on selecting ADP (Automatic Data

Processing)backup processing alternatives [PB86-154820] p 44 N86-26241 The development of a project plan for the Get Away Special Program p 64 N86-27306

MANAGEMENT SYSTEMS

Systems modeling and DBMS application in test assets management p 74 A86-43081 Testability management through MIL-STD-2165 p 80 A86-43901

An Operations Management System for the Space Station [AIAA PAPER 86-2329] p 40 A86-46952

[AIAA PAPER 86-2329] p 40 A86-46952 R and D limited partnerships (possible applications in advanced communications satellite technology experiment program) [NASA-CR-176333] p 61 N86-13221

Program Management System manual [DE86-005396] p 76 N86-28012

MANIPULATORS Sharpening the senses of industrial robots p 31 A86-40831 Time optimal robotic manipulator motions and work p 31 A86-42983 places for point to point tasks Robot end effector p 34 N86-27663 [PB86-1660421 Application of teleoperator expertise to robotics [DE86-003659] p 35 N86-29229 MANNED SPACE FLIGHT The Space Station program definition and preliminary systems design - Recent developments p 50 A86-15611 [IAF PAPER 85-18] Space Station operations [IAF PAPER 85-45] p 72 A86-15632 Earth based approaches to enhancing the health and safety of space operations p 77 A86-15833 [IAF PAPER 85-330] Concepts for the early realization of a manned mission to Mars [AAS 84-170] p 53 A86-28796 integrated logistics support - Five key areas of

p 73 A86-32930

p 88 A86-36449

engineering technology in space

Soviet spaceflight comes of age

The human role in space: Technology, economics and optimization --- Book p 3 A86-37037 Astronauts and cosmonauts biographical and statistical data, revised June 28, 1985 [GPO-52-498] p 7 N86-21499 The suitability of various spacecraft for future space applications missions [NASA-TM-88986] p 64 N86-27409 MANPOWER On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-1 p 4 N86-11075 MANUAL CONTROL A comparison of a manual and computer-integrated production process in terms of process control decision-making [AD-A168037] p 14 N86-32750 MANUALS Program Management System manual p 76 N86-28012 [DF86-005396] MANUFACTURING Robotic applications to automated composite aircraft component manufacturing (SME PAPER MF85-506) p 17 A86-24667 Satellite communications planning and equipment banufacturing in Latin America p 19 A86-30187 Robotics in aircraft manufacturing p 20 A86-35660 manufacturing in Latin America p 23 N86-11228 The factory of the future New technology implementation: Technical, economic and political factors p 24 N86-15172 Modeling and planning robotic manufacturing [AD-A161014] p 24 N86-19620 MAPPING A robust layered control system for a mobile robot p 33 N86-18736 [AD-A160833] ENVIROSAT-2000 report: Federal agency satellite requirements [NASA-TM-88752] p 63 N86-26355 MAPS Computer techniques for producing color maps [AD-A161159] p 42 N86-19955 MARINE BIOLOGY Marine-related research at MIT (Massachusetts Institute of Technology): A directory of research projects, 1985-1986 [PB86-158102] p 63 N86-26249 MARINE ENVIRONMENTS Marine-related research at MIT (Massachusetts Institute Technology): A directory of research projects, 1985-1986 [PB86-158102] p 63 N86-26249 MARINE RESOURCES Marine-related research at MIT (Massachusetts Institute Technology): A directory of research projects, 1985-1986 [PB86-158102] p 63 N86-26249 MARINE TRANSPORTATION Marine-related research at MIT (Massachusetts Institute Technology): A directory of research projects, 1985-1986 [PB86-158102] p 63 N86-26249 MARITIME SATELLITES Development and implementation of the Future Global Maritime Distress and Safety System (FGMDSS) p 77 A86-15839 [IAF PAPER 85-338] Inmarsat role in the future global maritime distress and safety system IAF PAPER 85-339] p 78 A86-15840 MARKET RESEARCH Turboprop airliners get bigger - Will they have a p 66 A86-10568 market? Space insurance - A resource for commercial space activities p 87 A86-32562 Insurance - Forms of coverage and current market situation --- for spacecraft and space operations p 89 A86-43344 Semimanufactured products made of copper and copper alloys: An analysis of production and sale in a world perspective [EUT/BDK/15] p 71 N86-31758 MARKETING Commercial marketing of Landsat data begins p 68 A86-24123 rapidly expanding p 68 A86-26464 Satellite communications - A market? Earth observation satellites - From technology push to p 68 A86-26465 market pull Helicopter customer support - Are we aware of how great it can be p 20 A86-35644 New job for NASA is marketing management p 69 A86-41681

Countertrade - A necessary part of marketing, or an expensive diversion? p 69 A86-44537

MARKING

Significant NASA inventions availa	ble for	licensing in
foreign countries [NASA-SP-7038(08)] A study of factors related to comme	p 94 rcial sp	N86-26243 ace platform
services [NASA-CR-176881]	р 96	N86-30744
Spinoff 1985 [NASA-TM-89240]	р 65	N86-31451
MARKING LOGMARS (logistics applications of	autom	ated marking
and reading symbols) clearingho directory		
[AD-A162327] MARKOV PROCESSES	p 75	N86-24586
Computer-aided engineering [AD-A162811]	p 81	N86-24256
MARS (PLANET) Space - The long range future	р 50	A86-14272
A millennium project - Mars 2000 [AAS 84-151]	р 50 р 53	A86-28777
Concepts for the early realization of to Mars		
[AAS 84-170] The search for common ground -	p 53	A86-28796
expedition by U.S. and U.S.S.R. Proceedings of the 2nd Annua	p 90	A86-49454 ference on
NASA/University Advanced Space De		
[NASA-TM-89399] MARS PROBES		Ň86-29888
Missions to Mars MARS SURFACE	p 60	A86-48100
The Mars base - International coope [AAS 84-154]	eration p 87	A86-28780
Scientific program for a Mars base [AAS 84-166]	p 53	A86-28792
MASS Technical activities 1983, Center for		
[PB86-140043] MATERIALS HANDLING	•	N86-26239
Space Processing Applications Rock SPAR 10		
[NASA-TM-86548] MATERIALS SCIENCE	p 76	N86-28972
Economic considerations of space n		A86-21886
Spacelab 3 mission - Broadening		
research		A86-34967
More precious than gold - The econ	omice	
processing in space Growth of electronic materials in mic	p 70	A86-44549
processing in space Growth of electronic materials in mid [AIAA PAPER 86-2356]	p 70 crograv p 75	A86-44549 ity A86-46963
processing in space Growth of electronic materials in mid [AIAA PAPER 86-2356] The role of laser technology in materi	p 70 crograv p 75 ials pro	A86-44549 ity A86-46963
processing in space Growth of electronic materials in mid [AIAA PAPER 86-2356] The role of laser technology in mater nondestructive testing in the 21st cent	p 70 crograv p 75 ials pro	A86-44549 ity A86-46963
processing in space Growth of electronic materials in mit (AIAA PAPER 86-2356) The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS	p 70 crograv p 75 ials pro ury p 75	A86-44549 ity A86-46963 cessing and A86-47139
processing in space Growth of electronic materials in mid [AIAA PAPER 86-2356] The role of laser technology in mater nondestructive testing in the 21st cent	p 70 crograv p 75 ials pro ury p 75	A86-44549 ity A86-46963 cessing and A86-47139
processing in space Growth of electronic materials in mic (AIAA PAPER 86-2356) The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303]	p70 crograv p75 ials pro ury p75 e Stat p59	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938
processing in space Growth of electronic materials in mic [AIAA PAPER 86-2356] The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Discounted cash flow model f modernization incentives program	p70 crograv p75 ialspro ury p75 e Stat p59 or the	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938 e industrial
processing in space Growth of electronic materials in mic (AIAA PAPER 86-2356) The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Discounted cash flow model f modernization incentives program [AD-A162968] Reliability prediction for spacecraft	p 70 p 75 ials pro ury p 75 e Stat p 59 or the p 25	A86-44549 ity A86-46963 ccessing and A86-47139 ion Health A86-46938 industrial N86-24589
processing in space Growth of electronic materials in mic [AIAA PAPER 86-2356] The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Discounted cash flow model f modernization incentives program [AD-A162968] Reliability prediction for spacecraft [AD-A164747] Leader-follower strategies under	p70 crograv p75 ials pro ury p75 e Stat p59 or the p25 p81	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938 e industrial
processing in space Growth of electronic materials in mic [AIAA PAPER 86-2356] The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Discounted cash flow model f modernization incentives program [AD-A162968] Reliability prediction for spacecraft [AD-A164747] Leader-follower strategies under information uncertainties [DE86-000203]	p 70 crograv p 75 ials pro ury p 75 e Stat p 59 or the p 25 p 81 moc p 13	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938 e industrial N86-24589 N86-26359 leling and N86-27950
processing in space Growth of electronic materials in mic (AIAA PAPER 86-2356) The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Discounted cash flow model f modernization incentives program [AD-A162968] Reliability prediction for spacecraft [AD-A162968] Reliability prediction for spacecraft [AD-A164747] Leader-follower strategies under information uncertainties [DE86-000203] Variable structure model following or robotics applications	p 70 crograv p 75 ials pro ury p 75 e Stat p 59 or the p 25 p 81 moc p 13 control	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938 e industrial N86-24589 N86-26359 leling and N86-27950 design for
processing in space Growth of electronic materials in mic (AIAA PAPER 86-2356) The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Discounted cash flow model f modernization incentives program [AD-A162968] Reliability prediction for spacecraft [AD-A164747] Leader-follower strategies under information uncertainties [DE86-000203] Variable structure model following of	p 70 crograv p 75 ials pro ury p 75 e Stat p 59 or the p 25 p 81 moc p 13	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938 e industrial N86-24589 N86-26359 leling and N86-27950
processing in space Growth of electronic materials in mic (AIAA PAPER 86-2356) The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Discounted cash flow model f modernization incentives program [AD-A162968] Reliability prediction for spacecraft [AD-A164747] Leader-follower strategies under information uncertainties [DE86-00203] Variable structure model following robotics applications [DE86-008136] A discrete control model of PLANT	p 70 crograv p 75 ials pro ury p 75 e Stat p 59 or the p 25 p 81 moc p 13 control p 35 p 35	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938 e industrial N86-24589 N86-26359 leling and N86-27950 design for N86-29234 N86-31220
processing in space Growth of electronic materials in mit [AIAA PAPER 86-2356] The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Discounted cash flow model f modernization incentives program [AD-A162968] Reliability prediction for spacecraft [AD-A164747] Leader-follower strategies under information uncertainties [DE86-000203] Variable structure model following of robotics applications [DE86-008136] A discrete control model of PLANT The quantitative modelling of habitability	p 70 p 70 p 75 alls pro- ury p 75 e Stat p 59 or the p 25 p 81 moc p 13 control p 35 p 47 huma	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938 e industrial N86-24589 N86-24589 N86-26359 leling and N86-27950 design for N86-29234 N86-31220 an spatial
processing in space Growth of electronic materials in mic (AIAA PAPER 86-2356) The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Discounted cash flow model f modernization incentives program [AD-A162968] Reliability prediction for spacecraft [AD-A162968] Reliability prediction for spacecraft [AD-A162968] Reliability prediction for spacecraft [AD-A164747] Leader-follower strategies under information uncertainties [DE86-00203] Variable structure model following in robotics applications [DE66-008136] A discrete control model of PLANT The quantitative modelling of habitability [NASA-CR-179716] MEASURING INSTRUMENTS	p 70 p 70 rorgraw p 75 ials pro ury p 75 e Stat p 59 or the p 25 p 81 moc p 13 control p 35 p 47 huma p 9	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938 e industrial N86-24589 N86-26359 leling and N86-27950 design for N86-29234 N86-31220
processing in space Growth of electronic materials in mit (AIAA PAPER 86-2356) The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility (AIAA PAPER 86-2303) Discounted cash flow model f modernization incentives program (AD-A162968) Reliability prediction for spacecraft (AD-A164747) Leader-follower strategies under information uncertainties [DE86-000203] Variable structure model following of robotics applications [DE86-008136] A discrete control model of PLANT The quantitative modelling of habitability [NASA-CR-179716] MEASURING INSTRUMENTS Sensor driven robot systems testbedo	p 70 prograw p 75 e Stat p 59 or the p 25 p 81 moc p 13 control p 35 p 47 huma p 9	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938 e industrial N86-24589 N86-24589 N86-26359 deling and N86-27950 design for N86-31220 an spatial N86-33210
processing in space Growth of electronic materials in mic (AIAA PAPER 86-2356) The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Discounted cash flow model f modernization incentives program [AD-A162968] Reliability prediction for spacecraft [AD-A162968] Reliability prediction for spacecraft [AD-A162968] Reliability prediction for spacecraft [AD-A164747] Leader-follower strategies under information uncertainties [DE86-000203] Variable structure model following in robotics applications [DE86-008136] A discrete control model of PLANT The quantitative modelling of habitability [NASA-CR-179716] MEASURING INSTRUMENTS Sensor driven robot systems testbed [DE86-005892] Institutional supporting research	p 70 p 75 ials pro- ury p 75 e Stat p 59 or the p 25 p 81 moc p 13 control p 35 p 47 huma p 9	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938 e industrial N86-24589 N86-26359 leling and N86-27950 design for N86-29234 N86-31220 an spatial N86-33210 N86-30412
processing in space Growth of electronic materials in mit [AIAA PAPER 86-2356] The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Discounted cash flow model f modernization incentives program [AD-A162968] Reliability prediction for spacecraft [AD-A16276] Leader-follower strategies under information uncertainties [DE86-000203] Variable structure model following of nabitability [DE86-008136] A discrete control model of PLANT The quantitative modelling of habitability [NASA-CR-179716] MEASURING INSTRUMENTS Sensor driven robot systems testbed [DE86-005892] Institutional supporting research 1985 [DE86-008580]	p 70 p 75 ials pro- p 75 e Stat p 59 or the p 25 p 81 moc p 13 control p 35 p 47 huma p 9 j p 35 and de p 65	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938 e industrial N86-24589 N86-24589 N86-24589 keling and N86-27950 design for N86-29234 N86-31220 an spatial N86-33210 N86-30412 evelopment, N86-30583
processing in space Growth of electronic materials in mic [AIAA PAPER 86-2356] The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Discounted cash flow model f modernization incentives program [AD-A162968] Reliability prediction for spacecraft [AD-A164747] Leader-follower strategies under information uncertainties [DE86-000203] Variable structure model following of robotics applications [DE86-008136] A discrete control model of PLANT The quantitative modelling of habitability [NASA-CR-179716] MEASURING INSTRUMENTS Sensor driven robot systems testbed (DE86-005882] Institutional supporting research 1985 [DE86-008580] Advanced instrumentation for aeror research	p 70 crogravy p 75 ials pro ury p 75 e Stat p 59 or the p 25 p 81 moc p 13 control p 35 p 47 huma p 9 j p 35 and de p 65 iautical	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938 e industrial N86-24589 N86-24589 N86-24589 keling and N86-27950 design for N86-32234 N86-31220 an spatial N86-33210 N86-30412 evelopment, N86-30583 propulsion
processing in space Growth of electronic materials in mit (AIAA PAPER 86-2366) The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Discounted cash flow model f modernization incentives program [AD-A162968] Reliability prediction for spacecraft [AD-A162968] Reliability prediction for spacecraft [AD-A162968] Reliability prediction for spacecraft [AD-A162968] Reliability prediction for spacecraft [AD-A164747] Leader-follower strategies under information uncertainties [DE86-000203] Variable structure model following in robotics applications [DE86-008136] A discrete control model of PLANT The quantitative modelling of habitability [INASA-CR-179716] MEASURING INSTRUMENTS Sensor driven robot systems testbed [DE86-005802] Institutional supporting research 1985 [DE86-008580] Advanced instrumentation for aeron research [INASA-TM-88853] MECHANICAL ENGINEERING	p 70 crogravy p 75 ials pro ury p 75 e Stat p 59 or the p 25 p 81 moc p 13 control p 35 p 47 huma p 9 j p 35 and de p 65 iautical	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938 e industrial N86-24589 N86-24589 N86-24589 keling and N86-27950 design for N86-29234 N86-31220 an spatial N86-33210 N86-30412 evelopment, N86-30583
processing in space Growth of electronic materials in mic [AIAA PAPER 86-2356] The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Discounted cash flow model f modernization incentives program [AD-A162968] Reliability prediction for spacecraft [AD-A162747] Leader-follower strategies under information uncertainties [DE86-000203] Variable structure model following of nobotics applications [DE86-008136] A discrete control model of PLANT The quantitative modelling of habitability [NASA-CR-179716] MEASURING INSTRUMENTS Sensor driven robot systems testbed [DE86-005892] Institutional supporting research 1985 [DE86-008500] Advanced instrumentation for aeror research [NASA-TM-88853] MECHANICAL ENGINEERING Robotics for engineers Book MECHANICAL MEASUREMENT	p 70 crogravy p 75 ials proving p 75 e Statt p 59 p 75 p 81 moc p 13 control p 35 p 47 humma p 93 p 35 p 65 p 27 p 27	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938 e industrial N86-24589 N86-24589 N86-24589 N86-24589 A86-27950 design for N86-31220 an spatial N86-31220 an spatial N86-33210 N86-30412 evelopment, N86-30583 propulsion N86-32703 A86-10560
processing in space Growth of electronic materials in mic (AIAA PAPER 86-2356) The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Discounted cash flow model f modernization incentives program [AD-A162968] Reliability prediction for spacecraft [AD-A162968] Reliability prediction for spacecraft [AD-A162968] Reliability prediction for spacecraft [AD-A162968] Reliability prediction for spacecraft [AD-A162968] Variable structure model following of robotics applications [DE86-000203] Variable structure model following of habitability [NASA-CR-179716] MEASURING INSTRUMENTS Sensor driven robot systems testbed [DE86-008582] Institutional supporting research 1985 [DE86-008580] Advanced instrumentation for aeron research [NASA-TM-88853] MECHANICAL ENGINEERING Robotics for engineers Book	p 70 crogravy p 75 ials proving p 75 e Statt p 59 p 75 p 81 moc p 13 control p 35 p 47 humma p 93 p 35 p 65 p 27 p 27	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938 e industrial N86-24589 N86-24589 N86-24589 N86-24589 A86-27950 design for N86-31220 an spatial N86-31220 an spatial N86-33210 N86-30412 evelopment, N86-30583 propulsion N86-32703 A86-10560
processing in space Growth of electronic materials in mic (AIAA PAPER 86-2356) The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Discounted cash flow model f modernization incentives program [AD-A162968] Reliability prediction for spacecraft [AD-A162747] Leader-follower strategies under information uncertainties [DE86-000203] Variable structure model following of robotics applications [DE86-008136] A discrete control model of PLANT The quantitative modelling of habitability [NASA-CR-179716] MEASURING INSTRUMENTS Sensor driven robot systems testbed [DE86-005880] Advanced instrumentation for aeron research [NASA-TM-88853] MECHANICAL ENGINEERING Robotics for engineers Book	p 70 crogravy p 75 ials pro ury p 75 e Stat p 59 or the p 25 p 81 moc p 13 control p 35 p 47 huma p 9 j 35 and de p 65 audical p 27 p 27 autical	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938 e industrial N86-24589 N86-24589 N86-24589 N86-24589 A86-27950 design for N86-31220 an spatial N86-31220 an spatial N86-33210 N86-30412 evelopment, N86-30583 propulsion N86-32703 A86-10560
processing in space Growth of electronic materials in mic (AIAA PAPER 86-2356) The role of laser technology in mater nondestructive testing in the 21st cent MATHEMATICAL MODELS An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Discounted cash flow model f modernization incentives program [AD-A162968] Reliability prediction for spacecraft [AD-A162968] Reliability prediction for spacecraft [AD-A162968] Reliability prediction for spacecraft [AD-A162968] Reliability prediction for spacecraft [AD-A162968] A clicete control model following of robotics applications [DE86-000203] Variable structure model following of habitability [NASA-CR-179716] MEASURING INSTRUMENTS Sensor driven robot systems testbed [DE86-008582] Institutional supporting research 1985 [DE86-008580] Advanced instrumentation for aeron research [NASA-TM-88853] MECHANICAL ENGINEERING Robotics for engineers Book MECHANICAL ENGINEEMENT	p 70 crogravy p 75 ials pro ury p 75 e Stat p 59 or the p 25 p 81 mod p 25 p 81 mod p 35 p 47 huma p 9 j 35 and de p 9 s 47 p 9 s 47 p 47 p 47 huma p 9 s 47 and de p 25 p 47 huma p 25 huma p 25 huma huma p 25 huma huma huma p 25 huma huma huma huma huma huma huma huma	A86-44549 ity A86-46963 cessing and A86-47139 ion Health A86-46938 e industrial N86-24589 N86-24589 N86-24589 N86-24589 N86-227950 design for N86-32703 A86-30412 vvelopment, N86-30412 vvelopment, N86-30583 propulsion N86-32703 A86-10560 propulsion N86-32703

Standard reference data publicati	ions, 196	4-1984
[PB86-155587]	p 81	N86-26409

MEMORY

- The psychophysics of workload A second look at the relationship between subjective measures and performance p 3 A86-33804 Man-machine systems of the 1990 decade: Cognitive
 - factors and human interface issues [AD-A163865] p 7 N86-25123 Parallel structures in human and computer memory
- [NASA-TM-89402] p 46 N86-29535 MEMORY (COMPUTERS) NASA supercomputer system to become available
- nationally [NASA-NEWS-RELEASE-86-92] p 44 N86-28628
- Parallel structures in human and computer memory [NASA-TM-89402] p 46 N86-29535 Database capacity planning and management
- p 48 N86-32338 [DE86-009076] MENTAL PERFORMANCE
- The effects of type of knowledge upon human problem solving in a process control task p1 A86-17771 Subjective workload and individual differences in information processing abilities
- [SAE PAPER 841491] p 2 A86-26011 The functional age profile - An objective decision criterion for the assessment of pilot performance capacities and capabilities p 3 A86-31823
- Why computers may never think like people p 31 A86-41648
- Derivational analogy: A theory of reconstructive problem solving and expertise acquisition [AD-A156817] p 12 N86-10899
- Schema-based theory of information presentation for distributed decision making [AD-A163150] p 13 N86-25992
- Human factors in rule-based systems (AD-A1653091 p 8 N86-26840 Mental models and problem solving with a knowledge-based expert system [AD-A165398] p 8 N86-26843
- Knowledge-based load leveling and task allocation in human-machine systems p 9 N86-32985 MESOSPHERE Systematic ground-based measurements of mesospheric water vapor p 55 A86-33544 METAL CUTTING USSR report: Machine tools and metalworking equipment [JPRS-UMM-85-014] p 24 N86-13742 Machine tools and metalworking USSR report: equipment
- [JPRS-UMM-85-013] p 24 N86-13745 METAL WORKING Machine tools and metalworking USSR report: equipment [JPRS-UMM-85-010] p 23 N86-11394 USSR report: Machine tools and metalworking equipment [JPRS-UMM-85-014] p 24 N86-13742 USSR report: Machine tools and metalworking quipment [JPRS-UMM-85-013] p 24 N86-13745 Implementation of computer-aided production systems p 32 N86-14611 detailed METEOROLOGICAL INSTRUMENTS
- Tomorrow's weather New accuracy in forecasting p 54 A86-32450 METEOROLOGICAL SATELLITES
- uture U.S. meteorological satellite systems p 49 A86-12361 [IAF PAPER 84-96]
- Future world meteorological satellite systems [IAF PAPER 85-87] p 82 A86-15663 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting opera 1985-2000. Volume 1 operational environmental satellites,
- AD-A1651431 p 14 N86-28007 METEOROLOGICAL SERVICES
- feteorological services of the world [WMO-2] p 63 N86-23184
- METHODOLOGY Estimating - The input into good project planning
- p 67 A86-17673 METROLOGY
- Technical activities 1983, Center for Basic Standards [PB86-140043] p 81 N86-26239 MICROCOMPUTERS
- On a microcomputer integrated system for structural engineering practices p 21 A86-39794 MICROGRAVITY APPLICATIONS
- A design for fluid management in space [IAF PAPER ST-85-04]
- p 50 A86-15949 A 3M/NASA basic research program in space p 52 A86-27896
- Present and future prospects of microgravity p 57 A86-37870

Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 Å86-46963 MICROWAVE LANDING SYSTEMS

- Will the USAF need ground-based air traffic control radar in the year 2000? AD-A1665041 p8 N86-29805 MICROWAVE RADIOMETERS Systematic ground-based measurements of ospheric wate p 55 A86-33544 vapor MIDAIR COLLISIONS Air safety: Federal Aviation Administration's role in
- developing mid-air collision avoidance back-up systems [PB86-197506] p 82 N86-32418 MILITARY AIRCRAFT
- is there life after 10,000 flight hours? n 79 A86-22402
- Knowledge engineering for a flight management expert system p 30 A86-28498
- Spare parts pricing Impact on logistics support p 74 A86-35647
- MILITARY HELICOPTERS One man and 3,000 million operations a second -Preparing for the LHX cockpit p 17 A86-24988 The field representative 'front line actioneer' ---p 17 A86-24988 helicopter manufacturer field service representative responsibilities p 20 A86-35645 MILITARY OPERATIONS Technology transfer and artificial intelligence p 36 N86-30581 [AD-A1660351 MILITARY TECHNOLOGY Space law in the United Nations --- Book p 85 A86-26546 Space Law - The disillusioned maiden in the military Garden of Eden p 86 A86-27883 Developing a maintenance concept for future electronic p 74 A86-43333 [AIAA PAPER 86-1145] Robotic refueling system for tactical and strategic aircraft [AD-D011980] p 92 N86-21540 Transfer of high-technology to the Soviet Union. A predicament for the US AD-A1664691 p 96 N86-30582 MILKY WAY GALAXY Extragalactic astronomy p 65 N86-31489 MINERAL DEPOSITS Exploration for strategic materials p 75 N86-24005 [PB86-126463] Marine-related research at MIT (Massachusetts Institute Technology): A directory of research projects, 1985-1986
- [PB86-158102] p 63 N86-26249 MINICOMPUTERS
- Aspects of cognitive complexity theory and research as applied to a managerial decision making simulation p 13 N86-22437
- [AD-A161376]
- MISSION ADAPTIVE WINGS
- Mission adaptive wing soars at NASA Facility p 26 N86-31563 [P86-10182]
- MISSION PLANNING The Space Station Polar Platforms - Integrating research
- and operational missions [AIAA PAPER 85-3000] p 49 A86-12935 ERS-1 - Mission objectives and system description
 - p 49 A86-13823
 - The Space Station program definition and preliminary systems design - Recent developments
- [IAF PAPER 85-18] p 50 A86-15611 Planning for Space Station utilization
- [IAF PAPER 85-48] p 10 A86-15635
- Mission strategy and spacecraft design for a Mars base program
- [AAS 84-169] p 53 A86-28795 Concepts for the early realization of a manned mission
- to Mars [AAS 84-170]
- p 53 A86-28796
- Commerce Lab A program of commercial flight opportunities p 56 A86-34965
- Spacelab 3 mission Broadening horizons in space
- p 56 A86-34967 research Enabling technologies for transition to utilization of
- space-based resources and operations p 56 A86-34992
- Interactive mission planning for a Space Shuttle flight p 56 A86-37187 experiment - A case history
- National space transportation and support tudy/mission requirements and architecture studies
- [AIAA PAPER 86-1211] p 11 A86-40602 The earth observing system --- instrument package
- planning for atmosphere, ocean and land studies [AAS PAPER 85-397] p 58 A86-43229
- Space Station polar orbiting platform Mission analysis and planning [AIAA PAPER 86-2178]
 - p 60 A86-47960

SUBJECT INDEX

ENVIROSAT-2000 report: Federa	l ager	ncy satellite
requirements [NASA-TM-88752]	p 63	N86-26355
Actions to implement the recom		
Presidential Commission on the Space		
Accident. Report to the President	p 94	N86-27352
MOBILE COMMUNICATION SYSTEMS		
The Canadian mobile satellite	servic	e and its
socio-economic assessment		100 15057
[IAF PAPER 85-364]	p 66	A86-15857
MOBILITY	- -	
Future directions in mobile teleopera		NOC 40070
[DE85-014308] MODELS	p 61	N86-12976
Mental models and problem	solvir	ig with a
knowledge-based expert system	201411	iy with a
[AD-A165398]	р 8	N86-26843
MODULES	P 0	100 200 10
Shuttle-launch triangular space stati	on	
[NASA-CASE-MSC-20676-1]	p 93	N86-24729
MOISTURE METERS	•	
Ice detector		
[NASA-CASE-LAR-13403-1]	p 93	N86-24673
MOMENTUM TRANSFER		
Tether applications for space station		
	p 76	N86-28418
MONITORS		
Expert systems development and ap [NASA-TM-86746]		
Alerted monitors: Human operators:	p 32 bided b	N86-11194
detectors	aiueu b	y automateu
[PB85-222750]	p 4	N86-13906
MONKEYS	P 7	100-10000
Evaluation of the need for a large	prima	te research
facility in space		
[NASA-CR-179661]	p 14	N86-32111
MONTE CARLO METHOD		
Computer-aided engineering		
[AD-A162811]	p 81	N86-24256
Risk assessment preprocessor (RAI		NOC 04070
[AD-A161914]	p 43	N86-24278
NOON		
MOON Space - The long range future	n 50	486.14272
Space - The long range future	p50	
Space - The long range future Toward a permanent lunar settlerr		
Space - The long range future Toward a permanent lunar settlerr decade: the Columbus Project	ient in	the coming
Space - The long range future Toward a permanent lunar settlerr		
Space - The long range future Toward a permanent lunar settlen decade: the Columbus Project [DE86-006709]	p 14	the coming N86-29874
Space - The long range future Toward a permanent lunar settlerr decade: the Columbus Project [DE86-006709] MOTION SIMULATION A study on robot path planning from	p 14	the coming N86-29874
Space - The long range future Toward a permanent lunar settler decade: the Columbus Project (DE86-006709) MOTION SIMULATION A study on robot path planning from MOTIVATION	p 14 p 14 a solie p 32	the coming N86-29874 d model A86-43061
Space - The long range future Toward a permanent lunar settlerr decade: the Columbus Project [DE86-006709] MOTION SIMULATION A study on robot path planning from MOTIVATION Productivity improvement in	p 14 p 14 a solid p 32 engin	the coming N86-29874 d model A86-43061 weering at
Space - The long range future Toward a permanent lunar settlerr decade: the Columbus Project [DE86-006709] MOTION SIMULATION A study on robot path planning from MOTIVATION Productivity improvement in Rocketdyne	p 14 p 14 p 32 engin p 5	the coming N86-29874 d model A86-43061 eeering at N86-15178
Space - The long range future Toward a permanent lunar settlerr decade: the Columbus Project (DE86-006709) MOTION SIMULATION A study on robot path planning from MOTIVATION Productivity improvement in Rocketdyne Productivity enhancement planning	p 14 p 14 p 32 engin p 5 using	the coming N86-29874 d model A86-43061 eeering at N86-15178 participative
Space - The long range future Toward a permanent lunar settlerr decade: the Columbus Project [DE86-006709] MOTION SIMULATION A study on robot path planning from MOTIVATION Productivity improvement in Rocketdyne Productivity enhancement planning management concepts	p 14 p 14 p 32 engin p 5 using p 6	the coming N86-29874 d model A86-43061 eeering at N86-15178 participative N86-15202
Space - The long range future Toward a permanent lunar settlerr decade: the Columbus Project [DE86-006709] MOTION SIMULATION A study on robot path planning from MOTIVATION Productivity improvement in Rocketdyne Productivity enhancement planning management concepts Results of innovative communicati	p 14 p 14 p 32 engin p 5 using p 6 on pro	the coming N86-29874 d model A86-43061 eeering at N86-15178 participative N86-15202 ccesses on
Space - The long range future Toward a permanent lunar settlerr decade: the Columbus Project [DE86-006709] MOTION SIMULATION A study on robot path planning from MOTIVATION Productivity improvement in Rocketdyne Productivity enhancement planning management concepts	p 14 p 14 p 32 engin p 5 using p 6 on pro	the coming N86-29874 d model A86-43061 eering at N86-15178 participative N86-15202 cocesses on noment
Space - The long range future Toward a permanent lunar settlen decade: the Columbus Project [DE86-006709] MOTION SIMULATION A study on robot path planning from MOTIVATION Productivity improvement in Rocketdyne Productivity enhancement planning management concepts Results of innovative communicati productivity gains in a high technology	p 14 p 14 p 32 engin p 5 using p 6 on pro	the coming N86-29874 d model A86-43061 eeering at N86-15178 participative N86-15202 ccesses on
Space - The long range future Toward a permanent lunar settlerr decade: the Columbus Project [DE86-006709] MOTION SIMULATION A study on robot path planning from MOTIVATION Productivity improvement in Rocketdyne Productivity enhancement planning management concepts Results of innovative communicati	p 14 p 14 a solid p 32 engin p 5 using p 6 on pro renviro p 6	the coming N86-29874 d model A86-43061 eering at N86-15178 participative N86-15202 cocesses on noment
Space - The long range future Toward a permanent lunar settler decade: the Columbus Project (DE86-006709) MOTION SIMULATION A study on robot path planning from MOTIVATION Productivity improvement in Rocketdyne Productivity enhancement planning management concepts Results of innovative communicati productivity gains in a high technology Developments in quality control (REPT-186) Man-machine systems of the 1990	p 14 p 14 p 32 engin p 5 using p 6 on pro enviro p 6 p 81	the coming N86-29874 d model A86-43061 N86-15178 participative N86-15202 occesses on onment N86-15203 N86-19638
Space - The long range future Toward a permanent lunar settlerr decade: the Columbus Project [DE86-006709] MOTION SIMULATION A study on robot path planning from MOTIVATION Productivity enhancement planning management concepts Results of innovative communicati productivity gains in a high technology Developments in quality control [REPT-186] Man-machine systems of the 1990 factors and human interface issues	p 14 p 14 p 32 engin p 5 using p 6 on pro enviro p 6 p 81	the coming N86-29874 d model A86-43061 N86-15178 participative N86-15202 occesses on onment N86-15203 N86-19638
Space - The long range future Toward a permanent lunar settlerr decade: the Columbus Project [DE86-006709] MOTION SIMULATION A study on robot path planning from MOTIVATION Productivity improvement in Rocketdyne Productivity enhancement planning management concepts Results of innovative communicati productivity gains in a high technology Developments in quality control [REPT-186] Man-machine systems of the 1990 factors and human interface issues [AD-A163865]	p 14 p 14 p 32 engin p 5 using p 6 on pro enviro p 6 p 81	the coming N86-29874 d model A86-43061 N86-15178 participative N86-15202 occesses on onment N86-15203 N86-19638
Space - The long range future Toward a permanent lunar settler decade: the Columbus Project (DE86-006709) MOTION SIMULATION A study on robot path planning from MOTIVATION Productivity improvement in Rocketdyne Productivity enhancement planning management concepts Results of innovative communicati productivity gains in a high technology Developments in quality control [REPT-186] Man-machine systems of the 1990 factors and human interface issues [AD-A163865] MULTIBEAM ANTENNAS	p 14 p 14 p 32 engin p 5 using p 6 on pr6 enviro p 81 decad p 7	the coming N86-29874 d model A86-43061 eering at N86-15178 participative N86-15202 ocesses on noment N86-15203 N86-19638 e: Cognitive N86-25123
Space - The long range future Toward a permanent lunar settler decade: the Columbus Project [DE86-006709] MOTION SIMULATION A study on robot path planning from MOTIVATION Productivity enhancement planning management concepts Results of innovative communicati productivity gains in a high technology Developments in quality control [(REPT-186] Man-machine systems of the 1990 factors and human interface issues [AD-A163865] MULTIBEAM ANTENNAS Improved system cost and perform	p 14 p 14 p 32 engin p 5 using p 6 on pr6 enviro p 81 decad p 7	the coming N86-29874 d model A86-43061 eering at N86-15178 participative N86-15202 ocesses on noment N86-15203 N86-19638 e: Cognitive N86-25123
Space - The long range future Toward a permanent lunar settlerr decade: the Columbus Project [DE86-006709] MOTION SIMULATION A study on robot path planning from MOTIVATION Productivity improvement in Rocketdyne Productivity enhancement planning management concepts Results of innovative communicati productivity gains in a high technology Developments in quality control [REPT-186] Man-machine systems of the 1990 factors and human interface issues [AD-A163865] MULTIBEAM ANTENNAS Improved system cost and perform multi-beam processing satellites	p 14 a soli p 32 engin p 5 using p 6 on pro enviro p 6 p 81 decad p 7 mance	the coming N86-29874 d model A86-43061 veering at N86-15178 participative N86-15178 veerses on noment N86-15203 N86-19638 le: Cognitive N86-25123 ACTS using
Space - The long range future Toward a permanent lunar settler decade: the Columbus Project [DE86-006709] MOTION SIMULATION A study on robot path planning from MOTIVATION Productivity enhancement planning management concepts Results of innovative communicati productivity gains in a high technology Developments in quality control [(REPT-186] Man-machine systems of the 1990 factors and human interface issues [AD-A163865] MULTIBEAM ANTENNAS Improved system cost and perform	p 14 p 14 p 32 engin p 5 using p 6 on pr6 enviro p 81 decad p 7	the coming N86-29874 d model A86-43061 eering at N86-15178 participative N86-15202 ocesses on noment N86-15203 N86-19638 e: Cognitive N86-25123

Ν

NASA PROGRAMS

An overview of the Space Station Technology/Advanced
Development Program
[IAF PAPER 85-28] p 10 A86-15619
Function, form, and technology - The evolution of Space
Station in NASA
[IAF PAPER 85-454] p 50 A86-15914
A design for fluid management in space
[IAF PAPER ST-85-04] p 50 A86-15949
How NASA prepared to cope with disaster
p 79 A86-25866
Artificial intelligence - NASA robotics for Space
Station p 30 A86-32538
Space Station Advanced Development Program
p 55 A86-32543
NASA-universities relationships in aero/space
engineering: A review of NASA's program
[NASA-CR-176307] p 61 N86-12158
US space programs: Cooperation and competition from
Europe
[BPA-CP-695] p 90 N86-12163
Index to NASA news releases and speeches, 1984

[NASA-TM-87514] p 41 N86-13224 Space station: ESA views on requirements for

experimental and operational Earth observation missions p 62 N86-18379

NASA: 1986 long-range program plan [NASA-TM-87560] p 63 N86-21420 NASA's long range plans (GPO-55-035) p 93 N86-22435 NASA patent abstracts bibliography: A continuing bibliography. Section 2: Indexes (supplement 28) [NASA-SP-7039(28)SECT-2] p 93 N86-22444 The great observatories for space astrophysics [NASA-CR-176754] p 63 N86-24712 NASA's FIA (National Aeronautics and Space Administration's Financial Integrity Act Program: NASA's progress in implementing Financial Integrity Act requirements [PB86-135100] p 94 N86-25288 Significant NASA inventions available for licensing in foreign countries [NASA-SP-7038(08)] p 94 N86-26243 NASA patent abstracts bibliography: A continuing bibliography. Section 1: Abstracts [NASA-SP-7039(29)-SECT-1] p 94 N86-28788 NASA Patent Abstracts Bibliography. A continuing bibliography. Section 2: Indexes (Supplement 29) p 94 N86-28789 [NASA-SP-7039(29)-SECT-2] A study of factors related to commercial space platform services [NASA-CR-176881] p 96 N86-30744 Spinoff 1985 [NASA-TM-89240] p 65 N86-31451 NASA's Aircraft Icing Analysis Program (NASA-TM-88791) p 82 N86-31548 Evaluation of the need for a large primate research facility in space [NASA-CR-179661] NASA-CR-179661] p 14 N86-32111 Historical data and analysis for the first five years of KSC STS payload processing [NASA-TM-831051 p 77 N86-32471 NASA SPACE PROGRAMS The Space Station program definition and preliminary systems design - Recent developments [IAF PAPER 85-18] p 50 A86-15611 Automation and robotics - Key to productivity --- in industry and space [IAF PAPER 85-32] p 28 A86-15623 The National Aeronautics and Space Administration (NASA) Tracking and Data Relay Satellite System (TDRSS) program Economic and programmatic, considerations [IAF PAPER 85-422] p 67 A86-15895 p 67 A86-15895 Government in action - The role of political science in outer space activities [IAE PAPER 85-498] n 83 A86-15942 Future operational plans for the National Space Transportation System [AIAA PAPER 86-0090] p 72 A86-19685 NASA develops Space Station p 51 A86-21519 International involvement in the US space station programme p 85 A86-22244 Future space goals - National comm nission defines U.S. options for the 21st century p 85 Space power systems - 'Spacecraft 2000' p 85 A86-24127 p 52 A86-24836 Cost in space - The price of government control p 68 A86-27885 Robotics for the United States Space Station p 29 A86-28073 Space Station planning p 73 A86-28581 [AAS 85-111] The civilian space program -A Washington perspective p 86 A86-28779 (AAS 84-153) Space Station - The first sten [AAS 84-160] p 87 A86-28786 Private funds will bolster tax dollars in the job of financing p 69 A86-29494 the station Spacecraft 2000 p 18 A86-29586 [AIAA PAPER 86-0616] US-Soviet intergovernmental agreement on cooperative space activities - Should it be re-established? p 87 A86-29698 Selecting interrelated R&D projects in space technology planning p 54 A86-29750 National space transportation systems planning p 54 A86-32527 Motivational contracting in space programs Government and industry prospectives p 55 A86-34963 low cost orbital p 56 A86-34991 p 57 A86-37853 Spacelab Hitchhiker, for rapid, resources The U.S. Space Station program New job for NASA is marketing management p 69 A86-41681 Developing the final frontier: International cooperation in the peaceful uses of outer space --- Book p 88 A86-42236 The Space Station - Past, present and future with some

The Space Station - Past, present and future with some thoughts on some legal questions that need to be addressed p 89 A86-43346

OFFICE AUTOMATION

The decision to develop the Space Shuttle p 58 A86-44404
p 58 A86-44404 Technology base for the future of space
p 59 A86-45709
Space Shuttle development p 11 A86-46425
NASA plans for spaceborne lidar - The Earth Observing
System p 59 A86-46763
Missions to Mars p 60 A86-48100
Assessment of US industry's technology trends and new
technology requirements [NASA-CR-176479] p 24 N86-17227
Research and technology
[NASA-TM-83099] p 62 N86-17265
Budget effects of the Challenger accident
p 92 N86-20464
NATURAL LANGUAGE (COMPUTERS)
Communication and miscommunication [AD-A162843] p 7 N86-24257
NAVIGATION
A cost analyst's guide to satellite autonomy and
fault-tolerant computing
[AD-A161853] p 71 N86-23630
NAVIGATION SATELLITES Development and implementation of the Future Global
Maritime Distress and Safety System (FGMDSS)
[IAF PAPER 85-338] p 77 A86-15839
NAVY
Suggestions for designers of navy electronic equipment.
Revision A. 1985 edition [AD-A165697] p 25 N86-28326
NETHERLANDS
Evaluation of research: Experiences and perspectives
in the Netherlands
[ESA-86-96709] p 65 N86-31461
NETWORK ANALYSIS
Risk assessment preprocessor (RAPP) [AD-A161914] p 43 N86-24278
NEWS
Index to NASA news releases and speeches, 1984
[NASA-TM-87514] p 41 N86-13224
National and international cooperation in remote sensing and applications
[AIAA PAPER 86-0412] p 84 A86-19861
Optimum management strategies for the NOAA
(National Oceanic and Atmospheric Administration)
polar-orbiting operational environmental satellites,
1985-2000. Volume 1 [AD-A165143] p 14 N86-28007
NOISE REDUCTION
Langley aerospace test highlights, 1985
[NASA-TM-87703] p 81 N86-26276
NONDESTRUCTIVE TESTS
The role of laser technology in materials processing and
nondestructive testing in the 21st century
p 75 A86-47139 Assessment of US industry's technology trends and new
Assessment of US industry's technology trends and new technology requirements
Assessment of US industry's technology trends and new technology requirements [NASA-CR-176479] p 24 N86-17227
Assessment of US industry's technology trends and new technology requirements [NASA-CR-176479] p 24 N86-17227 Nondestructive techniques for characterizing
Assessment of US industry's technology trends and new technology requirements [NASA-CR-176479] p 24 N86-17227 Nondestructive techniques for characterizing mechanical properties of structural materials: An
Assessment of US industry's technology trends and new technology requirements [NASA-CR-176479] p 24 N86-17227 Nondestructive techniques for characterizing mechanical properties of structural materials: An overview
Assessment of US industry's technology trends and new technology requirements [NASA-CR-176479] p 24 N86-17227 Nondestructive techniques for characterizing mechanical properties of structural materials: An
Assessment of US industry's technology trends and new technology requirements [NASA-CR-176479] p 24 N86-17227 Nondestructive techniques for characterizing mechanical properties of structural materials: An overview [NASA-TM-87203] p 80 N86-19636 NONPARAMETRIC STATISTICS The bootstrap method for assessing statistical
Assessment of US industry's technology trends and new technology requirements [NASA-CR-176479] p 24 N86-17227 Nondestructive techniques for characterizing mechanical properties of structural materials: An overview [NASA-TM-87203] p 80 N86-19636 NONPARAMETRIC STATISTICS The bootstrap method for assessing statistical accuracy
Assessment of US industry's technology trends and new technology requirements [NASA-CR-176479] p 24 N86-17227 Nondestructive techniques for characterizing mechanical properties of structural materials: An overview [NASA-TM-87203] p 80 N86-19636 NONPARAMETRIC STATISTICS The bootstrap method for assessing statistical accuracy [AD-A161257] p 81 N86-20047
Assessment of US industry's technology trends and new technology requirements [NASA-CR-176479] p 24 N86-17227 Nondestructive techniques for characterizing mechanical properties of structural materials: An overview [NASA-TN-87203] p 80 N86-19636 NONPARAMETRIC STATISTICS The bootstrap method for assessing statistical accuracy [AD-A161257] p 81 N86-20047 NUMERICAL ANALYSIS
Assessment of US industry's technology trends and new technology requirements [NASA-CR-176479] p 24 N86-17227 Nondestructive techniques for characterizing mechanical properties of structural materials: An overview [NASA-TM-87203] p 80 N86-19636 NONPARAMETRIC STATISTICS The bootstrap method for assessing statistical accuracy [AD-A161257] p 81 N86-20047
Assessment of US industry's technology trends and new technology requirements [NASA-CR-176479] p 24 N86-17227 Nondestructive techniques for characterizing mechanical properties of structural materials: An overview [NASA-TM-87203] p 80 N86-19636 NONPARAMETRIC STATISTICS The bootstrap method for assessing statistical accuracy [AD-A161257] p 81 N86-20047 NUMERICAL ANALYSIS Numerical analysis and the scientific method [DE86-005404] p 47 N86-29591 NUMERICAL CONTROL
Assessment of US industry's technology trends and new technology requirements [NASA-CR-176479] p 24 N86-17227 Nondestructive techniques for characterizing mechanical properties of structural materials: An overview [NASA-TM-87203] p 80 N86-19636 NONPARAMETRIC STATISTICS The bootstrap method for assessing statistical accuracy [AD-A161257] p 81 N86-20047 NUMERICAL ANALYSIS Numerical analysis and the scientific method [DE86-005404] p 47 N86-29591 NUMERICAL CONTROL Intelligent N/C controllers
Assessment of US industry's technology trends and new technology requirements [NASA-CR-176479] p 24 N86-17227 Nondestructive techniques for characterizing mechanical properties of structural materials: An overview [NASA-TM-87203] p 80 N86-19636 NONPARAMETRIC STATISTICS The bootstrap method for assessing statistical accuracy [AD-A161257] p 81 N86-20047 NUMERICAL ANALYSIS Numerical analysis and the scientific method [DE86-005404] p 47 N86-29591 NUMERICAL CONTROL
Assessment of US industry's technology trends and new technology requirements [NASA-CR-176479] p 24 N86-17227 Nondestructive techniques for characterizing mechanical properties of structural materials: An overview [NASA-TM-87203] p 80 N86-19636 NONPARAMETRIC STATISTICS The bootstrap method for assessing statistical accuracy [AD-A161257] p 81 N86-20047 NUMERICAL ANALYSIS Numerical analysis and the scientific method [DE86-005404] p 47 N86-29591 NUMERICAL CONTROL Intelligent N/C controllers [DE86-003132] p 35 N86-30387
Assessment of US industry's technology trends and new technology requirements [NASA-CR-176479] p 24 N86-17227 Nondestructive techniques for characterizing mechanical properties of structural materials: An overview [NASA-TM-87203] p 80 N86-19636 NONPARAMETRIC STATISTICS The bootstrap method for assessing statistical accuracy [AD-A161257] p 81 N86-20047 NUMERICAL ANALYSIS Numerical analysis and the scientific method [DE86-005404] p 47 N86-29591 NUMERICAL CONTROL Intelligent N/C controllers
Assessment of US industry's technology trends and new technology requirements [NASA-CR-176479] p 24 N86-17227 Nondestructive techniques for characterizing mechanical properties of structural materials: An overview [NASA-TM-87203] p 80 N86-19636 NONPARAMETRIC STATISTICS The bootstrap method for assessing statistical accuracy [AD-A161257] p 81 N86-20047 NUMERICAL ANALYSIS Numerical analysis and the scientific method [DE86-005404] p 47 N86-29591 NUMERICAL CONTROL Intelligent N/C controllers [DE86-003132] p 35 N86-30387

OCEAN BOTTOM		
Geodesy: A look to the future		
[NASA-CR-176283]	p 61	N86-11657
OCEAN SURFACE		
ERS-1 - Our new window on the	oceans fo	r the 1990s
	p 57	A86-38718
OCEANOGRAPHIC PARAMETERS	•	
ERS-1 - Our new window on the	oceans fo	r the 1990s
	D 57	A86-38718

OCEANOGRAPHY Marine-related research at MIT (Massachusetts Institute of Technology): A directory of research projects,

1985-1986 [PB86-158102] p 63 N86-26249 The overall plan: A scientific strategy --- Tropical Ocean

Global Atmosphere (TOGA) program p 64 N86-29463 OFFICE AUTOMATION Office automation: The administrative window into the

integrated DBMS p 41 N86-15174

ON-LINE SYSTEMS

ON-LINE SYSTEMS		
Measuring the value of information		
	p 45	N86-28799
Information resources management environment	пп р 46	N86-28803
	p 46	N86-29294
ONBOARD DATA PROCESSING		
Expert systems for Space Station aut	omatii p 28	A86-14548
An engineering approach to the use		
technology in avionics applications		
	p 34	N86-24687
OPERATING COSTS Space Station operations		
[IAF PAPER 85-45]	p 72	A86-15632
A review of unconventional aircraft de	esign a p 22	concepts A86-48995
Primer on operating and support (O		
space systems		
	p 71	N86-24588
OPERATING SYSTEMS (COMPUTERS) The world brain today: Scientographic	datab	ases. What
are they, how are they created and wh	nat are	they used
	p 44	N86-26007
OPERATIONAL HAZARDS Future directions in mobile teleoperat	ion	
	p 61	N86-12976
OPERATIONS		
Space Station on-orbit operations for Century	une (wenty mirst
[AIAA PAPER 86-2331]	p 74	A86-46954
OPERATIONS RESEARCH	of a	motion and
Evaluating Space Station applications robotics	ofauto p 31	A86-41000
Failures and successes of quantit		
management		100 44070
[ARW-03-THE-BDK/ORS/83-06] The group consensus problem	p 12	N86-11076
[AD-A164064]	р7	N86-26078
OPERATOR PERFORMANCE		
The effects of type of knowledge upo solving in a process control task		A86-17771
Predicted versus experienced	work	
performance on a supervisory control ta		A86-29879
The psychophysics of workload - A s		
relationship between subjective	meas	ures and
performance Workload assessment - Progress		A86-33804
decade	uunn	g the last
decade [SAE PAPER 851877]	р 3	A86-35440
decade [SAE PAPER 851877] Influence of complexity of control	р3 task.c	A86-35440
decade [SAE PAPER 851877]	p3 tasko alfuno	A86-35440
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS	p3 tasko alfuno p7	A86-35440 on level of tions when N86-23260
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute	p3 tasko alfuno p7 ernetw	A86-35440 on level of tions when N86-23260
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL DATA PROCESSING	p3 tasko alfund p7 ernetw p37	A86-35440 on level of titions when N86-23260 vorks A86-21973
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL DATA PROCESSING Optical processing for future compute	p3 task o al func p7 er netw p37 er netw	A86-35440 on level of tions when N86-23260 vorks A86-21973 vorks
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL DATA PROCESSING Optical processing for future compute	p3 task o al func p7 er netw p37 er netw	A86-35440 on level of titions when N86-23260 vorks A86-21973
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL DATA PROCESSING Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The	p 3 task c al func p 7 er netw p 37 er netw p 37 e Earth	A86-35440 on level of titions when N86-23260 vorks A86-21973 vorks A86-21973
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL DATA PROCESSING Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System	p 3 task c al func p 7 er netw p 37 er netw p 37 e Earth	A86-35440 on level of titions when N86-23260 vorks A86-21973 vorks A86-21973
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL DATA PROCESSING Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The	p 3 task c p 7 er netw p 37 er netw p 37 e Earth p 59	A86-35440 on level of titions when N86-23260 vorks A86-21973 vorks A86-21973
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL DATA PROCESSING Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition	p3 task c al func p7 er netw p37 e Earth p37 e Earth p37 ns? p16	A86-35440 on level of titions when N86-23260 vorks A86-21973 vorks A86-21973 n Observing A86-46763 A86-41961
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL DATA PROCESSING OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin	p3 task of al fund p7 er netw p37 er netw p37 e Earth p59 ns? p16 eering	A86-35440 on level of titons when N86-23260 vorks A86-21973 vorks A86-21973 n Observing A86-46763 A86-11961 design
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL DATA PROCESSING OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin	p 3 task o al fund p 7 er netw p 37 er netw p 37 e Earth p 59 ns? p 16 eering p 78	A86-35440 on level of titions when N86-23260 vorks A86-21973 vorks A86-21973 n Observing A86-46763 A86-11961
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL DATA PROCESSING OPTICAL PADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE85-014904]	p 3 task o al fund p 7 er netw p 37 er netw p 37 e Earth p 59 ns? p 16 eering p 78	A86-35440 on level of titons when N86-23260 vorks A86-21973 vorks A86-21973 n Observing A86-46763 A86-11961 design
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE85-014904] OPTIONS	p 3 task (al func p 7 er netw p 37 e Earth p 59 ms? p 16 eeering p 78 ents p 70	A86-35440 on level of titions when N86-23260 vorks A86-21973 n Observing A86-46763 A86-11961 design A86-17472
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL DATA PROCESSING Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE85-014904] OPTIONS	p 3 task (al func p 7 er netw p 37 e Earth p 59 ms? p 16 eeering p 78 ents p 70	A86-35440 on level of titions when N86-23260 vorks A86-21973 n Observing A86-46763 A86-11961 design A86-17472
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL PATA PROCESSING Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS OPTIONS OPTIONS	p 3 task of p 7 ar netw p 37 ar netw p 59 ar netw p 70 ar netw ar netw p 70 ar netw p 70 ar netw p 70 ar netw p 70 ar netw	A86-35440 on level of titions when N86-23260 vorks A86-21973 vorks A86-21973 n Observing A86-11961 design A86-17472 N86-12390 N86-12390
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL COMPUTERS Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] ORBITAL ASSEMBLY Robotics and the space station	p 3 task (c p 7 er netw p 37 er netw p 37 e Earth p 59 ns? p 16 eering p 78 ents p 70 p 70 p 29	A86-35440 on level of titions when N86-23260 vorks A86-21973 vorks A86-21973 n Observing A86-46763 A86-11961 design A86-17472 N86-12390 N86-12390 A86-20507
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS	p 3 task (c j fan	A86-35440 on level of titions when N86-23260 vorks A86-21973 vorks A86-21973 n Observing A86-46763 A86-11961 design A86-17472 N86-12390 N86-12390 A86-20507 earth-based A86-2106
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL COMPUTERS Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTICAL SSEMBLY Robotics and the space station Structures in space - Contractors a construction methods to microgravity Construction and control of large spa	p 3 task (c p 3 r netw p 37 e Earth p 59 ms? p 16 eeering p 78 p 70 ents p 70 ents p 70 ents p 70 ents p 70 ents p 70 ents p 70 ents p 7 ce start	A86-35440 on level of titions when N86-23260 vorks A86-21973 or Observing A86-21973 or Observing A86-46763 A86-11961 design A86-17472 N86-12390 N86-12390 A86-20507 earth-based A86-24106 jutures
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL COMPUTERS Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTICAL SSEMBLY Robotics and the space station Structures in space - Contractors a construction methods to microgravity Construction and control of large spa	p 3 task (c p 3 r netw p 37 e Earth p 59 ms? p 16 eeering p 78 p 70 ents p 70 ents p 70 ents p 70 ents p 70 ents p 70 ents p 70 ents p 7 ce start	A86-35440 on level of titions when N86-23260 vorks A86-21973 vorks A86-21973 n Observing A86-46763 A86-11961 design A86-17472 N86-12390 N86-12390 A86-20507 earth-based A86-2106
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL COMPUTERS Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE55-014904] OPTIONS Options for operational risk assessme [DE55-014904] OPTIONS Options for operational risk assessme [DE55-014904] OPTIONS Options for operational risk assessme [DE55-014904] ORBITAL ASSEMBLY Robotics and the space station Structures in space - Contractors a construction methods to microgravity Construction and control of large spa ORBITAL ELEMENTS Report on active and planned	p 3 task of p 7 er netw p 37 e Earth p 59 ns? p 16 eeering p 78 e P 16 eeering p 78 p 70 ents p 70 ents ents p 70 ents p 70 ents ents p 70 ents p 70 ents p 70 ents ents p 70 ents p 70 ents ents p 70 ents ents p 70 ents ents p 70 ents ents p 70 ents ents ents p 70 ents ents ents ents ents ents ents ents	A86-35440 on level of titions when N86-23260 vorks A86-21973 or Observing A86-21973 or Observing A86-46763 A86-11961 design A86-17472 N86-12390 N86-12390 A86-20507 earth-based A86-24106 jutures
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL DATA PROCESSING Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] ORBITAL ASSEMBLY Robotics and the space station Structures in space - Contractors a construction methods to microgravity Construction and control of large spa OPTISTAL ELEMENTS Report on active and planned experiments	p 3 ask of the second p 7 er network p 37 er n	A86-35440 on level of itions when N86-23260 vorks A86-21973 orks A86-21973 n Observing A86-46763 A86-11961 <i>design</i> A86-17472 N86-12390 N86-12390 N86-12390 A86-20507 sarth-based A86-24106 Jotures A86-37060 ecraft and
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL DATA PROCESSING Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] ORITIAL ASSEMBLY Robotics and the space station Structures in space - Contractors a construction methods to microgravity Construction and control of large spa ORBITAL ELEMENTS Report on active and planned experiments	p 3 task of p 7 er netw p 37 e Earth p 59 ns? p 16 eeering p 78 e P 16 eeering p 78 p 70 ents p 70 ents ents p 70 ents p 70 ents ents p 70 ents p 70 ents p 70 ents ents p 70 ents p 70 ents ents p 70 ents ents p 70 ents ents p 70 ents ents p 70 ents ents ents ents ents ents ents ents	A86-35440 on level of titions when N86-23260 vorks A86-21973 vorks A86-21973 observing A86-46763 A86-11961 design A86-17472 N86-12390 N86-12390 A86-20507 A86-22507 A86-22507 A86-24106 jctures A86-37060
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL DATA PROCESSING Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] ORBITAL ASSEMBLY Robotics and the space station Structures in space - Contractors a construction methods to microgravity Construction and control of large spa OPBITAL ELEMENTS Report on active and planned experiments [NASA-TM-87499] ORBITAL MANEUVERING VEHICLES Space Station polar orbiting platform	p 3 at a k of p 3 ar netw p 37 ar netw p 37 ar netw p 37 ar netw p 37 ar netw p 37 ar netw p 37 ar netw p 3 ar netw p 7 ar netw p 3 ar netw p 7 ar netw p 3 ar netw p 7 ar netw p 3 ar netw netw netw netw netw netw netw netw	A86-35440 on level of titions when N86-23260 vorks A86-21973 or Observing A86-21973 or Observing A86-11961 design A86-17472 N86-12390 N86-12390 N86-12390 A86-20507 earth-based A86-20507 earth-based A86-37060 ecraft and N86-13343
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] ORBITAL ASSEMBLY Robotics and the space station Structures in space - Contractors a construction methods to microgravity Construction and control of large space ORBITAL ELEMENTS Report on active and planned experiments [NASA-TM-87499] ORBITAL MANEUVERING VEHICLES Space Station polar orbiting platform and planning	p 3 task of al func p 7 er netw p 37 e Eanth p 59 er netw p 37 e Eanth p 59 er netw p 78 er netw p 78 ents p 70 ents p 70 ents p 77 space c stri p 17 space p 17 c stri p 29 ents p 17 c stri p 17 space p 17 spa	A86-35440 on level of titions when N86-23260 vorks A86-21973 or Observing A86-21973 or Observing A86-11961 design A86-17472 N86-12390 N86-12390 N86-12390 A86-20507 earth-based A86-20507 earth-based A86-37060 ecraft and N86-13343
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL DATA PROCESSING Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] ORBITAL ASSEMBLY Robotics and the space station Structures in space - Contractors a construction methods to microgravity Construction and control of large spa ORBITAL ELEMENTS Report on active and planned experiments [NASA-TM-87499] ORBITAL MANEUVERING VEHICLES Space Station polar orbiting platform and planning [AIAA PAPER 86-2178] ORBITAL POSITION ESTIMATION	p 3 p 3 a funct p 7 r netw p 37 r netw p 16 r netw p 79 r netw p 70 r netw p 29 r netw p 70 r 92 r netw p 21 r netw p 37 r netw p 70 r 92 r 161 r 17 r 10 r 10 r 10 r 10 r 10 r 10 r 10 r 10	A86-35440 on level of itions when N86-23260 vorks A86-21973 orks A86-21973 n Observing A86-46763 A86-11961 <i>design</i> A86-17472 N86-12390 N86-12390 N86-12390 A86-24106 Jotures A86-24106 Jotures A86-24106 Jotures A86-37060 ecraft and N86-13343 ion analysis A86-47960
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessment [DE85-014904] OPTIONS Options for operational risk assessment [DE85-014904] OPTIONS Options for operational risk assessment [DE85-014904] OPBITAL ASSEMBLY Robotics and the space station Structures in space - Contractors a construction methods to microgravity Construction and control of large space ORBITAL ELEMENTS Report on active and planned experiments [NASA-TM-87499] ORBITAL MANEUVERING VEHICLES Space Station polar orbiting platform and planning [AIAA PAPER 86-2178] ORBITAL POSITION ESTIMATION Report on active and planned	p 3 p 3 a funct p 7 r netw p 37 r netw p 16 r netw p 79 r netw p 70 r netw p 29 r netw p 70 r 92 r netw p 21 r netw p 37 r netw p 70 r 92 r 161 r 17 r 10 r 10 r 10 r 10 r 10 r 10 r 10 r 10	A86-35440 on level of titions when N86-23260 vorks A86-21973 vorks A86-21973 n Observing A86-46763 A86-11961 design A86-17472 N86-12390 N86-12390 N86-12390 A86-22507 A86-22507 A86-22507 A86-22500 ecraft and N86-13343 ion analysis
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL COMPUTERS Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS OPTI	p 3 p 3 a funct p 7 r netw p 37 r netw p 16 r netw p 79 r netw p 70 r netw p 29 r netw p 70 r 92 r netw p 21 r netw p 37 r netw p 70 r 92 r 161 r 17 r 10 r 10 r 10 r 10 r 10 r 10 r 10 r 10	A86-35440 on level of titions when N86-23260 vorks A86-21973 or Observing A86-21973 or Observing A86-17973 n Observing A86-17472 N86-12390 N86-12390 N86-12390 N86-12390 A86-24106 jetures A86-24106 jetures A86-37060 ecraft and N86-13343 ion analysis A86-47960 ecraft and
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessment [DE65-014904] OPTIONS Options for operational risk assessment [DE65-014904] OPTIONS Options for operational risk assessment [DE65-014904] OPTIONS Options for operational risk assessment [DE65-014904] OPBITAL ASSEMBLY Robotics and the space station Structures in space - Contractors a construction methods to microgravity Construction and control of large space ORBITAL ELEMENTS Report on active and planned experiments [NASA-TM-87499] ORBITAL MANEUVERING VEHICLES Space Station polar orbiting platform and planning [AIAA PAPER 86-2178] ORBITAL POSITION ESTIMATION Report on active and planned experiments [NASA-TM-87499] ORBITAL RENDEZVOUS	p 3 task of al func p 7 er netw p 37 er netw p 3 er netw p 3 er netw p 3 er netw p 3 er netw p 37 er netw p 78 er netw p 17 er netw p 17 er netw p 17 er netw p 17 er netw p 17 er netw p 18 er netw p 19 er netw p 19 er netw p 19 er netw p 19 er netw p 19 er netw p 19 er netw p 60 er spac	A86-35440 on level of titions when N86-23260 vorks A86-21973 or Observing A86-21973 or Observing A86-11961 design A86-17472 N86-12390 N86-12390 N86-12390 N86-12390 A86-20507 earth-based A86-2106 jetures A86-37060 ecraft and N86-13343 ion analysis A86-47960 ecraft and
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL COMPUTERS Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS OPTI	p 3 task of al func p 7 er netw p 37 e Eartf p 59 e Eartf p 78 e Eartf p 78 e earing p 78 e Fartf p 78 e Fartf p 78 e Fartf p 78 e Fartf p 70 e Fart	A86-35440 on level of titions when N86-23260 vorks A86-21973 or Observing A86-21973 or Observing A86-21973 or Observing A86-21973 or Observing A86-21973 or Observing A86-21973 or A86-21973 N86-12390 N86-12390 N86-12390 A86-20507 earth-based A86-24106 Jotures A86-37060 ecraft and N86-13343 on analysis A86-47960 ecraft and N86-13343
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL COMPUTERS Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS OPTI	p 3 task of al func p 7 er netw p 37 er netw p 3 er netw p 3 er netw p 3 er netw p 3 er netw p 37 er netw p 78 er netw p 17 er netw p 17 er netw p 17 er netw p 17 er netw p 17 er netw p 18 er netw p 19 er netw p 19 er netw p 19 er netw p 19 er netw p 19 er netw p 19 er netw p 60 er spac	A86-35440 on level of titions when N86-23260 vorks A86-21973 or Observing A86-21973 or Observing A86-11961 design A86-17472 N86-12390 N86-12390 N86-12390 N86-12390 A86-20507 earth-based A86-2106 jetures A86-37060 ecraft and N86-13343 ion analysis A86-47960 ecraft and
decade [SAE PAPER 851877] Influence of complexity of control activation of operators physiologica working with waiting OPTICAL COMPUTERS Optical processing for future compute OPTICAL COMPUTERS Optical processing for future compute OPTICAL RADAR NASA plans for spaceborne lidar - The System OPTIMIZATION Optimum wing - For all flight condition Quality control, reliability, and engin Book Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPTIONS Options for operational risk assessme [DE85-014904] OPBITAL ASSEMBLY Robotics and the space station Structures in space - Contractors a construction methods to microgravity Construction and control of large space ORBITAL ELEMENTS Report on active and planned experiments [NASA-TM-87499] ORBITAL POSITION ESTIMATION Report on active and planned experiments [NASA-TM-87499] ORBITAL RENDEZYOUS Tether applications for space station	p 3 p 3 p 4 p 3 p 5 p 7 p 7 p 7 p 7 p 7 p 7 p 7 p 7	A86-35440 on level of titions when N86-23260 vorks A86-21973 or Observing A86-21973 or Observing A86-21973 or Observing A86-21973 or Observing A86-21973 or Observing A86-21973 or A86-21973 N86-12390 N86-12390 N86-12390 A86-20507 earth-based A86-24106 Jotures A86-37060 ecraft and N86-13343 on analysis A86-47960 ecraft and N86-13343

A-18

Shuttle-launch triangular space station [NASA-CASE-MSC-20676-1] p 93 N86-24729	PARAMETER IDENTIFICATION Requirements, development and parametric analysis for
ORBITAL SPACE STATIONS	space systems division
Expert systems for Space Station automation	[AIAA PAPER 85-3078] p 16 A86-10936
p 28 A86-14548	In-process inspection of the parameters of the electron beam in electron beam welding p 19 A86-34124
Space Station utilization for technology purposes [IAF PAPER 85-50] p 50 A86-15636	PASSENGER AIRCRAFT
Human roles in future space systems	Turboprop airliners get bigger - Will they have a
[AAS PAPER 84-117] p 1 A86-17320	market? p 66 A86-10568 Starship I - A weight control challenge for next
NASA develops Space Station p 51 A86-21519	generation business aircraft
Space Station manager's next big job is to drum up business p 67 A86-24110	[SAWE PAPER 1682] p 20 A86-35223
Robotics for the United States Space Station	Which transport technologies will fly? p 69 A86-41037
p 29 A86-28073	PATENT POLICY
Private funds will bolster tax dollars in the job of financing the station p 69 A86-29494	The evolution of the agency's patent policy p 85 A86-24598
Space stations: Legal aspects of scientific and	Federal agencies' policies and practices are in
commercial use in a framework of transatlantic	accordance with patent and trademark amendments of
cooperation; Proceedings of the International Colloquium,	1980 [B-207939] p 91 N86-20175
Hamburg, West Germany, October 3, 4, 1984 p 88 A86-43335	NASA patent abstracts bibliography: A continuing
Possible models for specific space agreements	bibliography. Section 2: Indexes (supplement 28)
p 88 A86-43339	[NASA-SP-7039(28)SECT-2] p 93 N86-22444 Significant NASA inventions available for licensing in
Agreements between states and with international organizations on Space Station construction, transport	foreign countries
and orbital assembly p 88 A86-43340	[NASA-SP-7038(08)] p 94 N86-26243 NASA patent abstracts bibliography: A continuing
Applicable law and dispute settlement for Space	bibliography. Section 1: Abstracts
Station development p 89 A86-43343	[NASA-SP-7039(29)-SECT-1] p 94 N86-28788
 State supervision and registration of space stations p 89 A86-43345 	NASA Patent Abstracts Bibliography. A continuing bibliography. Section 2: Indexes (Supplement 29)
The Space Station - Past, present and future with some	[NASA-SP-7039(29)-SECT-2] p 94 N86-28789
thoughts on some legal questions that need to be	PATTERN RECOGNITION
addressed p 89 A86-43346 Aspects of law and practice in the United States and	Parallel structures in human and computer memory [NASA-TM-89402] p 46 N86-29535
space commercialization p 89 A86-43349	Report on the AI trip
Horizon 2000 and its relation to the Columbus	[IR-82] p 35 N86-30397
Programme p 59 A86-45643 Space Station on-orbit operations for the Twenty First	PAYLOAD INTEGRATION The development of a project plan for the Get Away
Century	Special Program p 64 N86-27306
[AIAA PAPER 86-2331] p 74 A86-46954	Historical data and analysis for the first five years of KSC STS payload processing
Space Station polar orbiting platform - Mission analysis and planning	[NASA-TM-83105] p 77 N86-32471
[AIAA PAPER 86-2178] p 60 A86-47960	PAYLOADS
Space Station evolution - The uncertainty principle	The Space Station Polar Platforms - Integrating research and operational missions
prevails p 60 A86-48373 Space Station overall management approach for	[AIAA PAPER 35-3000] p 49 A86-12935
operations	Federal government provision of third-party liability insurance to space vehicle users
[AIAA PAPER 86-2322] p 11 A86-49558	[NASA-CR-176346] p 90 N86-13230
Space station: ESA views on requirements for experimental and operational Earth observation missions	PERFORMANCE TESTS An example of integrated logistic support applied also
p 62 N86-18379	to production testing aircraft industry
Shuttle-launch triangular space station [NASA-CASE-MSC-20676-1] p 93 N86-24729	p 77 N86-30898 Mission adaptive wing soars at NASA Facility
Proceedings of the 2nd Annual Conference on	[P86-10182] p 26 N86-31563
NASA/University Advanced Space Design Program	PERSONNEL
[NASA-TM-89399] p 64 N86-29888 Space station p 65 N86-30602	Productivity improvement in engineering at Rocketdyne p 5 N86-15178
National Aeronautics and Space Administration	White collar productivity improvement: Sponsored
p 96 N86-31450	action research 1983 - 1985 [NASA-CR-176366] p 6 N86-21419
Support for global science: Remote sensing's challenge p 14 N86-32864	Suggestions for designers of navy electronic equipment.
The quantitative modelling of human spatial	Revision A. 1985 edition [AD-A165697] p 25 N86-28326
habitability	Human factors management
[NASA-CR-179716] p 9 N86-33210 ORGANIZATIONS	[DE86-008184] p 8 N86-31226
An annotated bibliography of literature integrating	Human Factors Review Plan [DE86-010561] p 9 N86-33023
organizational and systems theory [AD-A160912] p 12 N86-19249	PERSONNEL DEVELOPMENT
Leader-follower strategies under modeling and	Mentoring as a communication channel: Implications for innovation and productivity p 4 N86-15164
information uncertainties [DE86-000203] p 13 N86-27950	Streamlining: Reducing costs and increasing STS
Human Factors Review Plan	operations effectiveness p 5 N86-15194
[DE86-010561] p 9 N86-33023 Organization as information processing systems: Toward	In-house CAD training: A realistic approach [DE86-008926] p 8 N86-31251
a model of the research factors associated with significant	PERSONNEL MANAGEMENT
research outcomes	On the structure of manpower planning, a contribution of simulation experiments with decomposition methods
[AD-A168018] p 48 N86-33200 Organizations as information processing systems:	[MANPOWER-PLANNING-28] p 3 N86-11073
Environmental characteristics, company performance and	On the structure of manpower planning, a contribution
chief executive scanning, an empirical study [AD-A168035] p 15 N86-33201	of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075
OUTER SPACE TREATY	Mentoring as a communication channel: Implications
The participation of developing countries in space research p 84 A86-18392	for innovation and productivity p 4 N86-15164
Space Law - The disillusioned maiden in the military	A case study in R and D productivity: Helping the program manager cope with job stress and improve
Garden of Eden p 86 A86-27883	communication effectiveness p 4 N86-15170
Р	Streamlining: Reducing costs and increasing STS operations effectiveness p 5 N86-15194
r	Space shuttle descent design: From development to

PARALLEL PROCESSING (COMPUTERS)

Data Base Management: Proceedings of a conference [AD-A158285] p 44 N86-25999

Developments in quality control
[REPT-186] p 81 N86-19638
Comparison of scientific and technical personnel trends in the United States, France, West Germany and the United
Kingdom since 1970
[PB86-133030] p 7 N86-24554 Human factors management
[DE86-008184] p 8 N86-31226
PERSONNEL SELECTION
Astronauts and cosmonauts biographical and statistical data, revised June 28, 1985
[GPO-52-498] p 7 N86-21499
Human Factors Review Plan
[DE86-010561] p 9 N86-33023 PHARMACOLOGY
EOS production on the Space Station Electrophoresis
Operations/Space
[AIAA PAPER 86-2358] p 22 A86-46964 Marketing the use of the space environment for the
processing of biological and pharmaceutical materials
[NASA-CR-176334] p 70 N86-12243
PHONETICS Exploiting sequential phonetic constraints in recognizing
spoken words
[AD-A165913] p 34 N86-29120
PHYSICS AND CHEMISTRY EXPERIMENT IN SPACE Space science: Past, present and future
[GPO-55-239] p 92 N86-20436
PHYSIOLOGICAL EFFECTS
2010 - The symbionic cockpit p 18 A86-28455 Evaluation of the need for a large primate research
facility in space
[NASA-CR-179661] p 14 N86-32111
PHYSIOLOGICAL RESPONSES Influence of complexity of control task on level of
activation of operators physiological functions when
working with waiting p 7 N86-23260
PILOT PERFORMANCE
Automation in the cockpit - Who's in charge? [SAE PAPER 841534] p 37 A86-26005
Subjective workload and individual differences in
information processing abilities [SAE PAPER 841491] p 2 A86-26011
[SAE PAPER 841491] p 2 A86-26011 The functional age profile - An objective decision criterion
for the assessment of pilot performance capacities and
capabilities p 3 A86-31823 PLANETARY EVOLUTION
Space science: Past, present and future [GPO-55-239] p 92 N86-20436
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING PLANNING
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS p N86-33206 POLAR N86-33206
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING p 53 A86-28792 PLANETOLOGY p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond Heavy 1995 and beyond
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANETOLOGY scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] p 23 N86-11216
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANETOLOGY get and the science p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA PLAR N86-11216
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites,
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites, 1985-2000. Volume 1
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites,
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites, 1985-2000. Volume 1 [AD-A165143] p 14 N86-28007 POLICIES Government in action - The role of political science in
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites, 1985-2000. Volume 1 [AD-A165143] p 14 N86-28007 POLCIES Government in action - The role of political science in outer space activities
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANETOLOGY g 53 A86-28792 PLANETOLOGY p 53 A86-28792 PLANETOLOGY g 53 A86-28792 PLANNING g 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 D 286-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 NBAS-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration)) polar-orbiting operational environmental satellites, 1985-2000. Volume 1 [AD-A165143] p 14 N86-28007 POLICIES Government in action - The role of political science in outer space activities [IAF PAPER 85-498] p 83 A86-15942
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANETOLOGY Bearson p 88 A86-35562 PLANING p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1987-FY 1987-FY [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites, 1985-2000. Volume 1 [AD-A165143] p 14 N86-28007 POLCIEES Government in action - The role of political science in outer space activities p 83 A86-15942 [IAF PAPER 85-498] p 83 A86-15942 Future space goals - National commission defines U.S. o
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 [NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites, 1985-20007 POLICIES Government in action - The role of political science in outer space activities p 83 A86-15942 [IAF PAPER 85-498] p 83 A86-15942 Future space acguals - National commission defines U.S. optians for the 21st century p 85 A86-284127 Capitalism and democracy on the high frontiier
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites, 1985-2000. Volume 1 [AD-A165143] p 14 N86-28007 POLICES Government in action - The role of political science in outer space activities [IAF PAPER 85-498] p 83 A86-15942 Future space goals - National commission defines U.S. options for the 21st century p 85 A86-24127 Capitalism and democracy on the high frontier
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 (NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites, 1985-2000. Volume 1 [AD-A165143] p 14 N86-28007 POLICIES Government in action - The role of political science in outer space activities [IAF PAPER 8-498] p 83 A86-15942 Future space goals - National commission defines U.S. options for the 21st century p 85 A86-27887
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANETOLOGY p 53 A86-28792 PLANETOLOGY p 53 A86-28792 PLANETOLOGY p 53 A86-28792 PLANING p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites, 1985-2000, Volume 1 [AD-A165143] p 14 N86-28007 POLICES Government in action - The role of political science in outer space activities [IAF PAEER 85-498] p 83 A86-15942 Future space goals - National commission defines U.S. options for the 21st century p 85 A86-24127 Capitalism and democracy on the high frontier p 86 A86-27881 Learning from the past - Bringing Adam Smith into orbit Did p 10 A66-27887
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites, 1985-2000. Volume 1 [AD-A165143] p 14 N86-28007 POLICIES Government in action - The role of political science in outer space activities [IAF PAPER 85-498] p 83 A86-15942 Future space goals - National commission defines U.S. options for the 21st century p 85 A86-27881 Learning from the past - Bringing Adam Smith into orbit p 10 A86-27887 Space commercialization - An American case study in denationalization p 86 A86-27888
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites, 1985-2000. Volume 1 [AD-A165143] p 14 N86-28007 POLICES Government in action - The role of political science in outer space activities [IAF PAPER 8-4398] p 83 A86-15942 Future space goals - National commission defines U.S. options for the 21st century p 85 A86-27881 Learning from the past - Bringing Adam Smith into orbit p 10 A86-27887 Space commercialization - An American case study in denationalization - An American case study in denationalization participation in the Space Station program
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites, 1985-2000. Volume 1 [AD-A165143] p 14 N86-28007 POLICIES Government in action - The role of political science in outer space activities [IAF PAPER 85-498] p 83 A86-15942 Future space goals - National commission defines U.S. options for the 21st century p 85 A86-27881 Learning from the past - Bringing Adam Smith into orbit orbit p 10 A86-27881 Learning from the past - Bringing Adam Smith into orbit p 86 A86-27881 Japanese policy on participation in the Space Station program [AAS 85-114] p 86 A86-28533
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites, 1985-2000. Volume 1 [AD-A165143] p 14 N86-28007 POLICES Government in action - The role of political science in outer space activities [IAF PAPER 8-4398] p 83 A86-15942 Future space goals - National commission defines U.S. options for the 21st century p 85 A86-27881 Learning from the past - Bringing Adam Smith into orbit p 10 A86-27887 Space commercialization - An American case study in denationalization - An American case study in denationalization participation in the Space Station program
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites, 1985-2000. Volume 1 [AD-A165143] p 14 N86-28007 POLICIES Government in action - The role of political science in outer space activities [IAF PAPER 85-498] p 83 A86-15942 Future space goals - National commission defines U.S options for the 21st century p 85 A86-27881 Learning from the past - Bringing Adam Smith into orbit p 10 A86-27887 Space commercialization - An American case study in denationalization p 86 A86-27887 Space spolicy on participation in the Space Station program [AAS 85-114] p 86 A86-28583 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28779
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites, 1985-2000, Volume 1 [AD-A165143] p 14 N86-28007 POLICIES Government in action - The role of political science in outer space activities [IAF PAPER 85-498] <t< td=""></t<>
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANETOLOGY g 88 A86-35562 PLANETOLOGY p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 DE86-010457] DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond (NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites, 1985-2000. Volume 1 [AD-A165143] p 14 N86-28007 POLICES Government in action - The role of political science in outer space activities [IAF PAEE 85-489] p 83 A86-15942 Future space goals - National commission defines U.S. options for the 21st century p 86 A86-27881 Learning from the past - Bringing Adam Smith into orbit p 10 A86-27881 Learning from the past - Bringing Adam Smith into orbit p 10 A86-27881 Learning anese policy on participation in the Space Station program p 86 A86-27881
Space science:Past, present and future[GPO-55-239] p 92N86-20436PLANETOLOGYScientific program for a Mars base[AAS 84-166] p 53A86-28792PLANETOLOGY p 53A86-28792PLANETOLOGYPLANETOLOGY p 53A86-28792PLANNING p 88A86-35562Task planning for control of a sensor-based robot[DE86-004225] p 33N86-23954Information technology resources long-range plan, FY1987-FY 1991DE86-010457] p 48N86-23026POLAR ORBITSSpace Station polar orbiting platform - Mission analysisand planning[AIAA PAPER 86-2178] p 60A86-47960Heavy lift launch vehicles for 1995 and beyond(NASA-TM-86520] p 23N86-11216Optimum management strategies for the NOAA(National Oceanic and Atmospheric Administration)polar-orbiting operational environmental satellites, 1985-2000. Volume 1[AD-A165143] p 14N86-28007POLICIESGovernment in action - The role of political science in outer space activities[IAF PAPER 85-498] p 83A86-15942Future space goals - National commission defines U.S.options for the 21st century p 85A86-27887Space commercialization - An American case study in denationalization p 86A86-27883Japanese policy on participation in the Space Station program[AAS 85-114] p 86A86-28593The civilian space program - A
Space science: Past, present and future [GPO-55-239] p 92 N86-20436 PLANETOLOGY Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 PLANNING Europe aims for space independence p 88 A86-35562 Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Information technology resources long-range plan, FY 1987-FY 1991 [DE86-010457] p 48 N86-33206 POLAR ORBITS Space Station polar orbiting platform - Mission analysis and planning [AIAA PAPER 86-2178] p 60 A86-47960 Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] p 23 N86-11216 Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) polar-orbiting operational environmental satellites, 1985-2000. Volume 1 [AD-A165143] p 14 N86-28007 POLICES Government in action - The role of political science in outer space activities [IAF PAPER 85-498] p 83 A86-15942 Future space goals - National commission defines U.S. options for the 21st century p 85 A86-27881 Learning from the past - Bringing Adam Smith into orbit p 10 A86-27881 Learning from the past - Bringing Adam Smith into orbit p 10 A86-27881 Space commercialization - An American case study in denationalization p 86 A86-27881 The civilian space program - A Washington perspective [AAS 85-114] p 86 A86-28787 Status of space commercialization in the Space 3tation program [AAS 85-114] p 86 A86-28783 The civilian space program - A Washington perspective [AAS 84-153] p 86 A86-28783 The heavens and the earth: A political history of the space age Book p 87 A86-3134 Space Station in the 21st century - A social
Space science:Past, present and future[GPO-55-239] p 92N86-20436PLANETOLOGYScientific program for a Mars base[AAS 84-166] p 53A86-28792PLANETOLOGY p 53A86-28792PLANETOLOGYPLANETOLOGY p 53A86-28792PLANNING p 88A86-35562Task planning for control of a sensor-based robot[DE86-004225] p 33N86-23954Information technology resources long-range plan, FY1987-FY 1991DE86-010457] p 48N86-23026POLAR ORBITSSpace Station polar orbiting platform - Mission analysisand planning[AIAA PAPER 86-2178] p 60A86-47960Heavy lift launch vehicles for 1995 and beyond(NASA-TM-86520] p 23N86-11216Optimum management strategies for the NOAA(National Oceanic and Atmospheric Administration)polar-orbiting operational environmental satellites, 1985-2000. Volume 1[AD-A165143] p 14N86-28007POLICIESGovernment in action - The role of political science in outer space activities[IAF PAPER 85-498] p 83A86-15942Future space goals - National commission defines U.S.options for the 21st century p 85A86-27887Space commercialization - An American case study in denationalization p 86A86-27883Japanese policy on participation in the Space Station program[AAS 85-114] p 86A86-28593The civilian space program - A

US space programs: Cooperation and competition from Europe [BPA-CP-695] p 90 N86-12163 Regulatory aspects of commercial, space p 91 N86-17409 transportation Telecommunications alternatives for federal users: Market trends and decisionmaking criteria PB86-153764] p 13 N86-25687 Public laws of the 98th Congress relating to information [PB86-153764] policy [CRS-TK-7885-F] p 94 N86-27130 Worldwide report: Telecommunications policy, research and development [JPRS-TTP-86-011] p 95 N86-30064 Freedom of Information Act: Noncompliance with affirmative disclosure provisions [AD-A168589] p 96 N86-33204 POUTICS Government in action - The role of political science in outer space activities [IAF PAPER 85-498] p 83 A86-15942 The heavens and the earth: A political history of the space age --- Book p 87 A86-34134 New technology implementation: Technical, economic and political factors p 24 N86-15172 POLLUTION Marine-related research at MIT (Massachusetts Institute of Technology): A directory of research projects, 1985-1986 [PB86-158102] p 63 N86-26249 POSITION ERRORS Sensing strategies for disambiguating among multiple objects in known poses [AD-A165912] p 34 N86-29220 POSITIONING Geodesy: A look to the future [NASA-CR-176283] p 61 N86-11657 POSTFLIGHT ANALYSIS Space Processing Applications Rocket (SPAR) project: SPAR 10 [NASA-TM-86548] p 76 N86-28972 PREDICTION ANALYSIS TECHNIQUES Reliability prediction for spacecraft [AD-A164747] p 81 N86-26359 PREDICTIONS New maintainability prediction technique p 73 A86-22379 Geodesy: A look to the future [NASA-CR-176283] p 61 N86-11657 Sonic-boom research: Selected bibliography with annotation p 65 N86-30470 INASA-TM-876851 PRELAUNCH TESTS Environmental management of payload processing facilities [AIAA PAPER 85-6067] p 78 A86-17602 PREPROCESSING Risk assessment preprocessor (RAPP) [AD-A161914] p 43 N86-24278 PRESIDENTIAL REPORTS Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 1 [AD-A171402] p 93 N86-24726 Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 2 [AD-A171403] AD-A171403] p 95 N86-28974 Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 3 AD-A171403] p 95 N86-28975 Report of the Presidential Commission on the Space [AD-A171403] Shuttle Challenger Accident, volume 4 p 95 N86-28976 [AD-A171404] Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 5 p 95 N86-28977 [AD-A171404] PRESSURE Technical activities 1983, Center for Basic Standards [PB86-140043] p 81 N86-26239 PRINTED CIRCUITS The qualification and procurement of two-sided printed circuit boards (fused tin-lead or gold plated finish) ---European Space Agency [ESA-PSS-01-710-ISSUE-1] p 82 N86-32660 PROBLEM SOLVING Significance testing of rules in rule-based models of human problem solving p 2 A86-25038 Derivational analogy: A theory of reconstructive problem solving and expertise acquisition [AD-A156817] p 12 N86-10899 Problem solving under time-constraints [AD-A158921] p6 N86-15957 Decision procedures [AD-A163049] p 34 N86-25173 Human factors in rule-based systems p 8 N86-26840 [AD-A165309]

PRODUCTION MANAGEMENT

•• • • • • • • • • • •
Mental models and problem solving with a knowledge-based expert system
[AD-A165398] p 8 N86-26843 A discrete control model of PLANT
p 47 N86-31220
PROCESS CONTROL (INDUSTRY) The effects of type of knowledge upon human problem
solving in a process control task p 1 A86-17771 In-process inspection of the parameters of the electron
beam in electron beam welding p 19 A86-34124 USSR report: Machine tools and metalworking
equipment [JPRS-UMM-85-013] p 24 N86-13745
PROCUREMENT MANAGEMENT A technique for lowering risks during contract
negotiations p 57 A86-40999 The selection and acquisition of commercial aircraft fleets p 74 A86-44935
PROCUREMENT POLICY
Data for selection of space materials [ESA-PSS-01-701-ISSUE-1] p 77 N86-32584
The qualification and procurement of two-sided printed
circuit boards (fused tin-lead or gold plated finish)
European Space Agency [ESA-PSS-01-710-ISSUE-1] p 82 N86-32660
PRODUCT DEVELOPMENT
Logistics supportability considerations during conceptual and preliminary design of aircraft
[AIAA PAPER 85-3052] p 72 A86-10928
A new perspective on software management
p 38 A86-28424 Software management for integrated avionics systems
p 38 A86-28425
A proven software project audit methodology
p 39 A86-28427 Research and technology Fiscal Year 1985 report
[NASA-TM-86532] p 62 N86-17225
Evaluating R and D and new product development
ventures: An overview of assessment methods \$12.00/MF A01
[PB86-110806] p 13 N86-25289
A profile of selected firms awarded small business innovation research funds
[AD-A165664] p 64 N86-28805
PRODUCTION ENGINEERING New technology implementation: Technical, economic
new technology implementation. Technical, economic
and political factors p 24 N86-15172
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328 Balancing production level variations and inventory
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/41] p 77 N86-32329 Calculating workload norms for job shops
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] p 77 N86-32329
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/04] p 77 N86-32320 Calculating workload norms for job shops [BDK/KBS/84-04] p 26 N86-32330 The structuring of production control systems [THE/BDK/085/84/10] p 26 N86-32332
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] p 77 N86-32329 Calculating workload norms for job shops [BDK/N85/84-04] p 26 N86-32330 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] p 77 N86-32329 Calculating workload norms for job shops [BDK/KBS/84-04] p 26 N86-32330 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 PRODUCTION MANAGEMENT
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] p 77 N86-32329 Calculating workload norms for job shops [BDK/N85/84-04] p 26 N86-32330 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] p 23 A86-49571 Implementation of computer-aided production systems
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] p 77 N86-32329 Galculating workload norms for job shops [BDK/KBS/84-04] p 26 N86-32330 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] p 23 A86-49571 Implementation of computer-aided production systems detailed p 32 N86-14611
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] p 77 N86-32329 Calculating workload norms for job shops [BDK/KBS/84-04] p 26 N86-32330 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] p 23 A86-49571 Implementation of computer-aided production systems detailed p 32 N86-14611 Implementing quality/productivity improvement initiatives in an engineering environment
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] p 77 N86-32329 Calculating workload norms for job shops [BDK/KBS/84-04] p 26 N86-32330 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] p 23 A86-49571 Implementation of computer-aided production systems detailed p 32 N86-14611 Implementing quality/productivity improvement initiatives in an engineering environment p 80 N86-15158
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] p 77 N86-32329 Calculating workload norms for job shops [BDK/KBS/84-04] p 26 N86-32332 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] p 23 A86-49571 Implementation of computer-aided production systems detailed p 32 N86-14611 Implementing quality/productivity improvement initiatives in an engineering environment p 80 N86-15158
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] p 77 N86-32329 Calculating workload norms for job shops [BDK/KBS/84-04] p 26 N86-32330 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] p 23 A86-49571 Implementation of computer-aided production systems detailed p 32 N86-14611 Implementing quality/productivity improvement initiatives in an engineering environment p 80 N86-15158 Self-renewal: A strategy for quality and productivity
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry P 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] p 77 N86-32329 Calculating workload norms for job shops [BDK/K85/84-04] p 26 N86-32330 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] p 23 A86-49571 Implementation of computer-aided production systems detailed p 32 N86-14611 Implementation of computer-aided production systems detailed p 32 N86-15158 Self-renewal: A strategy for quality and productivity improvement p 80 N86-15150 The key to successful management of STS operations: An integrated production planning system p 12 N86-15161
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] p 77 N86-32329 Calculating workload norms for job shops [BDK/KBS/84-04] p 26 N86-32330 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] p 23 A86-49571 Implementation of computer-aided production systems detailed p 32 N86-14611 Implementing quality/productivity improvement p 80 N86-15158 Self-renewal: A strategy for quality and productivity improvement p 80 N86-15160 The key to successful management of STS operations: An integrated production planning system p 12 N86-15161 Management behavior, group climate and performance
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] p 77 N86-32329 Calculating workload norms for job shops [BDK/K85/84-04] p 26 N86-32332 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] p 23 A86-49571 Implementation of computer-aided production systems detailed p 32 N86-14611 Implementing quality/productivity improvement initiatives in an engineering environment p 80 N86-15158 Self-renewal: A strategy for quality and productivity improvement p 12 N86-15160 The key to successful management of STS operations: An integrated production planning system p 12 N86-15161 Management behavior, group climate and performance appraisal at NASA p A
and political factors p 24 N86-15172 An example of integrated logistic support applied also to production testing aircraft industry Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-30898 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] p 77 N86-32329 Calculating workload norms for job shops [BDK/KBS/84-04] p 26 N86-32330 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] p 23 A86-49571 Implementation of computer-aided production systems detailed p 32 N86-14611 Implementing quality/productivity improvement p 80 N86-15158 Self-renewal: A strategy for quality and productivity improvement p 80 N86-15160 The key to successful management of STS operations: An integrated production planning system p 12 N86-15161 Management behavior, group climate and performance appraisal at NASA p 4 N86-15163 Training managers for high productivity; Guidelines and a case history p 5 N86-15184
and political factors $p 24$ N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] p 77 N86-32329 Calculating workload norms for job shops [BDK/K85/84-04] p 26 N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] p 23 A86-49571 Implementation of computer-aided production systems detailed p 32 N86-14611 Implementing quality/productivity improvement initiatives in an engineering environment p 80 N86-15158 Self-renewal: A strategy for quality and productivity improvement p 12 N86-15161 The key to successful management of STS operations: An integrated production planning system p 12 N86-15161 Management behavior, group climate and performance appraisal at NASA p 5 N86-15163 Training managers for high productivity: Guidelines and a case history p 5 N86-15201
and political factors $p 24$ N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] $p 77$ N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] $p 77$ N86-32329 Calculating workload norms for job shops [BDK/RS/84-04] $p 26$ N86-32330 The structuring of production control systems [THE/BDK/0RS/84/10] $p 26$ N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] $p 23$ A86-49571 Implementation of computer-aided production systems detailed $p 32$ N86-15158 Self-renewal: A strategy for quality and productivity improvement $p 80$ N86-151563 The key to successful management of STS operations: An integrated production planning system p 12 N86-15161 Management behavior, group climate and performance appraisal at NASA $p 4$ N86-15163 Training managers for high productivity: Guidelines and a case history $p 5$ N86-15201 Developments in quality control [REPT-186] $p 81$ N86-19638
and political factors $p 24$ N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] p 77 N86-32329 Calculating workload norms for job shops [BDK/K85/84-04] p 26 N86-32330 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] p 23 A86-49571 Implementation of computer-aided production systems detailed p 32 N86-14611 Implementing quality/productivity improvement initiatives in an engineering environment p 80 N86-15158 Self-renewal: A strategy for quality and productivity improvement p 12 N86-15161 The key to successful management of STS operations: An integrated production planning system p 12 N86-15161 Management behavior, group climate and performance appraisal at NASA p 5 N86-15163 Training managers for high productivity: Guidelines and a case history p 5 N86-15163 Training managers for high productivity: Guidelines and a case history p 5 N86-15163 Training managers for high productivity: Guidelines and a case history p 5 N86-15163 Training managers for high productivity improvements in improvements and results p 5 N86-15163 Training managers for high productivity: Guidelines and a case history p 5 N86-15163 Training managers for high productivity: Guidelines and a case history p 5 N86-15163 Training managers for high productivity: Guidelines and a case history p 5 N86-15201 Developments in quality control [REPT-186] p 81 N86-19638 Influence of complexity of control task on level of
and political factors $p 24$ N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] $p 77$ N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/64] $p 77$ N86-32329 Calculating workload norms for job shops (BDK/RS/84-04) $p 26$ N86-32330 The structuring of production control systems [THE/BDK/ORS/84/10] $p 26$ N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] $p 23$ A86-49571 Implementation of computer-aided production systems detailed $p 32$ N86-14611 Implementing quality/productivity improvement initiatives in an engineering environment p 80 N86-15158 Self-renewal: A strategy for quality and productivity improvement $p 80$ N86-15163 The key to successful management of STS operations: An integrated production planning system p 12 N86-15161 Management behavior, group climate and performance appraisal at NASA $p 4$ N86-15163 Training managers for high productivity: Guidelines and a case history $p 5$ N86-15201 Developments in quality control [REPT-186] $p 81$ N86-19638 Influence of complexity of control task on level of activation of operators physiological functions when working with waiting $p 7$ N86-23260
and political factors $p 24$ N86-15172 An example of integrated logistic support applied also to production testing aircraft industry $p 77$ N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] $p 77$ N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] $p 77$ N86-32329 Calculating workload norms for job shops [BDK/K85/84-04] $p 26$ N86-32330 The structuring of production control systems [THE/BDK/0R5/84/10] $p 26$ N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] $p 23$ A86-49571 Implementation of computer-aided production systems detailed $p 32$ N86-14611 Implementation of computer-aided production systems detailed $p 32$ N86-15158 Self-renewal: A strategy for quality and productivity improvement $p 80$ N86-15160 The key to successful management of STS operations: An integrated production planning system p 12 N86-15161 Management behavior, group climate and performance appraisal at NASA $p 4$ N86-15163 Training managers for high productivity: Guidelines and a case history $p 5$ N86-15163 Implements and results $p 5$ N86-15163 Intraining managers for high productivity: Guidelines and a case history $p 5$ N86-15163 Intelluence of complexity of control task on level of activation of operators physiological functions when working with waiting $p 7$ N86-19638 Influence of complexity of control task on level of activation of operators physiological functions when working with waiting $p 7$ N86-2360
and political factors $p 24$ N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] $p 77$ N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/04] $p 77$ N86-32329 Calculating workload norms for job shops [BDK/RS/84-04] $p 26$ N86-32330 The structuring of production control systems [THE/BDK/068/84/10] $p 26$ N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] $p 23$ A86-49571 Implementation of computer-aided production systems detailed $p 32$ N86-15158 Self-renewal: A strategy for quality and productivity improvement $p 80$ N86-151563 The key to successful management of STS operations: An integrated production planning system p 12 N86-15161 Management behavior, group climate and performance appraisal at NASA $p 4$ N86-15163 Training managers for high productivity: Guidelines and a case history $p 5$ N86-15201 Developments in quality control [REPT-186] $p 81$ N86-19638 Influence of complexity of control task on level of activation of operators physiological functions when working with waiting $p 7$ N86-23260 Real-time production system for intelligent robot control [DE86-008501] $p 36$ N86-31271
and political factors $p 24$ N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] $p 77$ N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/84] $p 77$ N86-32329 Calculating workload norms for job shops [BDK/K85/84-04] $p 26$ N86-32330 The structuring of production control systems [THE/BDK/ORS/84/10] $p 26$ N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] $p 23$ A86-49571 Implementation of computer-aided production systems detailed $p 32$ N86-14611 Implementing quality/productivity improvement initiatives in an engineering environment p 80 N86-15158 Self-renewal: A strategy for quality and productivity improvement $p 12$ N86-15161 The key to successful management of STS operations: An integrated production planning system p 12 N86-15161 Management behavior, group climate and performance appraisal at NASA $p 4$ N86-15163 Training managers for high productivity: Guidelines and a case history $p 5$ N86-15180 Intain quality control [REPT-186] $p 81$ N86-19638 Influence of complexity of control task on level of activation of operators physiological functions when working with waiting $p 36$ N86-32721 Due-date reliability in a repair shop: Implications for
and political factors $p 24$ N86-15172 An example of integrated logistic support applied also to production testing aircraft industry p 77 N86-30898 Production and inventory control with the base stock system [EUT/BDK/12] $p 77$ N86-32328 Balancing production level variations and inventory variations in complex production systems [THE/BDK/04] $p 77$ N86-32329 Calculating workload norms for job shops [BDK/RS/84-04] $p 26$ N86-32330 The structuring of production control systems [THE/BDK/068/84/10] $p 26$ N86-32332 PRODUCTION MANAGEMENT The competitive and cooperative outlook for aircraft propulsion systems [AIAA PAPER 86-1134] $p 23$ A86-49571 Implementation of computer-aided production systems detailed $p 32$ N86-15158 Self-renewal: A strategy for quality and productivity improvement $p 80$ N86-151563 The key to successful management of STS operations: An integrated production planning system p 12 N86-15161 Management behavior, group climate and performance appraisal at NASA $p 4$ N86-15163 Training managers for high productivity: Guidelines and a case history $p 5$ N86-15201 Developments in quality control [REPT-186] $p 81$ N86-19638 Influence of complexity of control task on level of activation of operators physiological functions when working with waiting $p 7$ N86-23260 Real-time production system for intelligent robot control [DE86-008501] $p 36$ N86-31271

Structuring the production control problem in a repair shop [THE/BDK/KBS/84-16] p 27 N86-32334

n 93 N86-22435

p 64 N86-27306

PRODUCTION PLANNING A comparison of a manual and computer-integrated Robot software: Current state-of-the-art, and future NASA's long range plans p 42 N86-19630 production process in terms of process control challenges [GPO-55-035] The development of a project plan for the Get Away decision-making Implementation of artificial intelligence rules in a data [AD-A168037] p 14 N86-32750 base management system Special Program **PRODUCTION PLANNING** [NASA-CR-178048] p 33 N86-21220 First implementation plan for the World Climate Research program quality/productivity improvement Implementing The design and analysis of a network interface for the WCRP-5 initiatives in an engineering environment multi-lingual database system p 80 N86-15158 [AD-A164756] p 44 N86-27121 The key to successful management of STS operations: Standard generalized markup language: A technique for An integrated production planning system document interchange p 48 N86-31777 p 12 N86-15161 [DE86-011504] Production and inventory control with the base stock PROJECT MANAGEMENT The National Aeronautics and Space Administration system (EUT/BDK/12) p 77 N86-32328 (NASA) Tracking and Data Relay Satellite System (TDRSS) program Economic and programmatic, considerations [IAF PAPER 85-422] p 67 A86-15895 Balancing production level variations and inventory variations in complex production systems nlane? [THE/BDK/84] p 77 N86-32329 Estimating - The input into good project planning p 67 A86-17673 Calculating workload norms for job shops p 26 N86-32330 [BDK/KBS/84-04] Science operations management --- with Infrared The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N Astronomy Satellite project p 72 A86-19524 N86-32332 Systems engineering - Space Telescope project p 16 A86-19525 Due-date reliability in a repair shop: Implications for program organizational and work design The role of scientists in developing Hubble Space [THE/BDK/KBS/84-14] p 27 N86-32333 p 51 A86-19526 Telescope Structuring the production control problem in a repair Concurrent and sequential networks - Implications for project management shop p 52 A86-28055 [THE/BDK/KBS/84-16] p 27 N86-32334 The role of the technologist in space productivity research p 3 A86-34983 PRODUCTIVITY Automation and robotics - Key to productivity --- in Artificial intelligence - New tools for aerospace project ndustry and space p 30 A86-34986 managers [IAF PAPER 85-32] p 28 A86-15623 Advanced project management (2nd edition) --- Book Identifying technical innovations n 51 A86-17672 p 57 A86-38959 Productivity impacts of software auto nation The U.S. civil space program: A Review of the major p 68 A86-28418 issues Report of an AIAA Workshop, Alexandria, VA, July The role of the technologist in space productivity p 60 A86-47648 22, 23, 1986 --- Book n 3 A86-34983 The right stuff --- software system development for Earth R and D Productivity: New Challenges for the US Space Radiation Budget Experiment satellite Program p 41 A86-49872 p 61 N86-15157 [NASA-TM-87520] R and D Productivity: New Challenges for the US Space guality/productivity improvement Implementing Program [NASA-TM-87520] p 61 N86-15157 initiatives in an engineering environment p 80 N86-15158 Government-to-government cooperation in space Self-renewal: A strategy for quality and productivity p 91 N86-15166 station development p 80 N86-15160 improvement Productivity issues at organizational interfaces p 4 N86-15167 Mentoring as a communication channel: Implications A case study in R and D productivity: Helping the program manager cope with job stress and improve for innovation and productivity p 4 N86-15164 Productivity issues at organizational interfaces p 4 N86-15167 p 4 N86-15170 communication effectiveness A case study in R and D productivity: Helping the Technical and management information system: The program manager cope with job stress and improve tool for professional productivity on the space station communication effectiveness p 4 N86-15170 program p 41 N86-15171 Technical and management information system: The Establishing a successful management information tool for professional productivity on the space station system for project management p 41 N86-15171 [DE85-018543] p 42 N86-19251 program p 41 N86-15173 Computer systems measures The development of a project plan for the Get Away Productivity improvement in engineering at p 5 N86-15178 Special Program p 64 N86-27306 Rocketdyne Program Management System manual Software productivity improvement through software p 76 N86-28012 [DE86-005396] engineering technology p 42 N86-15180 PUBLIC LAW The policy maker looks at information p 45 N86-28794 productivity interactive Improved through p 12 N86-15181 communication olicy A programme manager's needs for information p 45 N86-28795 Information flow and work productivity through integrated information technology p 42 N86-15183 Software management tools: Lessons learned from Training managers for high productivity: Guidelines and p 47 N86-30360 USE a case history p 5 N86-15184 DEASEL: An expert system for software engineering Group structure and group process for effective space p 47 N86-30361 station astronaut teams p 5 N86-15186 Experience with a software engineering environment Productivity enhancement planning using participative nanagement concepts p 6 N86-15202 p 47 N86-30365 framework management concepts PROJECT PLANNING White collar productivity improvement: Sponsored voice data Planning for Telesat Canada's next generation action research 1983 - 1985 satellites p 6 N86-21419 [NASA-CR-176366] [IAE PAPER 85-354] p 10 A86-15849 Maintenance planning for the 1990's (initial planning) Estimating - The input into good project planning p 67 A86-17673 p 75 N86-22065 [PB86-106010] p 51 A86-21519 LOGMARS (logistics applications of automated marking NASA develops Space Station Planning for cost/schedule control in a software voice data and reading symbols) clearinghouse, applications development project directory p 38 A86-28422 p 75 N86-24586 [AD-A162327] A software management tool p 38 A86-28423 Space Station planning PRODUCTS [AAS 85-111] p 73 A86-28581 Semimanufactured products made of copper and copper ESA Space Station planning alloys: An analysis of production and sale in a world QUALITY [AAS 85-113] p 86 A86-28582 perspective [EUT/BDK/15] p 71 N86-31758 Selecting interrelated R&D projects in space technology communication p 54 A86-29750 planning **PROFILE METHOD (FORECASTING)** Satellite communications planning and equipment Assured access to space during the 1990's p 19 A86-30187 manufacturing in Latin America p 92 N86-21453 [GPO-53-617] National space transportation systems planning **PROGRAM VERIFICATION (COMPUTERS)** p 54 A86-32527 p 40 A86-45470 Advances in software inspections Book Status of ESA's planning for the Space Station A comparison of software verification techniques p 59 A86-44530 [NASA-TM-88585] p 43 N86-19965 Planning design and implementation of a statewide Software verification and testing p 40 A86-46104 geographic information system [NASA-TM-885871 p 43 N86-19966 Research and technology Fiscal Year 1985 report **PROGRAMMING LANGUAGES** [NASA-TM-86532] p 62 N86-17225 Perspectives on artificial intelligence programming Assured access to space during the 1990's [GPO-53-617] p 29 A86-27167 p 92 N86-21453 A-20

p 64 N86-29477 **PROP-FAN TECHNOLOGY** What technologies await the future airliner? p 19 A86-31038 PROPULSION Future directions in aeropropulsion technology p 49 Å86-11602 PROPULSION SYSTEM CONFIGURATIONS Can we develop the 1.5 million pound aerospace p 55 A86-34195 The competitive and cooperative outlook for aircraft ropulsion systems [AIAA PAPER 86-1134] p 23 A86-49571 PROPULSION SYSTEM PERFORMANCE Summary of results of NASA F-15 flight research p 25 N86-26277 [NASA-TM-86811] Aeropropulsion opportunities for the 21st century p 26 N86-31585 [NASA-TM-88817] Advanced instrumentation for aeronautical propulsion [NASA-TM-88853] p 27 N86-32703 **PROPULSIVE EFFICIENCY** Aeropropulsion opportunities for the 21st century [NASA-TM-88817] p 26 N86-3 p 26 N86-31585 PROTECTION Options for operational risk assessments [DE85-014904] p 70 N86-12390 PSYCHOACOUSTICS Acoustics Division recent accomplishments and research plans p 65 N86-31340 NASA-TM-890121 **PSYCHOLOGICAL EFFECTS** 2010 - The symbionic cockpit p 18 A86-28455 PSYCHOLOGICAL FACTORS Subjective workload and individual differences in information processing abilities p 2 A86-26011 [SAE PAPER 841491] The psychophysics of workload - A second look at the between subjective measures and relationship p 3 A86-33804 performance A theoretically based review of theory and research in judgment and decision making AD-A164914 n 13 N86-27113 PSYCHOMOTOR PERFORMANCE Influence of complexity of control task on level of activation of operators physiological functions when working with waiting p 7 N86-23260 PSYCHOPHYSICS The psychophysics of workload - A second look at the between subjective measures and relationship p 3 A86-33804 performance Public laws of the 98th Congress relating to information [CRS-TK-7885-F] p 94 N86-27130 Legislation for software rights protection at last SNIAS-861-422-114] p 96 N86-32343 PUBLIC RELATIONS Index to NASA news releases and speeches, 1984 [NASA-TM-87514] p 41 N86-13224 p 41 N86-13224 PULSE CODE MODULATION Method and apparatus for operating on companded PCM [NASA-CASE-KSC-11285-1] p 94 N86-27513 PULSE COMMUNICATION Satellite communications basics - A colloquium lecture p 18 A86-29680 Method and apparatus for operating on companded PCM [NASA-CASE-KSC-11285-1] p 94 N86-27513 Q

- Improved productivity
- p 12 N86-15181 Quality circles: Organizational adaptations. improvements and results p 5 N86-15201 QUALITY CONTROL Quality control, reliability, and engineering design ---ook p 78 A86-17472

through

interactive

- Reliability requirements and contractual provisions p 78 A86-22377 Establishing software QA - An exercise in frustration
- p 39 A86-35657 --- Quality Assurance The role of laser technology in materials processing and
- nondestructive testing in the 21st century p 75 A86-47139

Implementing			improvement
initiatives in an eng	ineering envir		100 45450
		p 80	N86-15158
Self-renewal: A	strategy for	quality an	d productivity
improvement		p 80	N86-15160
Developments in	quality control	ol	
[REPT-186]		p 81	N86-19638
Cost uncertainty	assessment	methodolo	gy: A critical
overview			
[AD-A161920]		p 71	N86-24575
Program Manage	ement System	manual	
[DE86-005396]	-	p 76	N86-28012
QUANTUM THEORY			
Technical activiti	es 1983, Cei	nter for Ba	sic Standards
[PB86-140043]		p 81	N86-26239
QUASARS			
Extragalactic astr	ronomy	p 65	N86-31489
QUEUEING THEORY	,		
Calculating workl	oad norms fo	r job shops	
[BDK/KBS/84-04]		p 26	

R

RADIO GALAXIES		
Extragalactic astronomy RADIOGRAPHY	р 65	N86-31489
Nondestructive techniques for mechanical properties of structural overview		aracterizing erials: An
[NASA-TM-87203]	p 80	N86-19636
READ-ONLY MEMORY DEVICES Method and apparatus for operating o	n comp	anded PCM
voice data [NASA-CASE-KSC-11285-1]	p 94	N86-27513
READING		
LOGMARS (logistics applications of a and reading symbols) clearingho directory		ted marking applications
[AD-A162327]	p 75	N86-24586
REAL TIME OPERATION An engineering approach to the use	of exp	ert systems
technology in avionics applications		
[NASA-TM-88263] Real-time production system for	p 34 intelli	N86-24687 gent robot
control	intern	gent robot
[DE86-008501]	p 36	N86-31271
RED SHIFT		NIGE 01400
Extragalactic astronomy REDUCED GRAVITY	p 65	N86-31489
Science requirements for Space [SAE PAPER 851368]		
Commerce Lab - A program of a		A86-23552
opportunities	p 56	A86-34965
REENTRY	•	
		elopment to
operations REFUELING	p 24	N86-15197
Robotic refueling system for tac	tical ar	nd strategic
aircraft		ia olialogio
[AD-D011980] REGRESSION ANALYSIS	p 92	N86-21540
A technique for lowering risks	durin	g contract
negotiations	p 57	A86-40999
The bootstrap method for ass	essing	statistical
accuracy [AD-A161257]	p 81	N86-20047
REGULATIONS	р 01	1100-20047
Telecommunications alternatives f Market trends and decisionmaking crite	or fed eria	eral users:
[PB86-153764]	p 13	N86-25687
Significant NASA inventions availab	le for	licensing in
foreign countries [NASA-SP-7038(08)]	p 94	N86-26243
A study of factors related to commer		
services		
[NASA-CR-176881]	p 96	N86-30744
Freedom of Information Act: No affirmative disclosure provisions	ncomp	liance with
[AD-A168589]	p 96	N86-33204
RELIABILITY		
Software productivity improvement	throug	h software
engineering technology A cost analyst's guide to satelli	p 42	N86-15180
A cost analyst's guide to satellit fault-tolerant computing	ie auto	onomy and
[AD-A161853]	ρ71	N86-23630
Suggestions for designers of navy ele	ctronic	equipment.
Revision A. 1985 edition	- 05	
[AD-A165697] Survey of Soviet work in reliability	p 25	N86-28326
[AD-A167607]	p 82	N86-32766
RELIABILITY ANALYSIS		
Implications of new aircraft a performance	vionics	
Survey of Soviet work in reliability	p 78	A86-22178
[AD-A167607]	p 82	N86-32766

RELIABILITY ENGINEERING Quality control, reliability, and engineering design ---Book p 78 A86-17472 Innovative stimulus testing at the lowest level of assembly to reduce costs and induce reliability p 78 A86-22185 Reliability requirements and contractual provisions p 78 A86-22377 Planning and monitoring reliability growth in accordance p 79 A86-23009 with MIL-STDs and handbooks The airline engineering role in the management of safety p 80 A86-49084 REMOTE CONTROL Future directions in mobile teleoperation p 61 N86-12976 [DE85-014308] Robotic refueling system for tactical and strategic aircraft (AD-D011980) p 92 N86-21540 REMOTE HANDLING National Aeronautics and Space Administration p 91 N86-13234 Robot end effector [PB86-166042] p 34 N86-27663 Application of teleoperator expertise to robotics [DE86-003659] p 35 N86-29229 REMOTE MANIPULATOR SYSTEM Space telerobotics - A few more hurdles p 31 A86-37047 Proceedings of the 2nd Annual Conference on NASA/University Advanced Space Design Program [NASA-TM-89399] p 64 N86-29888 REMOTE SENSING Future U.S. meteorological satellite systems [IAF PAPER 84-96] A86-12361 p 49 The Space Station Polar Platforms - Integrating research and operational missions [AIAA PAPER 85-3000] p 49 A86-12935 ERS-1 - Mission objectives and system description p 49 A86-13823 The ERS-1 program and its future applications p 50 A86-14095 Remote sensing research - The past as prolog p 10 A86-19487 Future of remote sensing - A viewpoint from industry p 16 A86-19489 National and international cooperation in remote sensing and applications p 84 A86-19861 [AIAA PAPER 86-0412] The needs of developing countries in the application of satellite technology for disaster management p 84 A86-21123 Use of satellite data in international disaster management The view from the U.S. Department of State p 85 A86-21126 Commercial marketing of Landsat data begins A86-24123 p 68 NASA centers will stimulate industry R & D p 73 A86-24128 Earth observation satellites - From technology push to p 68 A86-26465 market pull Space remote sensing systems: An introduction ---Book p 73 A86-26525 Space law in the United Nations --- Book p 85 A86-26546 The space industry for communications and remote sensina [AAS 85-136] p 52 A86-28593 ERS-1 - Our new window on the oceans for the 1990s p 57 A86-38718 NASA plans for spaceborne lidar - The Earth Observing p 59 A86-46763 System Commercialization of the land remote sensing system: An examination of mechanisms and issues p 24 N86-14710 [E86-10008] Space station: ESA views on requirements for experimental and operational Earth observation missions p 62 N86-18379 ESA and its Earth observation programs p 66 N86-32849 Support for global science: Remote sensing's challenge p 14 N86-32864 REMOTE SENSORS Requirements, development and parametric analysis for space systems division [AIAA PAPER 85-3078] p 16 A86-10936 The earth observing system --- instrument package planning for atmosphere, ocean and land studies [AAS PAPER 85-397] p 58 A80 p 58 A86-43229 REPLACING Budget effects of the Challenger accident p 92 N86-20464 REPORTS Research and technology [NASA-TM-83099] p 62 N86-17265

RESEARCH /	AND DEVEL	OPMENT
------------	-----------	--------

Federal agencies' policies and practices are in accordance with patent and trademark amendments of 1980 [B-207939] p 91 N86-20175

Scientific and technical papers presented or published by JSC authors in 1985

[NASA-TM-58273] p 76 N86-30568 RESCUE OPERATIONS

Development and implementation of the Future Global Maritime Distress and Safety System (FGMDSS) p 77 A86-15839 [IAF PAPER 85-338]

Inmarsat role in the future global maritime distress and safety system [IAF PAPER 85-339] p 78 A86-15840

RESEARCH A 3M/NASA basic research program in space

p 52 A86-27896 Evaluation of research: Experiences and perspectives

in the Netherlands [ESA-86-96709] p 65 N86-31461 RESEARCH AIRCRAFT

X-aircraft for world leadership in aeronautics

p 19 A86-31330 Summary of results of NASA F-15 flight research program

[NASA-TM-86811] p 25 N86-26277 RESEARCH AND DEVELOPMENT

Plan for the implementation of the World Climate Research Programme p 49 A86-10403 Large airplane derivative development methodology [AIAA PAPER 85-3043] p 15 A86-10926 Some comparisons of US and USSR aircraft design

developments [AIAA PAPER 85-3060] p 15 A86-10930 Space Station utilization for technology purposes

p 50 A86-15636 [IAF PAPER 85-50] Commercialization of space A comprehensive approach

[JAF PAPER 85-431] p 50 A86-15902 Function, form, and technology - The evolution of Space Station in NASA

HAE PAPER 85-4541 p 50 A86-15914 Identifying technical innovations p 51 A86-17672 Commercialization of space . The investment A86-18385 opportunities p 67 The participation of developing countries in space p 84 A86-18392 research

Washington broadens its efforts to aid small business p 67 A86-24102 NASA centers will stimulate industry R & D

p 73 A86-24128 Development and validation of a mathematical model

of human decisionmaking for human-computer communication p 2 A86-25037

Ariane 5 - A new launcher for Europe [AAS 84-226] p 18 A86-28596 Spacecraft 2000

[AIAA PAPER 86-0616] n 18 A86-29586 X-aircraft for world leadership in aeronautics

p 19 A86-31330 National space transportation systems planning

p 54 A86-32527

Man's permanent presence in space; Proceedings of the Third Annual Aerospace Technology Symposium, University of New Orleans, LA, November 7, 8, 1985

- p 55 A86-32904 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Spacelab Hitchhiker, for rapid, low cost orbital
- p 56 A86-34991 resources

Advanced concepts transport aircraft of 1995 p 20 A86-35438 SAE PAPER 8518081 Workload assessment - Progress during the last

aherah [SAE PAPER 851877] p 3 A86-35440

Management of high-technology research and development --- Book p 57 A86-37428

Nuclear power for earth orbit and beyond p 57 A86-38623 Next generation aircraft structures - The need for

co-ordinated Canadian R & D programs p 21 A86-39567

Commerical use of space - Status and prospects p 58 A86-41154

Keys to engineering management reducing the risks of R&D start-ups planning p 21 A86-41155 World aerospace profile 1986 --- Book

p 21 A86-44919 Tough composite materials: Recent developments -p 22 A86-45300 Book

Automation and robotics for Space Station in the wenty-first century p 40 A86-49552 [AIAA PAPER 86-2300]

NASA-universities relationships in engineering: A review of NASA's program in aero/space [NASA-CR-176307] p 61 N86-12158

RESEARCH FACILITIES

Marketing the use of the space er	wironn	nent for the
processing of biological and pharma [NASA-CR-176334]	n 70	N86-12243
R and D Productivity: New Challenge		
Program		
[NASA-TM-87520]	p 61	N86-15157
Managing cooperative research	and d	
ventures		N86-15165
Productivity issues at organizational		
Efficiency and innegation. Stone to	p4	N86-15167
Efficiency and innovation: Steps to interactions	p 62	N86-15168
A case study in R and D productiv		lelping the
program manager cope with job st		
communication effectiveness	p 4	N86-15170
Research and technology Fiscal Yea		
[NASA-TM-86532]	p 62	N86-17225
Research and technology	- 60	100 47005
[NASA-TM-83099] Technology achievements and	p 62	N86-17265 ections for
Technology achievements and communication satellites of the future	proje	
[NASA-TM-87201]	p 62	N86-17595
High speed aeronautics	r	
[GPŎ-51-341]	p 91	N86-19284
Federal agencies' policies and	practic	es are in
accordance with patent and trademar	rk ame	endments of
1980	- 04	NOC 00175
[B-207939]	p 91	N86-20175
Technology transfer [GPO-49-539]	p 92	N86-20177
NASA: 1986 long-range program pla		
[NASA-TM-87560]	p 63	N86-21420
Academic science/engineering: R a		
year 1983 (detailed statistical tables)		
[PB86-120706]		N86-23482
Guide to programs, fiscal year 1986:		
National Science Foundation Progra [PB86-125184]	p 93	N86-23484
Evaluating R and D and new produced		
ventures: An overview of assessment m		
A01		
[PB86-110806]		N86-25289
Trends in industrial R and D activi	ties in	the United
States, Europe and Japan, 1963-83		
[PB86-141371]	p 63	N86-25290
Linking science, technology and eco	p 44	N86-26006
Langley aerospace test highlights, 19		100-20000
[NASA-TM-87703]		N86-26276
Financing applied R and D in smaller	p 81	N86-26276 anies
Financing applied R and D in smaller (PB86-196987)	р 81 rcomp р 71	anies N86-28783
Financing applied R and D in smaller (PB86-196987) The Value of Information as an	p 81 r comp p 71 Integ	anies N86-28783 ral Part of
Financing applied R and D in smaller (PB86-196987) The Value of Information as an Aerospace and Defence R and D Prog	p 81 comp p 71 Integ ramme	anies N86-28783 ral Part of es
Financing applied R and D in smaller [PB86-196987] The Value of Information as an Aerospace and Defence R and D Prog [AGARD-CP-385]	p 81 r comp p 71 Integ ramme p 45	anies N86-28783 ral Part of s N86-28793
Financing applied R and D in smaller (PB86-196987) The Value of Information as an Aerospace and Defence R and D Prog	p 81 r comp p 71 Integ ramme p 45 mation	anies N86-28783 ral Part of es N86-28793
Financing applied R and D in smaller (PB86-196987) The Value of Information as an Aerospace and Defence R and D Prog (AGARD-CP-385) The costs of not having refined infor	p 81 p 71 Integ ramme p 45 mation p 45	anies N86-28783 ral Part of 88 N86-28793 N86-28798
Financing applied R and D in smaller [PB86-196987] The Value of Information as an Aerospace and Defence R and D Prog [AGARD-CP-385]	p 81 p 71 Integ ramme p 45 mation p 45	anies N86-28783 ral Part of 88 N86-28793 N86-28798
Financing applied R and D in smaller (PB86-196987) The Value of Information as an Aerospace and Defence R and D Prog [AGARD-CP-385] The costs of not having refined infor Information resources management	p 81 p 71 Integ ramme p 45 mation p 45 t in th	anies N86-28783 ral Part of 8 N86-28793 N86-28798 e R and D
Financing applied R and D in smaller [PB86-196987] The Value of Information as an Aerospace and Defence R and D Prog [AGARD-CP-385] The costs of not having refined infor Information resources management environment Space station	p 81 r comp p 71 Integ ramme p 45 mation p 45 t in th p 46	anies N86-28783 ral Part of 95 N86-28793 N86-28798 e R and D N86-28803
Financing applied R and D in smaller [PB86-196987] The Value of Information as an Aerospace and Defence R and D Prog [AGARD-CP-385] The costs of not having refined infor Information resources management environment Space station	p 81 r comp p 71 Integ ramme p 45 mation p 45 c in th p 46 p 65	anies N86-28783 ral Part of is N86-28793 N86-28798 e R and D N86-28803 N86-30602
Financing applied R and D in smallel [PB86-196987] The Value of Information as an Aerospace and Defence R and D Prog [AGARD-CP-385] The costs of not having refined infor Information resources management environment Space station RESEARCH FACILITIES Evaluation of the need for a large facility in space	p 81 r comp p 71 Integ ramme p 45 t in th p 46 p 65 prima	anies N86-28783 ral Part of is N86-28793 N86-28798 e R and D N86-28803 N86-30602 te research
Financing applied R and D in smallel (PB86-196987) The Value of Information as an Aerospace and Defence R and D Prog [AGARD-CP-385] The costs of not having refined infor Information resources management environment Space station RESEARCH FACILITIES Evaluation of the need for a large facility in space [NASA-CR-179661]	p 81 r comp p 71 Integ ramme p 45 mation p 45 c in th p 46 p 65	anies N86-28783 ral Part of is N86-28793 N86-28798 e R and D N86-28803 N86-30602
Financing applied R and D in smallel (PB86-196987) The Value of Information as an Aerospace and Defence R and D Prog [AGARD-CP-385] The costs of not having refined infor Information resources management environment Space station RESEARCH FACILITIES Evaluation of the need for a large facility in space [NASA-CR-179661] RESEARCH MANAGEMENT	p 81 r comp p 71 Integ ramme p 45 mation p 45 t in th p 46 p 65 prima	anies N86-28783 ral Part of rs N86-28793 N86-28798 e R and D N86-28803 N86-30602 te research N86-32111
Financing applied R and D in smaller [PB86-196987] The Value of Information as an Aerospace and Defence R and D Prog [AGARD-CP-385] The costs of not having refined infor Information resources management environment Space station RESEARCH FACILITIES Evaluation of the need for a large facility in space [NASA-CR-179661] RESEARCH MANAGEMENT Computer networking for scientists	p 81 r comp p 71 Integ ramme p 45 mation p 45 t in th p 46 p 65 prima p 14 p 37	anies N86-28783 ral Part of is N86-28793 N86-28793 N86-28798 e R and D N86-28003 N86-30602 te research N86-32111 A86-27166
Financing applied R and D in smallel (PB86-196987) The Value of Information as an Aerospace and Defence R and D Prog [AGARD-CP-385] The costs of not having refined infor Information resources management environment Space station RESEARCH FACILITIES Evaluation of the need for a large facility in space [NASA-CR-179661] RESEARCH MANAGEMENT Computer networking for scientists Selecting interrelated R&D projects in	p 81 r comp p 71 Integ ramme p 45 mation p 45 t in th p 46 p 65 p fima p 14 p 37 space	anies N86-28783 ral Part of s N86-28793 N86-28798 e R and D N86-28803 N86-30602 te research N86-32111 A86-27166 technology
Financing applied R and D in smallel (PB86-196987) The Value of Information as an Aerospace and Defence R and D Prog [AGARD-CP-385] The costs of not having refined infor Information resources management environment Space station RESEARCH FACILITIES Evaluation of the need for a large facility in space [NASA-CR-179661] RESEARCH MANAGEMENT Computer networking for scientists Selecting interrelated R&D projects in planning	p 81 r comp p 71 Integ ramme p 45 mation p 45 t in th p 46 p 65 prima p 14 p 37 space p 54	anies N86-28783 ral Part of s N86-28793 N86-28793 N86-28798 e R and D N86-28803 N86-30602 te research N86-32111 A86-27166 technology A86-29750
Financing applied R and D in smaller (PB86-196987) The Value of Information as an Aerospace and Defence R and D Prog [AGARD-CP-385] The costs of not having refined infor Information resources management environment Space station RESEARCH FACILITIES Evaluation of the need for a large facility in space [NASA-CR-179661] RESEARCH MANAGEMENT Computer networking for scientists Selecting interrelated R&D projects in planning Spacelab 3 mission - Broadening h	p 81 r comp p 71 Integ ramme p 45 t in th p 46 p 65 prima p 14 p 37 space p 54 orizon	anies N86-28783 ral Part of rs N86-28793 N86-28798 e R and D N86-28803 N86-30602 te research N86-32111 A86-27166 rtechnology A86-29766 s in space
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Financing applied R and D in smaller [PB86-196967] The Value of Information as an Aerospace and Defence R and D Prog [AGARD-CP-385] The costs of not having refined infor Information resources management environment Space station RESEARCH FACILITIES Evaluation of the need for a large facility in space [NASA-CR-179661] RESEARCH MANAGEMENT Computer networking for scientists Selecting interrelated R&D projects in planning Spacelab 3 mission - Broadening h research Management of high-technology development Book NASA-universities relationships engineering: A review of NASA's prog [NASA-CR-176307] R and D limited partnerships (possi advanced communications satellite tech program) [NASA-CR-176333] Managing cooperative research ventures Efficiency and innovation: Steps tor interactions Research and technology [NASA-TM-83099] Academic science/engineering: R a year 1983 (detailed statistical tables) [PB86-120706] Guide to programs, fiscal year 1986: National Science Foundation Progra [PB86-125184] Comparison of scientific and technica	p 81 r comp p 71 Integ ramme p 45 mation p 45 p 65 p 71 r and 65 p 73 r aspace p 54 orizon p 54 orizon p 55 r essi p 61 and d p 62 m ard d p 62 p 63 p 63 p 63 p 64 p 65 r essi p 65 r essi essi p 65 r essi essi essi essi essi essi essi essi	anies N86-28783 ral Part of s N86-28793 N86-28793 N86-28793 N86-28798 e R and D N86-28803 N86-30602 te research N86-32111 A86-27166 technology A86-29750 s in space A86-37428 aero/space N86-12158 olications in rexperiment N86-13221 evelopment N86-135165 ollaborative N86-15165 N86-17265 tunds, fiscal N86-23482 a describing nd Activities N86-23484 onel trends
Financing applied R and D in smalled (PB86-196987) The Value of Information as an Aerospace and Defence R and D Prog [AGARD-CP-385] The costs of not having refined infor Information resources management environment Space station RESEARCH FACILITIES Evaluation of the need for a large facility in space [NASA-CR-179661] RESEARCH MANAGEMENT Computer networking for scientists Selecting interrelated R&D projects in planning Spacelab 3 mission - Broadening h research Management of high-technology development Book NASA-universities relationships engineering: A review of NASA's prog [NASA-CR-176307] R and D limited partnerships (possil advanced communications satellite tech program) [NASA-CR-176333] Managing cooperative research ventures Efficiency and innovation: Steps tor interactions Research and technology [NASA-TM-83099] Academic science/engineering: R a year 1983 (detailed statistical tables) [PB86-125184] Comparison of scientific and technica in the United States, France, West Germ	p 81 r comp p 71 Integ ramme p 45 mation p 45 p 65 p 71 r and 65 p 73 r aspace p 54 orizon p 54 orizon p 55 r essi p 61 and d p p 62 m ard d p f 925 Guide ms ara l p 93 r essi p 63 p 61 and d p 62 guide ms ara l p 93 f 14 p 65 r essi p 65 p 61 and d p 62 guide ms ara l p 93 f 14 p 65 r essi p 65 p 61 a p 65 guide ms ara l p 95 f 14 p 65 r essi p 65 p 61 a p 65 p 65 p 65 p 61 a p 65 p 61 a p 65 p 65 p 65 p 65 p 65 p 65 p 66 p 65 p 65	anies N86-28783 ral Part of s N86-28793 N86-28793 N86-28793 N86-28798 e R and D N86-28803 N86-30602 te research N86-32111 A86-27166 technology A86-29750 s in space A86-37428 aero/space N86-12158 olications in rexperiment N86-13221 evelopment N86-135165 ollaborative N86-15165 N86-17265 tunds, fiscal N86-23482 a describing nd Activities N86-23484 onel trends
Financing applied R and D in smalled (PB86-196987) The Value of Information as an Aerospace and Defence R and D Prog [AGARD-CP-385] The costs of not having refined infor Information resources management environment Space station RESEARCH FACILITIES Evaluation of the need for a large facility in space [NASA-CR-179661] RESEARCH MANAGEMENT Computer networking for scientists Selecting interrelated R&D projects in planning Spacelab 3 mission - Broadening h research Management of high-technology development Book NASA-universities relationships engineering: A review of NASA's prog [NASA-CR-176307] R and D limited partnerships (possi advanced communications satelilite tech program) [NASA-CR-176333] Managing cooperative research ventures Efficiency and innovation: Steps tor interactions Research and technology [NASA-TM-83099] Academic science/engineering: R a year 1983 (detailed statistical tables) [PB86-120706] Guide to programs, fiscal year 1986: National Science Foundation Progra [PB86-125184] Comparison of scientific and technica in the United States, France, West Germ Kingdom since 1970	p 81 p 81 r comp p 45 mation p 45 p 45 p 46 p 65 p 71 n 10 p 46 p 65 p 71 space p 54 r ess p 57 r ess p 56 r ess p 57 r ess p 57 r ess p 56 r ess p 57 r ess p 57 r ess p 56 r ess p 57 r ess p 56 r ess p 57 r ess p 57 r ess p 56 r ess p 57 r ess p 56 r ess p 57 r ess p 56 r ess p 56 r ess p 57 r ess p 56 r	anies N86-28783 ral Part of s N86-28793 N86-28793 N86-28793 N86-28798 e R and D N86-28803 N86-30602 te research N86-32111 A86-27166 technology A86-32111 A86-27166 technology A86-324967 oarch and A86-37428 aero/space N86-12158 oblications in rexperiment N86-12158 oblications in resperiment N86-12158 oblications in sevelopment N86-15165 Indaborative N86-15168 N86-17265 Iunds, fiscal N86-23482 o describing of Activities N86-23484 onnel trends d the United
Financing applied R and D in smalled (PB86-196987) The Value of Information as an Aerospace and Defence R and D Prog [AGARD-CP-385] The costs of not having refined infor Information resources management environment Space station RESEARCH FACILITIES Evaluation of the need for a large facility in space [NASA-CR-179661] RESEARCH MANAGEMENT Computer networking for scientists Selecting interrelated R&D projects in planning Spacelab 3 mission - Broadening h research Management of high-technology development Book NASA-universities relationships engineering: A review of NASA's prog [NASA-CR-176307] R and D limited partnerships (possil advanced communications satellite tech program) [NASA-CR-176333] Managing cooperative research ventures Efficiency and innovation: Steps tor interactions Research and technology [NASA-TM-83099] Academic science/engineering: R a year 1983 (detailed statistical tables) [PB86-125184] Comparison of scientific and technica in the United States, France, West Germ	p 81 r comp p 71 Integ ramme p 45 mation p 45 p 65 p 71 r and 65 p 73 r aspace p 54 orizon p 54 orizon p 55 r essi p 61 and d p p 62 m ard d p f 925 Guide ms ara l p 93 r essi p 63 p 61 and d p 62 guide ms ara l p 93 f 14 p 65 r essi p 65 p 61 and d p 62 guide ms ara l p 93 f 14 p 65 r essi p 65 p 61 a p 65 guide ms ara l p 95 f 14 p 65 r essi p 65 p 61 a p 65 p 65 p 65 p 61 a p 65 p 61 a p 65 p 65 p 65 p 65 p 65 p 65 p 66 p 65 p 65	anies N86-28783 ral Part of s N86-28793 N86-28793 N86-28793 N86-28798 e R and D N86-28803 N86-30602 te research N86-32111 A86-27166 technology A86-29750 s in space A86-37428 aero/space N86-12158 olications in rexperiment N86-13221 evelopment N86-135165 ollaborative N86-15165 N86-17265 tunds, fiscal N86-23482 a describing nd Activities N86-23484 onel trends
Financing applied R and D in smalled (PB86-196987) The Value of Information as an Aerospace and Defence R and D Prog [AGARD-CP-385] The costs of not having refined infor Information resources management environment Space station RESEARCH FACILITIES Evaluation of the need for a large facility in space [NASA-CR-179661] RESEARCH MANAGEMENT Computer networking for scientists Selecting interrelated R&D projects in planning Spacelab 3 mission - Broadening h research Management of high-technology development Book NASA-universities relationships engineering: A review of NASA's prog [NASA-CR-176307] R and D limited partnerships (possi advanced communications satelilite tech program) [NASA-CR-176333] Managing cooperative research ventures Efficiency and innovation: Steps tor interactions Research and technology [NASA-TM-83099] Academic science/engineering: R a year 1983 (detailed statistical tables) [PB86-120706] Guide to programs, fiscal year 1986: National Science Foundation Progra [PB86-125184] Comparison of scientific and technica in the United States, France, West Germ Kingdom since 1970	p 81 p 81 r comp p 45 mation p 45 p 45 p 46 p 65 p 71 n 10 p 46 p 65 p 71 space p 54 r ess p 57 r ess p 56 r ess p 57 r ess p 57 r ess p 56 r ess p 57 r ess p 57 r ess p 56 r ess p 57 r ess p 56 r ess p 57 r ess p 57 r ess p 56 r ess p 57 r ess p 56 r ess p 57 r ess p 56 r ess p 56 r ess p 57 r ess p 56 r	anies N86-28783 ral Part of s N86-28793 N86-28793 N86-28793 N86-28798 e R and D N86-28803 N86-30602 te research N86-32111 A86-27166 technology A86-32111 A86-27166 technology A86-324967 oarch and A86-37428 aero/space N86-12158 oblications in rexperiment N86-12158 oblications in resperiment N86-12158 oblications in sevelopment N86-15165 Indaborative N86-15168 N86-17265 Iunds, fiscal N86-23482 o describing of Activities N86-23484 onnel trends d the United

SUBJECT INDEX

Robotics in aircraft manufacturing

p 20 A86-35660

States, Europe and Japan, 1963-83	rities in	the United	
[PB86-141371]	p 63	N86-25290	
Creativity in Science - a symposium [DE86-003289]	n 60	NR6 07100	
A profile of selected firms awarde	p63 dsmal	N86-27109 I business	
innovation research funds			
[AD-A165664] University funding. Assessing	p 64 federa	N86-28805 Il fundina	
mechanisms for university research		a randing	
[AD-A165721]	p 95	N86-28806	
Cryogenic wind tunnels for high testing	неупо	las number	
[NASA-TM-87743]	p 26	N86-29872	
Life Sciences Space Station plann			
reference payload for the Life Se Facility	Jences	Research	
[NASA-TM-89188]		N86-30302	
Evaluation of research: Experiences in the Netherlands	s and p	erspectives	
[ESA-86-96709]	p 65	N86-31461	
Evaluation of the need for a large	e prima	te research	
facility in space [NASA-CR-179661]	p 14	N86-32111	
Advanced instrumentation for aeron			
research	n 97	NOC 22702	
[NASA-TM-88853] Organization as information processir	p 27 1a syste	N86-32703 ms: Toward	
a model of the research factors associa			
research outcomes [AD-A168018]	p 48	N86-33200	
University funding: Federal funding			
support of university research	-		
[AD-A168023] RESEARCH PROJECTS	p 66	N86-33212	
Remote sensing research - The pas			
RESOURCE ALLOCATION	p 10	A86-19487	
Space WARC '85 - A look back	p 82	A86-11023	
RESOURCES MANAGEMENT	•		
Space technology and resource man		nt A86-41981	
RETROFITTING	p 58	A60-41901	
Retrofitting avionics - Closing	the p	erformance	
'Generation gap' [SAE PAPER 851813]	p 79	A86-38324	
RETURN TO EARTH SPACE FLIGHT	pra	A00+30324	
Missions to Mars	- EO	AOC 40100	
	p 60	A86-48100	
REUSABLE LAUNCH VEHICLES		AB0-40100	
		A86-44543	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK	urope? p 59		
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E	urope? p 59	A86-44543	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK	urope? p 59 ce p 78		
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurand Underwriters worldwide incurred unexpected losses, signifying change	urope? p 59 ce p 78 \$600 es ahea	A86-44543 A86-22394 million in d in space	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assuranc Underwriters worldwide incurred unexpected losses, signifying change insurance	urope? p 59 ce p 78 \$600 is ahea p 85	A86-44543 A86-22394 million in	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assuranc Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk managemen	urope? p 59 ce p 78 \$600 es ahea p 85 t p 68	A86-44543 A86-22394 million in d in space A86-24122 A86-26453	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurand Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management Keys to engineering management re	urope? p 59 ce p 78 \$600 es ahea p 85 t p 68 educing	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 the risks of	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assuranc Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk managemen	urope? p 59 ce p 78 \$600 is ahea p 85 t p 68 iducing p 21	A86-44543 A86-22394 million in d in space A86-24122 A86-26453	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurand Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management Keys to engineering management re R&D start-ups planning The broker's role in space insurance	urope? p 59 ce p 78 \$600 es ahea p 85 t p 68 educing p 21 p 90	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 the risks of A86-41155 A86-44540	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management Keys to engineering management re R&D start-ups planning	urope? p 59 p 78 \$600 es ahea p 85 t p 68 ducing p 21 p 90 systems	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 the risks of A86-41155 A86-44540	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurand Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management Keys to engineering management re R&D start-ups planning The broker's role in space insurance	urope? p 59 ce p 78 \$600 es ahea p 85 t p 68 educing p 21 p 90	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 the risks of A86-41155 A86-44540	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert s	urope? p 59 p 78 \$600 ss ahea p 85 t p 68 ducing p 90 systems p 90 p 90	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 the risks of A86-41155 A86-44540 A86-44541 A86-46375	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assuranc Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert si computer security risk analysis	urope? p 59 ce p 78 \$600 is ahea p 85 t p 68 ducing p 21 p 90 systems p 90 systems p 90 ystems	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 the risks of A86-41155 A86-44540 A86-44541 A86-46375	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert s computer security risk analysis [DE85-014134] Risk propensity, action readiness	urope? p 59 ce p 78 \$600 ss ahea p 85 t p 68 sducing p 21 p 90 systems p 90 systems p 90 systems p 90 ystems p 90	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 the risks of A86-41155 A86-44540 A86-44541 A86-44541 A86-46375 to perform N86-10841	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert s computer security risk analysis [DE85-014134] Risk propensity, action readiness societal and individual decision makers	urope? p 59 ce p 78 \$600 ss ahea p 85 t p 68 ducing p 21 p 90 systems p 90 systems p 90 ystems p 90 ystems p 90	A86-44543 A86-22394 million in d in space A86-24122 A86-24122 A86-24122 A86-44125 A86-41155 A86-44540 A86-44541 A86-46375 to perform N86-10841 te roles of	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert s computer security risk analysis [DE85-014134] Risk propensity, action readiness	urope? p 59 ce p 78 \$600 ss ahea p 85 t p 68 ducing p 21 p 90 systems p 90 systems p 90 systems p 90 p 90 ystems p 12	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 the risks of A86-41155 A86-44540 A86-44541 A86-44541 A86-46375 to perform N86-10841	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert s computer security risk analysis (DE85-014134) Risk propensity, action readiness societal and individual decision makers [IZF-1984-27] Options for operational risk assessm [DE85-014904]	urope? p 59 ce p 78 \$600 ss ahea p 85 t p 68 ducing p 90 systems p 90 systems p 90 systems p 90 systems p 90 systems p 90 systems p 91 and th s p 71 state p 92 systems p 90 systems p 90 s	A86-44543 A86-22394 million in d in space A86-24122 A86-24122 A86-24122 A86-44125 A86-41155 A86-44540 A86-44541 A86-46375 to perform N86-10841 te roles of	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assuranc Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert si computer security risk analysis [DE85-014134] Risk propensity, action readiness societal and individual decision makers [IZF-1984-27] Options for operational risk assessm [DE85-014904] Risk assessment preprocessor (RAF	urope? p 59 \$600 p 78 \$600 p 85 p 68 p 68 p 90 p 90 p 90 p 90 oystems p 41 p 12 tents p 72 p 78 p 78	A86-44543 A86-22394 million in d in space A86-24122 A86-24122 A86-24122 A86-44540 A86-44540 A86-44541 A86-46375 to perform N86-10841 te roles of N86-11077 N86-12390	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert s computer security risk analysis (DE85-014134) Risk propensity, action readiness societal and individual decision makers [IZF-1984-27] Options for operational risk assessm [DE85-014904]	urope? p 59 58 58 58 58 50 58 50 50 50 50 50 50 50 50 50 50 50 50 50	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 the risks of A86-44540 A86-44540 A86-44541 A86-44541 A86-44541 N86-10841 te roles of N86-11077 N86-11077 N86-12390 N86-24278	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurance Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert si computer security risk analysis [DE85-014134] Risk propensity, action readiness societal and individual decision makers [IZF-1984-27] Options for operational risk assessm [DE85-014904] Risk assessment preprocessor (RAF [AD-A161914] A study of factors related to commer services	urope? p 59 p 58 p 78 8600 ss aheae p 85 p 68 p 68 p 21 p 90 p 91 p 81 q 71 p 91 p 92 p 91 p 92 p 91 p 92 p 91 p 93 p 91 p 92 p 93 p 9	A86-44543 A86-22394 million in d in space A86-24122 A86-24122 A86-24122 A86-44540 A86-44540 A86-44541 A86-46375 to perform N86-10841 te roles of N86-11077 N86-12390 N86-24278 ce platform	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert s computer security risk analysis (DE85-014134) Risk propensity, action readiness societal and individual decision makers [IZF-1984-27] Options for operational risk assessm [DE85-014904] Risk assessment preprocessor (RAF [AD-A161914] A study of factors related to commer	urope? p 59 58 58 58 58 50 58 50 50 50 50 50 50 50 50 50 50 50 50 50	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 the risks of A86-44540 A86-44540 A86-44541 A86-44541 A86-44541 N86-10841 te roles of N86-11077 N86-11077 N86-12390 N86-24278	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurand Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert sp computer security risk analysis [DE85-014134] Risk propensity, action readiness societal and individual decision makers [IZF-1984-27] Options for operational risk assessm [DE85-014904] Risk assessment preprocessor (RAF [AD-A161914] A study of factors related to commer services [NASA-CR-176881] ROBOTICS Automation and robotics for the	urope? p 59 \$600 \$5000 \$50000 \$5000 \$5000 \$5000 \$5000 \$5000 \$50000 \$5000 \$5000 \$5000 \$5000 \$50000 \$5000 \$5000 \$	A86-44543 A86-22394 million in d in space A86-24122 A86-24122 A86-24545 A86-41155 A86-44540 A86-44541 A86-46375 to perform N86-10841 er roles of N86-11077 N86-12390 N86-24278 cc platform N86-30744 Station -	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert s computer security risk analysis [DE85-014134] Risk propensity, action readiness societal and individual decision makers [IZF-1984:27] Options for operational risk assessm (DE85-014904] Risk assessment preprocessor (RAF [AD-A161914] A study of factors related to commer services [NASA-CR-176881] ROEOTICS Automation and robotics for the Recommendations	urope? p 59 ce p 78 \$600 us ahea p 85 t p 68 t p 68 t p 68 t p 90 systems p 90 systems p 90 p 41 and th s p 12 t p 12 t p 12 t p 43 cial spa p 96 Space p 27	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 the risks of A86-44540 A86-44540 A86-44541 A86-46375 to perform N86-10841 te roles of N86-11077 N86-12390 N86-24278 ce platform N86-30744 Station - A86-10200	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurand Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert si computer security risk analysis [DE85-014134] Risk propensity, action readiness societal and individual decision makers [IZF-1984-27] Options for operational risk assessm [DE85-014904] Risk assessment preprocessor (RAF [AD-A161914] A study of factors related to commer services [NASA-CR-176881] ROBOTICS Automation and robotics for the Recommendations Robotics for engineers Book Automation and robotics - Key to	urope? p 59 p 59 p 78 \$600 p 85 \$600 p 85 p 85 t p 68 ducing p 21 p 90 p 90 p 90 p 90 p 90 y stems p 90 y 90 p 90 y 85 t p 69 p 90 p 90 y 90 p 70 p 90 p 70 p 77 p 7	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 the risks of A86-41155 A86-44540 A86-44540 A86-44541 A86-46375 to perform N86-10841 te roles of N86-11077 N86-12390 N86-24278 ce platform N86-30744 Station - A86-10200 A86-10200 A86-10200	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert s computer security risk analysis [DE85-014134] Risk propensity, action readiness societal and individual decision makers [IZF-1984-27] Options for operational risk assessm [DE85-014904] Risk assessment preprocessor (RAF [AD-A161914] A study of factors related to commer services [MASA-CR-176881] ROBOTICS Automation and robotics for the Recommendations Robotics for engineers Book Automation and robotics - Key to industry and space	urope? p 59 ce p 78 \$600 ss ahea p 85 t p 68 t p 68 t p 90 systems p 90 systems p 90 p 90 systems p 91 p 12 entrop 41 and th s p 12 cial spa p 95 p 43 cial spa p 96 Space p 27 p 43 cial spa p 96 p 43 cial spa p 96 p 43 p 43 p 43 p 45 p 45 p 45 p 45 p 45 p 45 p 45 p 45	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 A86-44540 A86-44540 A86-44540 A86-44541 A86-46375 to perform N86-10841 te roles of N86-11077 N86-12390 N86-24278 ce platform N86-30744 Station - A86-10200 A86-10560 ctivity in	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert s computer security risk analysis [DE85-014134] Risk propensity, action readiness societal and individual decision makers [IZF-1984-27] Options for operational risk assessm [DE85-014904] Risk assessment preprocessor (RAF [AD-A161914] A study of factors related to commer services [IAS-A-CR-176881] ROBOTICS Automation and robotics for the Recommendations Robotics for engineers Book Automation and robotics - Key to industry and space [IAF PAPER 85-32]	urope? p 59 p 78 \$600 p 85 \$600 p 85 p 85 p 98 p 90 p 90 p 90 p 90 y stems p 90 y 90 y 90 y 90 y 90 p 90 y 90 p 90 y 90 p 91 p 90 p 92 p 97 p	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 the risks of A86-41155 A86-44540 A86-44540 A86-44541 A86-46375 to perform N86-10841 te roles of N86-10841 te roles of N86-11077 N86-12390 N86-24278 ce platform N86-30744 Station - A86-10200 A86-10560 ctivity in A86-15623	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert s computer security risk analysis [DE85-014134] Risk propensity, action readiness societal and individual decision makers [IZF-1984-27] Options for operational risk assessm [DE85-014904] Risk assessment preprocessor (RAF [AD-A161914] A study of factors related to commer services [MASA-CR-176881] ROBOTICS Automation and robotics for the Recommendations Robotics for engineers Book Automation and robotics - Key to industry and space	urope? $p 59$ p 59 p 65 p 85 p 85 t p 68 p 90 p 90 p 90 p 90 p 90 p 90 p 90 p 90 p 12 p 12 p 12 p 12 p 91 p 12 p 12 p 92 p 21 p 92 p 90 p 21 p 90 p 20 p 27 p produ p 28 p 20 p 20	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 A86-44540 A86-44540 A86-44541 A86-4375 to perform N86-10841 te roles of N86-11077 N86-12390 N86-24278 ce platform N86-30744 Station - A86-10200 A86-10200 A86-10200 A86-10200 A86-10560 ctivity in A86-15623 otics for the conomy	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert s computer security risk analysis (DE85-014134) Risk propensity, action readiness societal and individual decision makers (IZF-1984-27) Options for operational risk assessm (DE85-014194) Risk assessment preprocessor (RAF (AD-A161914) A study of factors related to commer services (NASA-CR-176881) ROBOTICS Automation and robotics for the Recommendations Robotics for engineers Book Automation and robotics - Key to industry and space (IAF PAPER 85-32) Future uses of machine intelligence a Space Station and implications for the	urope? $p 59$ p 59 p 78 p 60 p 85 p 85 p 90 p 90 p 90 p 90 p 90 p 90 p 90 p 90 p 90 p 30 p 90 p 30 p 90 p 30 p 90 p 30 p 27 p 27 p 20 p 28 and r th $p 28and r th p 28and r th p 29p 20p 20$	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 the risks of A86-4155 A86-44540 A86-44540 A86-44541 A86-46375 to perform N86-10841 te roles of N86-10841 te roles of N86-11077 N86-12390 N86-24278 ce platform N86-30744 Station - A86-10200 A86-10560 ctivity in A86-15623 ofics for the conomy A86-20426	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert s computer security risk analysis [DE85-014134] Risk propensity, action readiness societal and individual decision makers [IZF-1984-27] Options for operational risk assessm [DE85-014904] Risk assessment preprocessor (RAF [AD-A161914] A study of factors related to commer services [NASA-CR-176881] ROBOTICS Automation and robotics for the Recommendations Robotics for engineers Book Automation and robotics for the Space Station and implications for the Robotics and the space station Intelligent interfaces for human coi	urope? $p 59$ p 59 p 78 s 600 p 78 s 600 p 78 s 600 p 78 p 78 p 85 p 95 p 90 p 90 p 92 p 90 p 90 p 90 p 90 p 90 p 78 p 12 p 90 p 90 p 30 p 12 p 28 p 12 p 29 p 28 p 12 p 29	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 the risks of A86-41155 A86-44540 A86-44541 A86-4375 to perform N86-10841 te roles of N86-10841 te roles of N86-10841 te roles of N86-10841 te roles of N86-10841 te roles of N86-1077 N86-24278 ce platform N86-30744 Station - A86-10500 A86-10500 A86-10500 ctivity in A86-15623 ofics for the conomy A86-20426 A86-20426 A86-20426	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert s computer security risk analysis [DE85-014134] Risk propensity, action readiness societal and individual decision makers [IZF-1984-27] Options for operational risk assessm [DE85-014904] Risk assessment preprocessor (RAF [AD-A161914] A study of factors related to commer services [MASA-CR-176881] ROBOTICS Automation and robotics for the Recommendations Robotics for engineers Book Automation and robotics - Key to industry and space [IAF PAPER 85-32] Future uses of machine intelligence a Space Station and implications for the Robotics and the space station Intelligent interfaces for human col automation and smart systems	urope? $p 59$ p 59 p 78 p 60 p 85 p 85 p 90 p 30 p 90 p 30 p 90 p 30 p 90 p 30 p 90 p 30 p 20 p 20	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 the risks of A86-41155 A86-41155 A86-44540 A86-44541 A86-46375 to perform N86-10841 te roles of N86-10841 te roles of N86-20207 A86-10560 ctivity in A86-15623 otics for the conomy A86-20507 advanced A86-20507 advanced A86-20507	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert s computer security risk analysis [DE85-014134] Risk propensity, action readiness societal and individual decision makers [IZF-1984-27] Options for operational risk assessm [DE85-014904] Risk assessment preprocessor (RAF [AD-A161914] A study of factors related to commer services [NASA-CR-176881] ROBOTICS Automation and robotics for the Recommendations Robotics for engineers Book Automation and robotics for the Space Station and implications for the Robotics and the space station Intelligent interfaces for human coi	urope? $p 59$ ce $p 58$ See $p 78$ Seo $p 78$ Seo $p 78$ Seo $p 78$ Seo $p 78$ p 97 p 95 p 90 p 90 p 90 p 90 p 90 p 90 p 90 p 90 p 91 p 90 p 92 p 90 p 92 p 96 p 92 p 96 p 92 p 96 p 92 p 97 p 90 p 90 p 92 p 90 p 77 p 90 p 12 p 90 p 29 p 29 p 90 p 29 p 90 p 90 p 29 p 20 p 20	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 the risks of A86-41155 A86-44540 A86-44541 A86-4375 to perform N86-10841 te roles of N86-10841 te roles of N86-10200 A86-20206 A86-20206 A86-20426 A86-20488 on	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert s computer security risk analysis [DE85-014134] Risk propensity, action readiness societal and individual decision makers [IZF-1984-27] Options for operational risk assessm [DE85-014904] Risk assessment preprocessor (RAF [AD-A161914] A study of factors related to commer services [IAS-A-CR-176881] ROBOTICS Automation and robotics for the Recommendations Robotics for engineers Book Automation and robotics - Key to industry and space [IAF PAPER 85-32] Future uses of machine intelligence a Space Station and implications for the Robotics and the space station Intelligent interfaces for human col automation and smart systems Robotics for the United States Space Artificial intelligence - NASA	urope? p 59 ce p 78 \$600 is a hear p 85 t p 85 t p 65 t p 90 p 90 p 90 p 90 p 90 p 90 p 90 p 90	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 A86-44540 A86-44540 A86-44540 A86-44541 A86-44541 A86-10841 te roles of N86-10841 te roles of N86-11077 N86-12390 N86-24278 ce platform N86-30744 Station - A86-30744 Station - A86-10200 A86-10560 ctivity in A86-10560 ctivity in A86-20426 A86-20507 advanced A86-21889 on A86-28073	
REUSABLE LAUNCH VEHICLES A fully reusable launch vehicle for E RISK Decision making in product assurant Underwriters worldwide incurred unexpected losses, signifying change insurance Insurance in space risk management re R&D start-ups planning The broker's role in space insurance Insurance and commercial satellite s Something has to change Framework for generating expert s computer security risk analysis [DE85-014134] Risk propensity, action readiness societal and individual decision makers [IZF-1984-27] Options for operational risk assessm [DE85-014904] Risk assessment preprocessor (RAF [AD-A161914] A study of factors related to commer services [MASA-CR-176881] ROBOTICS Automation and robotics for the Recommendations Robotics for engineers Book Automation and robotics - Key to industry and space [IAF PAPER 85-32] Future uses of machine intelligence a Space Station and implications for the Robotics and the space station Intelligent interfaces for human col automation and smart systems	urope? p 59 ce p 78 \$600 ss ahea p 85 t p 68 t p 68 t p 69 p 90 p 90 p 90 p 90 p 90 p 90 p 90 p 9	A86-44543 A86-22394 million in d in space A86-24122 A86-26453 A86-44540 A86-44540 A86-44540 A86-44541 A86-44541 A86-10841 te roles of N86-10841 te roles of N86-11077 N86-12390 N86-24278 ce platform N86-30744 Station - A86-30744 Station - A86-10200 A86-10560 ctivity in A86-10560 ctivity in A86-20426 A86-20507 advanced A86-21889 on A86-28073	

Trends in industrial R and D activities in the United

Space telerobotics - A few more hurdles p 31 A86-37047 Smart robots: A handbook of intelligent robotic systems p 31 A86-37624 Automation requirements derived from space p 11 A86-40526 manufacturino Sharpening the senses of industrial robots p 31 A86-40831 Evaluating Space Station applications of automation and robotics p 31 A86-41000 Time optimal robotic manipulator motions and work places for point to point tasks p 31 A86-42983 A study on robot path planning from a solid model p 32 A86-43061 State of the art in intelligent/brilliant robots p 32 A86-43884 Automation and robotics for Space Station in the twenty-first century [AIAA PAPER 86-2300] p 40 A86-49552 Machine tools and metalworking USSR report: equipment [JPRS-UMM-85-0101 p 23 N86-11394 National Aeronautics and Space Administration p 91 N86-13234 Machine tools and metalworking USSR report: equipment [JPRS-UMM-85-014] p 24 N86-13742 USSR report: Machine tools and metalworking eauipment [JPRS-UMM-85-013] p 24 N86-13745 A robust layered control system for a mobile robot AD-A160833 p 33 N86-18736 [AD-A160833] Modeling and planning robotic manufacturing [AD-A161014] p 24 N86-19620 Robotic refueling system for tactical and strategic aircraft [AD-D011980] p 92 N86-21540 Task planning for control of a sensor-based robot p 33 N86-23954 [DE86-004225] Role of robotics in solving production, social problems p 34 N86-26062 Robot end effector [PB86-1660421 p 34 N86-27663 Sensing strategies for disambiguating among multiple objects in known poses p 34 N86-29220 [AD-A165912] Application of teleoperator expertise to robotics [DE86-003659] p 35 N86-29229 Variable structure model following control design for robotics applications [DE86-008136] p 35 N86-29234 Robotic simulation p 35 N86-30390 [DE86-006517] Report on the AI trip p 35 N86-30397 [IR-82] Evaluating space station applications of automation and robotics technologies from a human productivity point of p 14 N86-31412 view ROBOTS Robotics for engineers --- Book p 27 A86-10560 Computer architecture for intelligent robots p 28 A86-13529 Robotics and the space station p 29 A86-20507 CAD/CAM designer - Jack of all trades p 29 A86-21895 Robotic applications to automated composite aircraft component manufacturing [SME PAPER MF85-506] p 17 A86-24667 Smart robots: A handbook of intelligent robotic p 31 A86-37624 systems Sharpening the senses of industrial robots p 31 A86-40831 State of the art in intelligent/brilliant robots p 32 A86-43884 A robust layered control system for a mobile robot p 33 N86-18736 [AD-A160833] Robot software: Current state-of-the-art, and future p 42 N86-19630 challenges Allocation of tasks to robots for improved safety [DE86-002366] p 33 N86-22955 Economic applications of assemply robots. Economic analysis and classification systems for robot assembly [PB86-154465] p 34 N86-25808 Application of teleoperator expertise to robotics [DE86-003659] p 35 N86-29229 Variable structure model following control design for robotics applications p 35 N86-29234 [DE86-008136] Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 Robotic simulation p 35 N86-30390 [DE86-006517]

Sensor driven robot systems testbed [DE86-005892] p 35 N86-30412
Real-time production system for intelligent robot
control
[DE86-008501] p 36 N86-31271 ROCKET ENGINE DESIGN
Development history of the Space Shuttle Main
Engine
[AIAA PAPER 86-1635] p 21 A86-42764 RULES
Significance testing of rules in rule-based models of
human problem solving p 2 A86-25038
_
S
SAFETY
Allocation of tasks to robots for improved safety
[DE86-002366] p 33 N86-22955
SAFETY FACTORS
Threat-strategy technique - A system safety tool for advanced design in Space Station hazard analysis
p 79 A86-32947
SAFETY MANAGEMENT
Development and implementation of the Future Global Maritime Distress and Safety System (FGMDSS)
[IAF PAPER 85-338] p 77 A86-15839
Airports build for future traffic amid new security concern p 80 A86-48371
concern p 80 A86-48371 The airline engineering role in the management of
safety p 80 A86-49084
Options for operational risk assessments [DE85-014904] p 70 N86-12390
Actions to implement the recommendations of the
Presidential Commission on the Space Shuttle Challenger
Accident. Report to the President p 94 N86-27352 Procedures for cause oriented analysis and
consequence oriented analysis
[DOT/FAA/PM-86/21] p 44 N86-28067 SAMPLING
Computer-aided engineering
[AD-A162811] p 81 N86-24256 SARSAT
Development and implementation of the Future Global
Maritime Distress and Safety System (FGMDSS)
[IAF PAPER 85-338] p 77 A86-15839 SATELLITE ANTENNAS
Satellite communications basics - A colloquium lecture
p 18 A86-29680 SATELLITE DESIGN
Requirements, development and parametric analysis for
space systems division
[AIAA PAPER 85-3078] p 16 A86-10936 An overview of the Space Station Technology/Advanced
Development Program
[IAF PAPER 85-28] p 10 A86-15619 Space Station Advanced Development Program
p 55 A86-32543
Threat-strategy technique - A system safety tool for
advanced design in Space Station hazard analysis p 79 A86-32947
Spacelab Hitchhiker, for rapid, low cost orbital
resources p 56 A86-34991 SATELLITE IMAGERY
The needs of developing countries in the application
of satellite technology for disaster management
p 84 A86-21123 Use of satellite data in international disaster
management The view from the U.S. Department of
State p 85 A86-21126 Commercial marketing of Landsat data begins
p 68 A86-24123
SATELLITE INSTRUMENTS Geodesy: A look to the future
[NASA-CR-176283] p 61 N86-11657
SATELLITE NETWORKS
Future U.S. meteorological satellite systems [IAF PAPER 84-96] p 49 A86-12361
The Canadian mobile satellite service and its
socio-economic assessment [IAF PAPER 85-364] p 66 A86-15857
Global interconnectivity in the next two decades - A
scenario
Satellite system operations - A view from the trenches
[AIAA PAPER 86-0705] p 11 A86-29652
A chronicle of policy and procedure - The formulation of the Reagan administration policy on international
satellite telecommunications p 87 A86-30290
SATELLITE ORBITS Expert systems for satellite stationkeeping
p 30 A86-28497
Report on active and planned spacecraft and
experiments
experiments [NASA-TM-87499] p 61 N86-13343

ENVIROSAT-2000 report: Federal agency satellite	
requirements [NASA-TM-88752] p 63 N86-26355	
SATELLITE SOUNDING	
Space remote sensing systems: An introduction Book p 73 A86-26525 SATELLITE TRANSMISSION	
International space law and direct broadcast satellites p 85 A86-24675	
Improved system cost and performance ACTS using multi-beam processing satellites	
[AIAA PAPER 86-0645] p 69 A86-29607 SATELLITE-BORNE INSTRUMENTS	
The earth observing system instrument package	
planning for atmosphere, ocean and land studies [AAS PAPER 85-397] p 58 A86-43229 SATELLITES	
A cost analyst's guide to satellite autonomy and fault-tolerant computing	
[AD-A161853] p 71 N86-23630 SCHEDULES	
NASA's long range plans	
[GPO-55-035] p 93 N86-22435 SCHEDULING	
Planning for cost/schedule control in a software development project p 38 A86-28422	
Budget effects of the Challenger accident	
p 92 N86-20464 Calculating workload norms for job shops	
[BDK/KBS/84-04] p 26 N86-32330 SCIENTIFIC SATELLITES	
History of British space science Book	
p 87 A86-33604 SCIENTISTS	
Computer networking for scientists p 37 A86-27166 Academic science/engineering: R and D funds, fiscal	
year 1983 (detailed statistical tables)	
[PB86-120706] p 25 N86-23482 Guide to programs, fiscal year 1986: Guide describing	
National Science Foundation Programs and Activities	
[PB86-125184] p 93 N86-23484 Creativity in Science - a symposium	
[DE86-003289] p 63 N86-27109	
The information needs of scientists and engineers in aerospace p 45 N86-28796	
SELF ADAPTIVE CONTROL SYSTEMS	
'Smart' engine components - A micro in every blade? p 17 A86-21896	
A self-repairing aircraft? new control methods for fighter stabilization p 16 A86-14243	
Optical processing for future computer networks p 37 A86-21973	
SEQUENTIAL ANALYSIS	
Concurrent and sequential networks - Implications for project management p 52 A86-28055	
SERVICE LIFE	
ls there life after 10,000 flight hours? p 79 A86-22402	
SERVICES Measuring the value of information and information	
systems, services and products p 45 N86-28799	
Computing Services Software Library [DE86-009491] p 48 N86-32340	
SHIPS	
Marine-related research at MIT (Massachusetts Institute of Technology): A directory of research projects,	
1985-1986 [PB86-158102] p 63 N86-26249	
SHOPS	
A comparison of a manual and computer-integrated	
production process in terms of process control decision-making	
production process in terms of process control decision-making [AD-A168037] p 14 N86-32750	
production process in terms of process control decision-making [AD-A168037] p 14 N86-32750 SIGNIFICANCE Significance testing of rules in rule-based models of	
production process in terms of process control decision-making (AD-A168037] p 14 N86-32750 SIGNIFICANCE Significance testing of rules in rule-based models of human problem solving p 2 A86-25038 SIMULATION	
production process in terms of process control decision-making [AD-A168037] p 14 N86-32750 SIGNIFICANCE Significance testing of rules in rule-based models of human problem solving p 2 A86-25038 SIMULATION Aspects of cognitive complexity theory and research as	
production process in terms of process control decision-making (AD-A168037] p 14 N86-32750 SIGNIFICANCE Significance testing of rules in rule-based models of human problem solving p 2 A86-25038 SIMULATION	
production process in terms of process control decision-making [AD-A168037] p 14 N86-32750 SIGNIFICANCE Significance testing of rules in rule-based models of human problem solving p 2 A86-25038 SIMULATION Aspects of cognitive complexity theory and research as applied to a managerial decision making simulation [AD-A161376] p 13 N86-22437 Robotic simulation	
production process in terms of process control decision-making [AD-A168037] p 14 N86-32750 SIGNIFICANCE Significance testing of rules in rule-based models of human problem solving p 2 A86-25038 SIMULATION Aspects of cognitive complexity theory and research as applied to a managerial decision making simulation [AD-A161376] p 13 N86-22437	
production process in terms of process control decision-making [AD-A168037] p 14 N86-32750 SIGNIFICANCE Significance testing of rules in rule-based models of human problem solving p 2 A86-25038 SIMULATION Aspects of cognitive complexity theory and research as applied to a managerial decision making simulation [AD-A161376] p 13 N86-22437 Robotic simulation [DE86-006517] p 35 N86-30390 Sonic-boom research: Selected bibliography with annotation	
production process in terms of process control decision-making [AD-A168037] p 14 N86-32750 SIGNIFICANCE Significance testing of rules in rule-based models of human problem solving p 2 A86-25038 SIMULATION Aspects of cognitive complexity theory and research as applied to a managerial decision making simulation [AD-A161376] p 13 N86-22437 Robotic simulation [DE86-006517] p 35 N86-30390 Sonic-boom research: Selected bibliography with	
production process in terms of process control decision-making [AD-A168037] p 14 N86-32750 SIGNIFICANCE Significance testing of rules in rule-based models of human problem solving p 2 A86-25038 SIMULATION Aspects of cognitive complexity theory and research as applied to a managerial decision making simulation [AD-A161376] p 13 N86-22437 Robotic simulation [DE86-006517] p 35 N86-30390 Sonic-boom research: Selected bibliography with annotation [NASA-TM-87685] p 65 N86-30470 SINGLE STAGE TO ORBIT VEHICLES Hotol spaceplane is designed to slash launch costs by	
production process in terms of process control decision-making [AD-A168037] p 14 N86-32750 SIGNIFICANCE Significance testing of rules in rule-based models of human problem solving p 2 A86-25038 SIMULATION Aspects of cognitive complexity theory and research as applied to a managerial decision making simulation [AD-A161376] p 13 N86-22437 Robotic simulation [DE86-006517] p 35 N86-30390 Sonic-boom research: Selected bibliography with annotation [NASA-TM-87685] p 65 N86-30470 SINGLE STAGE TO ORBIT VEHICLES	

SIZE DETERMINATION Rapid sizing methods for airplanes [AIAA PAPER 85-4031]

p16 A86-10960

SOFTWARE TOOLS

SOCIAL FACTORS The Canadian mobile satellite service and its
socio-economic assessment
[IAF PAPER 85-364] p 66 A86-15857
Government in action - The role of political science in outer space activities
[IAF PAPER 85-498] p 83 A86-15942
Space Station in the 21st century - A social
perspective [AIAA PAPER 86-2349] p 11 A86-50265
The quantitative modelling of human spatial
habitability [NASA-CR-179716] D 9 N86-33210
[NASA-CR-179716] p 9 N86-33210 SOFTWARE ENGINEERING
The discipline of software acquisition
[AIAA PAPER 85-5056] p 36 A86-11412
Using automated tools to reduce software costs and insure system integrity
[AIAA PAPER 85-6013] p 36 A86-11445
Enhanced maintenance and explanation of expert
systems through explicit models of their development p 28 A86-14847
Expert systems and the 'myth' of symbolic reasoning
p 28 A86-14850
Ada instructional techniques for managers and programmers p 38 A86-28409
Software automation for higher productivity
p 38 A86-28416
Planning for cost/schedule control in a software development project p 38 A86-28422
A software management tool p 38 A86-28423
A new perspective on software management
p 38 A86-28424 Software management for integrated avionics systems
p 38 A86-28425
A proven software project audit methodology p 39 A86-28427
Establishing software QA - An exercise in frustration
Quality Assurance p 39 A86-35657
Integrated structural analysis for rapid design support [AIAA PAPER 86-1010] p 39 A86-38868
Advances in software inspections p 40 A86-45470
The right stuff software system development for Earth
Radiation Budget Experiment satellite p 41 A86-49872
Software productivity improvement through software
engineering technology p 42 N86-15180 Quantitative evaluation of software methodology
[NASA-CR-176522] p 42 N86-19022
Space station: The role of software
p 43 N86-23315 Procedures for cause oriented analysis and
consequence oriented analysis
[DOT/FAA/PM-86/21] p 44 N86-28067 USSR report: Cybernetics, computers and automation
technology
[JPRS-UCC-86-004] p 45 N86-28694
Software management tools: Lessons learned from use p 47 N86-30360
DEASEL: An expert system for software engineering
p 47 N86-30361 Experience with a software engineering environment
framework p 47 N86-30365
A relational database environment for software
development [IR-86] p 47 N86-30398
Los Alamos software development tools
[DE86-006024] p 48 N86-31248
User systems guidelines for software projects [DE86-010490] p 48 N86-33048
SOFTWARE TOOLS
Considerations for the implementation of intelligent workstation networks
[AIAA PAPER 85-4001] p 36 A86-10948
Using automated tools to reduce software costs and
insure system integrity [AIAA PAPER 85-6013] p 36 A86-11445
Productivity impacts of software automation
p 68 A86-28418 A software management tool p 38 A86-28423
A software management tool p so Aco-20423 Artificial intelligence - New tools for aerospace project
managers p 30 A86-34986
Advances in software inspections p 40 A86-45470 Software productivity improvement through software
engineering technology p 42 N86-15180
Software verification and testing
[NASA-TM-88587] p 43 N86-19966 Procedures for cause oriented analysis and
consequence oriented analysis
[DOT/FAA/PM-86/21] p 44 N86-28067 Software management tools: Lessons learned from
use p 47 N86-30360

use p 47 N86-30360 A relational database environment for software development [IR-86] p 47 N86-30380

SOLAR ACTIVITY EFFECTS

Los Alamos software development tools [DE86-006024] p 48 N86-31248
Computing Services Software Library [DE86-009491] p 48 N86-32340
[DE86-009491] p 48 N86-32340 SOLAR ACTIVITY EFFECTS
Systematic ground-based measurements of
mesospheric water vapor p 55 A86-33544
Solar System Space science: Past, present and future
[GPO-55-239] p 92 N86-20436
SOLAR TERRESTRIAL INTERACTIONS
Space science: Past, present and future [GPO-55-239] p 92 N86-20436
SONIC BOOMS
Sonic-boom research: Selected bibliography with
annotation [NASA-TM-87685] p 65 N86-30470
[NASA-TM-87685] p 65 N86-30470 SOVIET SATELLITES
The USSR and satellite communications - Competition
and cooperation p 84 A86-18389
SPACE ADAPTATION SYNDROME NASA Workshop on Animal Gravity-Sensing Systems
[NASA-TM-88249] p 66 N86-32950
SPACE BASES
The Mars base - International cooperation
[AAS 84-154] p 87 A86-28780 Scientific program for a Mars base
[AAS 84-166] p 53 A86-28792
Mission strategy and spacecraft design for a Mars base
program
[AAS 84-169] p 53 A86-28795 Enabling technologies for transition to utilization of
space-based resources and operations
p 56 A86-34992
SPACE COLONIES Anthropology and the humanization of space
[IAF PAPER 85-497] p 83 A86-15941
Technology base for the future of space
p 59 A86-45709
Toward a permanent lunar settlement in the coming decade: the Columbus Project
[DE86-006709] p 14 N86-29874
SPACE COMMERCIALIZATION
The economics of space launchers - Outlook for the
future [IAF PAPER 85-420] p 66 A86-15893
Commercialization of space - A comprehensive
approach
[IAF PAPER 85-431] p 50 A86-15902 Technology programs and related policies - Impacts on
rechnology programs and related policies - impacts on
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 84 A86-18384 Commercialization of space - The investment
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 84 A86-18384 Commercialization of space - The investment opportunities p 67 A86-18385
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 84 A86-18384 Commercialization of space - The investment opportunities p 67 A86-18385 Future of remote sensing - A viewpoint from industry
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 84 A86-18384 Commercialization of space - The investment opportunities p 67 A86-18385
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 84 A86-18384 Commercialization of space - The investment opportunities p 67 A86-18385 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 84 A86-18384 Commercialization of space - The investment opportunities p 67 A86-18385 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy p 29 A86-20426
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic taw p 84 A86-18384 Commercialization of space - The investment opportunities p 67 A86-18385 Future of remote sensing - A viewpoint from industry p 16 A86-19499 Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy p 29 A86-20426 Economic considerations of space manufacturing
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 84 A86-18384 Commercialization of space - The investment opportunities p 67 A86-18385 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy p 29 A86-20426
$\begin{array}{c} \mbox{communications satellite business ventures} \\ \mbox{[IAF PAPER 85-433]} & p \ 82 \ A86-15903 \\ \mbox{International cooperation and competition in civilian} \\ \mbox{space activities} & p \ 83 \ A86-17743 \\ \mbox{US space commercialization - Effects on space law and } \\ \mbox{domestic law} & p \ 84 \ A86-18384 \\ \mbox{Commercialization of space - The investment} \\ \mbox{opportunities} & p \ 67 \ A86-18385 \\ \mbox{Future of remote sensing - A viewpoint from industry} \\ \mbox{p to f a86-19499} \\ \mbox{Future uses of machine intelligence and robotics for the} \\ \mbox{Space Station and implications for the U.S. economy} \\ \mbox{p 2 \ A66-20426} \\ \mbox{Economic considerations of space manufacturing} \\ \mbox{p $67 \ A86-21886} \\ \mbox{Satellite leasing - Cheap access to space} \\ \mbox{p $72 \ A86-22267} \end{array}$
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 84 A86-18384 Commercialization of space - The investment opportunities p 67 A86-18385 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy p 29 A86-20426 Economic considerations of space manufacturing p 67 A86-21886 Satellite leasing - Cheap access to space p 72 A86-22267 Washington broadens its efforts to aid small business
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 84 A86-18384 Commercialization of space - The investment opportunities p 67 A86-18385 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy p 29 A86-20426 Economic considerations of space manufacturing p 67 A86-21886 Satellite leasing - Cheap access to space p 72 A86-22267 Washington broadens its efforts to aid small business p 67 A86-2102
$\begin{array}{l lllllllllllllllllllllllllllllllllll$
$\begin{array}{l lllllllllllllllllllllllllllllllllll$
$ \begin{array}{llllllllllllllllllllllllllllllllllll$
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 84 A86-18384 Commercialization of space - The investment opportunities p 67 A86-18385 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy p 29 A86-20426 Economic considerations of space manufacturing p 67 A86-21866 Satellite leasing - Cheap access to space p 72 A86-2267 Washington broadens its efforts to aid small business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24104 Space Station manager's next big job is to drum up business p 67 A86-24116 Commercial spirit combines with hard-headed business sense p 10 A86-24121 NASA centers will stimulate industry R & D p 73 A86-24128 Space: The commercial opportunities; Proceedings of the International Business Strategy Conference, London,
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 84 A86-18384 Commercialization of space - The investment opportunities p 67 A86-18385 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy p 29 A86-20426 Economic considerations of space manufacturing p 67 A86-21886 Satellite leasing - Cheap access to space p 72 A86-22267 Washington broadens its efforts to aid small business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24101 Entrepreneurial spirit combines with hard-headed business sense p 10 A86-24110 Entrepreneurial spirit combines with hard-headed business will stimulate industry R D p 73 A86-24128 Space: The commercial opportunities; Proceedings of the International Business Strategy Conference, London, England, October 31, November 1, 1984
$ \begin{array}{llllllllllllllllllllllllllllllllllll$
communications satellite business ventures [IAF PAPER 85-433] p g2 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space acommercialization - Effects on space law and domestic law p 64 A86-18384 Commercialization of space - The investment opportunities p 67 A86-18385 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy p 29 A86-20426 Economic considerations of space manufacturing p 67 A86-21886 Satellite leasing - Cheap access to space p 72 A86-2267 Washington broadens its efforts to aid small business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space p 67 A86-24104 Space Station manager's next big job is to drum up business p 10 A86-24110 Entrepreneurial spirit combines with hard-headed business sense p 10 A86-24116 Commercial marketing of Landsat data begins p 68 A86-24123 NASA centers will stimulate industry R & D p 73 A86-24128 Space: The commercial opportunities; Proceedings of the International Business Strategy Conference, London, England, October 31, November 1, 1984 p 68 A86-26451 Insurance in space risk management
$ \begin{array}{llllllllllllllllllllllllllllllllllll$
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 64 A66-18384 Commercialization of space - The investment opportunities p 67 A86-18385 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy p 29 A86-20426 Economic considerations of space manufacturing p 67 A86-21886 Satellite leasing - Cheap access to space p 72 A86-22267 Washington broadens its efforts to aid small business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24101 Entrepreneurial spirit combines with hard-headed business sense p 10 A86-24112 NASA centers will stimulate industry R & D p 73 A86-24123 NASA centers will stimulate industry R & D p 68 A86-24511 Insurance in space risk management p 68 A86-26451 Insurance in space risk management p 68 A86-26453 Satellite communications - A rapidly expanding market? p 68 A86-26454
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 84 A86-18385 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future of remote sensing - A viewpoint from industry p 29 A86-20426 Economic considerations for the U.S. economy p 29 A86-20426 Economic considerations of space manufacturing p 67 A86-21866 Satellite leasing - Cheap access to space p 72 A86-2267 Washington broadens its efforts to aid small business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24104 Space Station manager's next big job is to drum up business p 67 A86-24116 Commercial marketing of Landsat data begins p 68 A86-24128 Space: The commercial opportunities; Proceedings of the International Business Strategy Conference, London, England, October 31, November 1, 1984 p 68 A86-26453 Satellite communications - A rapidly expanding market? p 68 A86-26454 Earth observation satellites - From technology push to
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 84 A86-18385 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future of remote sensing - A viewpoint from industry p 29 A86-20426 Economic considerations of space manufacturing p 29 A86-20426 Economic considerations of space manufacturing p 27 A86-21866 Satellite leasing - Cheap access to space p 72 A86-22267 Washington broadens its efforts to aid small business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24104 Space Station manager's next big job is to drum up business p 67 A86-24116 Commercial marketing of Landsat data begins p 68 A86-24112 NASA centers will stimulate industry R & D p 73 A86-24128 Space: The commercial opportunities; Proceedings of the International Business Strategy Conference, London, England, October 31, November 1, 1984 p 68 A86-26451 Insurance in space risk management p 68 A86-26453 Satellite communications - A rapidly expanding market? p 68 A86-26453
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 84 A86-18384 Commercialization of space - The investment opportunities p 67 A86-18385 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy p 29 A86-20426 Economic considerations of space manufacturing p 67 A86-21886 Satellite leasing - Cheap access to space p 72 A86-22267 Washington broadens its efforts to aid small business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business Strategy Conference, London, England, October 31, November 1, 1984 p 68 A86-26451 Insurance in space risk management p 68 A86-26453 Satellite communications - A rapidly expanding market? p 68 A86-26455 The new space race - Remarks for space activity
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 84 A86-18384 Commercialization of space - The investment opportunities p 67 A86-18385 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy p 29 A86-20426 Economic considerations of space manufacturing p 67 A86-21886 Satellite leasing - Cheap access to space p 72 A86-2267 Washington broadens its efforts to aid small business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites with hard-headed business sense p 10 A86-24116 Commercial marketing of Landsat data begins p 66 A86-24123 NASA centers will stimulate industry R & D p 73 A86-24128 Space: The commercial opportunities; Proceedings of the International Business Strategy Conference, London, England, October 31, November 1, 1984 p 66 A86-26451 Insurance in space risk management p 66 A86-26453 Satellite communications - A rapidly expanding market? p 68 A86-26451 The new space race - Remarks for space activity and profits p 86 A86-27877
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 84 A86-18384 Commercialization of space - The investment opportunities p 67 A86-18385 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy p 29 A86-20426 Economic considerations of space manufacturing p 67 A86-21886 Satellite leasing - Cheap access to space p 72 A86-22267 Washington broadens its efforts to aid small business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business Strategy Conference, London, England, October 31, November 1, 1984 p 68 A86-26451 Insurance in space risk management p 68 A86-26453 Satellite communications - A rapidly expanding market? p 68 A86-26455 The new space race - Remarks for space activity
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space acommercialization - Effects on space law and domestic law p 84 A86-18384 Commercialization of space - The investment opportunities p 67 A86-19489 Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy p 29 A86-20426 Economic considerations of space manufacturing p 67 A86-21886 Satellite leasing - Cheap access to space p 72 A86-21886 Satellite leasing - Cheap access to space p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24104 Space Station manager's next big job is to drum up business sense p 10 A86-24104 Space: The commercial opportunities; Proceedings of the International Business Strategy Conference, London, England, October 31, November 1, 1984 p 68 A86-24651 Insurance in space risk management p 68 A86-24651 Insurance in space risk management p 68 A86-26451 The new space race - Remarks
communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 International cooperation and competition in civilian space activities p 83 A86-17743 US space commercialization - Effects on space law and domestic law p 84 A86-18385 Commercialization of space - The investment opportunities p 67 A86-18385 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future of remote sensing - A viewpoint from industry p 16 A86-19489 Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy p 29 A86-20426 Economic considerations of space manufacturing p 67 A86-21886 Satellite leasing - Cheap access to space p 72 A86-22267 Washington broadens its efforts to aid small business p 67 A86-24102 Shuttle launches of satellites are making space a bottomline business p 67 A86-24104 Space Station manager's next big job is to drum up business p 67 A86-24116 Commercial marketing of Landsat data begins p 68 A86-24118 Space: The commercial opportunities; Proceedings of the Interpreneurial spirit combines with hard-headed business sense p 10 A86-24116 Commercial marketing of Landsat data begins p 68 A86-24128 Space: The commercial opportunities; Proceedings of the International Business Strategy Conference, London, England, October 31, November 1, 1984 p 68 A86-24551 Insurance in space risk management p 68 A86-26451 Insurance in space risk management p 68 A86-26455 The new space race - Remarks

p 68 A86-27886 Learning from the past - Bringing Adam Smith into p 10 A86-27887 orhit Space commercialization - An American case study in p 86 A86-27888 denationalization Private funds will bolster tax dollars in the job of financing p 69 A86-29494 the station Ariane and Arianespace status and capability p 18 A86-29668 [AIAA PAPER 86-0671] Status of space commercialization in the USA p 87 A86-29696 Communications satellite business ventures - Measuring the impact of technology programmes and related policies p 69 A86-29699 Space insurance - A resource for commercial space p 87 A86-32562 activities Commerical use of space - Status and prospects p 58 A86-41154 New job for NASA is marketing management p 69 A86-41681 Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-43341 Contractual and related agreements required for a p 89 A86-43342 satellite launch Insurance - Forms of coverage and current market situation --- for spacecraft and space operations p 89 A86-43344 Aspects of law and practice in the United States --- and space commercialization p 89 A86-43349 Financial structure for participation in industrial space p 69 A86-44538 projects The broker's role in space insurance p 90 A86-44540 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials A86-44549 processing in space p 70 Something has to change p 90 A86-46375 appropriations LANDSAT Authorizing for commercialization N86-20174 [H-REPT-99-177] p 91 appropriations Authorizing for Landsat commercialization [HR-REPT-99-177] p 93 N86-22448 Research and competition: Best partners p 76 N86-25321 [NASA-TM-87313] A study of factors related to commercial space platform [NASA-CB-176881] n 96 N86-30744 National Aeronautics and Space Administration p 96 N86-31450 Spinoff 1985 NASA-TM-892401 p 65 N86-31451 SPACE ERECTABLE STRUCTURES Construction and control of large space structures p 21 A86-37060 SPACE EXPLORATION p 50 A86-14272 Space - The long range future Government in action - The role of political science in outer space activities [IAF PAPER 85-498] p 83 A86-15942 Human development and the conquest of space p 83 A86-18381 A millennium project - Mars 2000 [AAS 84-151] p 53 A86-28777 Beyond the Space Station [AAS 84-161] p 53 A86-28787 Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 Developing the final frontier: International cooperation in the peaceful uses of outer space --- Book p 88 A86-42236 p 60 Missions to Mars A86-48100 Space science: Past, present and future [GPO-55-239] p 92 N86-20436 The great observatories for space astrophysics [NASA-CR-176754] p 63 N86-24712 The suitability of various spacecraft for future space applications missions [NASA-TM-88986] p 64 N86-27409 Proceedings of the 2nd Annual Conference on NASA/University Advanced Space Design Program p 64 N86-29888 [NASA-TM-89399] SPACE FLIGHT Research and technology Fiscal Year 1985 report [NASA-TM-86532] p 62 N86-17225 The suitability of various spacecraft for future space applications missions [NASA-TM-889861 p 64 N86-27409 SPACE FLIGHT FEEDING

Four important issues in the civil space area

NASA Facts: Space Shuttle food systems [NF-150/1-86] p 9 N86-32102

SUBJECT INDEX

SPACE FLIGHT STRESS A review of the psychological aspects of space flight p 2 A86-29090 Group structure and group process for effective space station astronaut teams p 5 N86-15186 NASA Workshop on Animal Gravity-Sensing Systems p 66 N86-32950 [NASA-TM-88249] SPACE HABITATS Development of space technology for ecological p 63 N86-19943 habitats SPACE INDUSTRIALIZATION Space stations and space platforms - Concepts, design, p 51 A86-17301 p 16 A86-20591 infrastructure, and uses Have factory, will launch Space Station manager's next big job is to drum up p67 A86-24110 husiness Space materials resources and processing options -Their influence on future space operations p 73 A86-27897 Management of outer space for the benefit of p 54 A86-31218 mankind Enabling technologies for transition to utilization of space-based resources and operations p 56 A86-34992 Financial structure for participation in industrial space p 69 A86-44538 projects Economic aspects of space industrialization p 70 A86-45636 Technology base for the future of space p 59 A86-45709 SPACE LAW p 83 A86-18368 Space law challenged US space commercialization - Effects on space law and p 84 A86-18384 domestic law Management of outer space n 84 A86-19261 Space law in the United Nations --- Book p 85 A86-26546 Capitalism and democracy on the high frontier p 86 A86-27881 Space Law - The disillusioned maiden in the military arden of Eden p 86 A86-27883 Garden of Eden Space insurance - A resource for commercial space ctivities p 87 A86-32562 Space stations: Legal aspects of scientific and activities commercial use in a framework of transatlantic conneration: Proceedings of the International Colloquium, Hamburg, West Germany, October 3, 4, 1984 p 88 A86-43335 Possible models for specific space agreements A86-43339 p 88 Agreements between states and with international organizations --- on Space Station construction, transport and orbital assembly p 88 A86-43340 Contractual and related agreements required for a atellite launch p 89 A86-43342 Applicable law and dispute settlement --- for Space tation development p 89 A86-43343 satellite launch Station development Insurance - Forms of coverage and current market situation --- for spacecraft and space operations p 89 A86-43344 State supervision and registration --- of space stations p 89 A86-43345 The Space Station - Past, present and future with some thoughts on some legal questions that need to be addressed p 89 A86-43346 Aspects of law and practice in the United States --- and p 89 A86-43349 space commercialization Space Station evolution - The uncertainty principle p 60 A86-48373 prevails SPACE LOGISTICS Space Station operations [IAF PAPER 85-45] p 72 A86-15632 Integrated logistics support - Five key areas of ngineering technology in space p 73 A86-32930 engineering technology in space Logistics support economy and efficiency through consolidation and automation p 74 A86-34956 Enabling technologies for transition to utilization of space-based resources and operations p 56 A86-34992 A cost analyst's guide to satellite autonomy and fault-tolerant computing [AD-A161853] p 71 N86-23630 Tether applications for space station p 76 N86-28418 SPACE MAINTENANCE Maintainability planning for the Space Station p 73 A86-32095 [AIAA PAPER 86-9754] Automation requirements derived from space p 11 A86-40526 manufacturing SPACE MANUFACTURING p 29 A86-20507 Robotics and the space station Economic considerations of space manufacturing p 67 A86-21886 derived from space p 11 A86-40526 Automation requirements manufacturing

Economic aspects of space industrialization
p 70 A86-45636
EOS production on the Space Station Electrophoresis
Operations/Space [AIAA PAPER 86-2358] p 22 A86-46964
Marketing the use of the space environment for the
processing of biological and pharmaceutical materials
[NASA-CR-176334] p 70 N86-12243
SPACE MISSIONS
Insurance for space ventures [IAF PAPER 85-435] p 83 A86-15905
The roles of astronauts and machines for future space
operations
[SAE PAPER 851332] p 1 A86-23521
Japanese policy on participation in the Space Station
program [AAS 85-114] p 86 A86-28583
Beyond the Space Station
[AAS 84-161] p 53 A86-28787
Mission strategy and spacecraft design for a Mars base
program [AAS 84-169] p 53 A86-28795
Concepts for the early realization of a manned mission
to Mars
[AAS 84-170] p 53 A86-28796
Selecting interrelated R&D projects in space technology planning p 54 A86-29750
Spacelab 3 mission - Broadening horizons in space
research p 56 A86-34967
SPACE PLATFORMS
Space stations and space platforms - Concepts, design, infrastructure, and uses p 51 A86-17301
Introduction - Space Station and platform roles in
supporting future space endeavors p 51 A86-17307
Satellite leasing - Cheap access to space
p 72 A86-22267 Space Station polar orbiting platform - Mission analysis
and planning
[AIAA PAPER 86-2178] p 60 A86-47960
SPACE POWER REACTORS Space law in the United Nations Book
p 85 A86-26546
Nuclear power for earth orbit and beyond
p 57 A86-38623
SPACE PROCESSING Economic considerations of space manufacturing
p 67 A86-21886
Satellite leasing - Cheap access to space
p 72 A86-22267
NASA centers will stimulate industry R & D
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options -
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897
NASA centers will stimulate industry A & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Prescription for profits p 56 A86-35526
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-35526 Prescription for profits p 56 A86-35526 Electrophoresis operations in space - A promising new
NASA centers will stimulate industry R & D p 73 A86-24128 p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Prescription for profits p 56 A86-3526 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Prescription for profits p 56 A86-3526 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Prescription for profits p 56 A86-3526 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity
NASA centers will stimulate industry R & D p 73 A86-24128 p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Prescription for profits p 56 A86-34965 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity [AIA PAPER 86-2356] p 75 A86-46963
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Prescription for profits p 56 A86-34965 Prescription for profits p 56 A86-34965 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46663 Space Processing Applications Rocket (SPAR) project:
NASA centers will stimulate industry R & D p 73 A86-24128 p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commercial term p 73 A86-34965 Prescription for profits p 56 A86-34965 Prescription for profits p 56 A86-34965 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 Space Processing Applications Rocket (SPAR) project: SPAR 10 [NASA-TM-86548] p 76 N86-28972
NASA centers will stimulate industry R & D p 73 A86-24128 p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Prescription for profits p 56 A86-34526 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 Space Processing Applications Rocket (SPAR) project: SPAR 10 [NASA-TM-86548] p 76 N86-28972 SPACE PROGRAMS p 76 N86-28972 SPACE PROGRAMS State stat
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight options p 56 A86-34965 Prescription for profits p 56 A86-3526 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-44963 Space Processing Applications Rocket (SPAR) project: SPAR 10 [NASA-TM-86548] p 76 N86-28972 SPACE PROGRAMS Management of outer space for the benefit of p 76 N86-28972
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Prescription for profits p 56 A86-34965 Prescription for profits p 56 A86-34965 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 Space Processing Applications Rocket (SPAR) project: SPAR 10 [NASA-TM-86548] p 76 N86-28972 SPACE PROGRAMS Management of outer space for the benefit of markind p 54 A86-31218
NASA centers will stimulate industry R & D p 73 A86-24128 p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 Prescription for profits p 56 Electrophoresis operations in space - A promising new commercial venture p 59 p 70 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 Space Processing Applications Rocket (SPAR) project: SPACE PROGRAMS Management of outer space for the benefit of mankind p 54 A86-31218 The heavens and the earth: A political history of the space age Book
NASA centers will stimulate industry R & D p 73 A86-24128 p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 Prescription for profits p 56 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 Space Processing Applications Rocket (SPAR) project: SPAR 10 [NASA-TM-86548] Management of outer space for the benefit of mankind p 54 A86-31218 The heavens and the earth: A political history of the space age Book p 87 A86-31218
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Prescription for profits p 56 A86-3526 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44549 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46543 Space Processing Applications Rocket (SPAR) project: SPAR 10 [NASA-TM-86548] p 76 N86-28972 SPACE PROGRAMS Management of outer space for the benefit of mankind p 54 A86-31218 The heavens and the earth: A political history of the space age Book p 87 A86-34134 Internationalization of the Space Station p 56 A86-34974
NASA centers will stimulate industry R & D p 73 A86-24128 p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 Prescription for profits p 56 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 Space Processing Applications Rocket (SPAR) project: SPAR 10 [NASA-TM-86548] Management of outer space for the benefit of mankind p 54 A86-31218 The heavens and the earth: A political history of the space age Book p 87 A86-31218
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Prescription for profits p 56 A86-3526 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 Space Processing Applications Rocket (SPAR) project: SPAR 10 [NASA-TM-86548] p 76 N86-28972 SPACE PROGRAMS Management of outer space for the benefit of mankind p 54 A86-31218 The heavens and the earth: A political history of the space age - Book p 87 A86-34974 The U.S. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July 22, 23, 1986 Book p 60 A86-47648
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Prescription for profits p 56 A86-34965 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 Space Processing Applications Rocket (SPAR) project: SPAR 10 [NASA-TM-86548] p 76 N86-28972 SPACE PROGRAMS Management of outer space for the benefit of mankind p 54 A86-31134 Internationalization of the Space Station p 56 A86-34974 The U.S. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July 22, 23, 1986 Book p 60 A86-47648 Projections of space systems opportunities and
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Prescription for profits p 56 A86-34566 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-466963 Space Processing Applications Rocket (SPAR) project: SPAR 10 [NASA-TM-86548] p 76 N86-28972 SPACE PROGRAMS Management of outer space for the benefit of mankind p 54 A86-31218 The heavens and the earth: A political history of the space age - Book p 87 A86-34134 Internationalization of the Space Station p 56 A86-34974 The U.S. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July 22, 23, 1986 Book p 60 A86-47648 Projections of space systems opportunities and technologies for the 2000 to 2030 time period p 60 A86-48451
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Prescription for profits p 56 A86-34965 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 Space Processing Applications Rocket (SPAR) project: SPAR 10 [NASA-TM-86548] p 76 N86-28972 SPACE PROGRAMS Management of outer space for the benefit of mankind p 54 A86-31218 The heavens and the earth: A political history of the space age Book p 87 A86-34134 Internationalization of the Space Station p 56 A86-34974 The U.S. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July 22, 23, 1986 Book p 0 A86-47648 Projections of space systems opportunities and technologies for the 2000 to 2030 time period p 60 A86-48451 The search for common ground with joint Mars
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Prescription for profits p 56 A86-3526 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 Space Processing Applications Rocket (SPAR) project: SPAR 10 [NASA-TM-86548] p 76 N86-28972 SPACE PROGRAMS Management of outer space for the benefit of mankind p 54 A86-31218 The heavens and the earth: A political history of the space age Book p 87 A86-34074 The U.S. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July 22, 23, 1986 Book p 60 A86-47648 Projections of space systems opportunities and technologies for the 2000 to 2030 time period p 60 A86-48451 The search for common ground with joint Mars expedition by U.S. and U.S.S.R. p 90 A86-49454
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Prescription for profits p 56 A86-34965 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 Space Processing Applications Rocket (SPAR) project: SPAR 10 [NASA-TM-86548] p 76 N86-28972 SPACE PROGRAMS Management of outer space for the benefit of mankind p 54 A86-31218 The heavens and the earth: A political history of the space age Book p 87 A86-34134 Internationalization of the Space Station p 56 A86-34974 The U.S. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July 22, 23, 1986 Book p 0 A86-47648 Projections of space systems opportunities and technologies for the 2000 to 2030 time period p 60 A86-48451 The search for common ground with joint Mars
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Prescription for profits p 56 A86-3526 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 Space Processing Applications Rocket (SPAR) project: SPAR 10 [NASA-TM-86548] p 76 N86-28972 SPACE PROGRAMS Management of outer space for the benefit of mankind p 54 A86-31218 The heavens and the earth: A political history of the space age Book p 87 A86-34134 Internationalization of the Space Station p 56 A86-34974 The U.S. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July 22, 23, 1986 Book p 60 A86-47648 Projections of space systems opportunities and technologies for the 2000 to 2030 time period p 60 A86-48451 The search for common ground with joint Mars expedition by U.S. and U.S.S.R. p 90 A86-49454 US space programs: Cooperation and competition from Europe [BPA-CP-695] p 90 N86-12163
NASA centers will stimulate industry R & D p 73 A86-24128Space materials resources and processing options - Their influence on future space operations p 73 A86-27897Commerce Lab - A program of commercial flight opportunitiesp 56 A86-34965Prescription for profitsp 59 A86-44548More precious than gold - The economics of materialsprocessing in spacep 70 A86-44549Growth of electronic materials in microgravity[AIAA PAPER 86-2356]p 75 A86-46963Space Processing Applications Rocket (SPAR) project:SPAR 10[NASA-TM-86548]Management of outer space for the benefit of mankindp 56 A86-31218The heavens and the earth: A political history of the space age Bookp 87 A86-34134Internationalization of the Space Stationp 56 A86-34974The U.S. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July22, 23, 1986 Bookp 60 A86-47648Projections of space systems opportunities and technologies for the 2000 to 2030 time periodp 60 A86-48451The search for common ground with joint Mars expedition by U.S. and U.S.S.R.p 90 A86-48451The search for common ground with joint Mars expedition by U.S. and U.S.S.R.p 90 A86-412163R and D Productivity: New Challenges for the US Spacep 90 A86-12163
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 Prescription for profits p 56 A86-34965 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 Space Processing Applications Rocket (SPAR) project: SPACE PROGRAMS Management of outer space for the benefit of mankind p 54 A86-34128 The heavens and the earth: A political history of the space age Book p 87 A86-34134 Internationalization of the Space Station p 66 A86-34574 The U.S. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July 22, 23, 1986 Book p 60 A86-47451 The search for common ground with joint Mars expedition by U.S. and U.S.S.R. p 90 A86-49454 US space programs: Cooperation and competition from Europe [BPA-CP-695] p 90 N86-12163 R and D Productivity: New Challenges for the US Space Program
NASA centers will stimulate industry R & D p 73 A86-24128Space materials resources and processing options - Their influence on future space operations p 73 A86-27897Commerce Lab - A program of commercial flight opportunitiesp 56 A86-34965Prescription for profitsp 59 A86-44548More precious than gold - The economics of materialsprocessing in spacep 70 A86-44549Growth of electronic materials in microgravity[AIAA PAPER 86-2356]p 75 A86-46963Space Processing Applications Rocket (SPAR) project:SPAR 10[NASA-TM-86548]Management of outer space for the benefit of mankindp 56 A86-31218The heavens and the earth: A political history of the space age Bookp 87 A86-34134Internationalization of the Space Stationp 56 A86-34974The U.S. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July22, 23, 1986 Bookp 60 A86-47648Projections of space systems opportunities and technologies for the 2000 to 2030 time periodp 60 A86-48451The search for common ground with joint Mars expedition by U.S. and U.S.S.R.p 90 A86-48451The search for common ground with joint Mars expedition by U.S. and U.S.S.R.p 90 A86-412163R and D Productivity: New Challenges for the US Spacep 90 A86-12163
NASA centers will stimulate industry R & D p 73 A86-24128Space materials resources and processing options - Their influence on future space operationsp 73 A86-27897Commerce Lab - A program of commercial flight opportunitiesp 56 A86-34965Prescription for profitsp 56 A86-34965Prescription for profitsp 56 A86-34965Prescription for profitsp 56 A86-34965Prescription for profitsp 59 A86-44548More precious than gold - The economics of materials processing in spacep 70 A86-44549Growth of electronic materials in microgravity[AIAA PAPER 86-2356]p 76 N86-28972SPACE PROGRAMSManagement of outer space for the benefit of mankindp 54 A86-34134Internationalization of the Space for the banefit of mankindp 56 A86-34974The U.S. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July 22, 23, 1986 Bookp 60 A86-47648Projections of space systems opportunities and technologies for the 2000 to 2030 time periodp 60 A86-48451The search for common ground with joint Mars expedition by U.S. and U.S.S.R.p 90 N86-12163R and D Productivity: New Challenges for the US Space Program[NASA-TM-87520]p 61 N86-15157 Productivity issues at organizational interfaces P 4 N86-15167
NASA centers will stimulate industry R & D p 73 A86-24128Space materials resources and processing options - Their influence on future space operations p 73 A86-27897Commerce Lab - A program of commercial flight opportunitiesp 56 A86-34965Prescription for profitsp 56 A86-3526Electrophoresis operations in space - A promising new commercial venturep 59 A86-44548More precious than gold - The economics of materials processing in spacep 70 A86-44549Growth of electronic materials in microgravity [AIAA PAPER 86-2356]p 75 A86-46963Space Processing Applications Rocket (SPAR) project: SPACE PROGRAMSp 76 N86-28972SPACE PROGRAMSmaagement of outer space for the benefit of mankindp 56 A86-34134Internationalization of the Space Stationp 56 A86-34974The U.S. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July 22, 23, 1986 Bookp 60 A86-34974The search for common ground with joint Mars expedition by U.S. and U.S.S.R.p 90 A86-44545US space programs: Cooperation and competition from Europep 61 N86-12163R and D Productivity: New Challenges for the US Space Programp 61 N86-15157Productivity issues at organizational interfaces P 4 N86-15167p 4 N86-15167
NASA centers will stimulate industry R & D p 73 A86-24128 Space materials resources and processing options - Their influence on future space operations p 73 A86-27897 Commerce Lab - A program of commercial flight opportunities p 56 A86-38526 Prescription for profits p 56 A86-35526 Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548 More precious than gold - The economics of materials processing in space p 70 A86-44549 Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46549 Space Processing Applications Rocket (SPAR) project: SPAR 10 [NASA-TM-86548] p 76 N86-28972 SPACE PROGRAMS Management of outer space for the benefit of mankind p 56 A86-34134 Internationalization of the Space Station m LS. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July 22, 23, 1986 Book p 60 A86-47648 Projections of space systems opportunities and technologies for the 2000 to 2030 time period p 60 A86-48451 The search for common ground with joint Mars expedition by U.S. and U.S.S.R. p 90 N86-12163 R and D Productivity: New Challenges for
NASA centers will stimulate industry R & D p 73 A86-24128Space materials resources and processing options - Their influence on future space operations p 73 A86-27897Commerce Lab - A program of commercial flight opportunitiesp 56 A86-34965Prescription for profitsp 56 A86-34965Prescription for profitsp 56 A86-3526Electrophoresis operations in space - A promising new commercial venturep 59 A86-44548More precious than gold - The economics of materials processing in spacep 70 A86-44549Growth of electronic materials in microgravity [AIAA PAPER 86-2256]p 75 A86-46963Space Processing Applications Rocket (SPAR) project: SPACE PROGRAMSSPA N66-28972SPACE PROGRAMSManagement of outer space for the benefit of mankindp 76 N86-28971The heavens and the earth: A political history of the space age Bookp 76 A86-34134Internationalization of the Space Stationp 56 A86-34974The U.S. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July 22, 23, 1986 Bookp 60 A86-47648Projections of space systems opportunities and technologies for the 2000 to 2030 time period $p 60 A86-48451$ p 60 A86-48451The search for common ground with joint Mars expedition by U.S. and U.S.S.R.p 90 A86-49454US space programs: Cooperation and competition from Europep 61 N86-15157Productivity: New Challenges for the US Space Productivity issues at organizational interfaces $p 4$ N86-15167SPACE PSYCHOLOGYA review of the psychological aspects of space flight $p 2$ A86-29090
NASA centers will stimulate industry R & D p 73 A86-24128Space materials resources and processing options - Their influence on future space operations p 73 A86-27897Commerce Lab - A program of commercial flight opportunitiesp 56 A86-34965Prescription for profitsp 56 A86-3526Electrophoresis operations in space - A promising new commercial venturep 59 A86-44548More precious than gold - The economics of materials processing in spacep 70 A86-44549More precious than gold - The economics of materials processing Applications Rocket (SPAR) project: SPAR 10p 75 A86-46963Space Processing Applications Rocket (SPAR) project: SPAR 10p 76 N86-28972SPACE PROGRAMSp 76 N86-28972Management of outer space for the benefit of mankindp 54 A86-31218 p 56 A86-34974The heavens and the earth: A political history of the space age Bookp 87 A86-34974The U.S. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July 22, 23, 1986 Bookp 60 A86-48451The search for common ground with joint Mars expedition by U.S. and U.S.S.R.p 90 N86-12163 R and D Productivity: New Challenges for the US Space Program[NASA-TM-87520]p 61 N86-15157 Productivity issues at organizational interfaces p 4 N86-15167SPACE RATIONSp 2 A86-29090SPACE RATIONSp 2 A86-29090
NASA centers will stimulate industry R & D p 73 A86-24128Space materials resources and processing options - Their influence on future space operations p 73 A86-27897Commerce Lab - A program of commercial flight opportunitiesp 56 A86-34965Prescription for profitsp 56 A86-34965Prescription for profitsp 56 A86-3526Electrophoresis operations in space - A promising new commercial venturep 59 A86-44548More precious than gold - The economics of materials processing in spacep 70 A86-44549Growth of electronic materials in microgravity [AIAA PAPER 86-2256]p 75 A86-46963Space Processing Applications Rocket (SPAR) project: SPACE PROGRAMSSPA N66-28972SPACE PROGRAMSManagement of outer space for the benefit of mankindp 76 N86-28971The heavens and the earth: A political history of the space age Bookp 76 A86-34134Internationalization of the Space Stationp 56 A86-34974The U.S. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July 22, 23, 1986 Bookp 60 A86-47648Projections of space systems opportunities and technologies for the 2000 to 2030 time period $p 60 A86-48451$ p 60 A86-48451The search for common ground with joint Mars expedition by U.S. and U.S.S.R.p 90 A86-49454US space programs: Cooperation and competition from Europep 61 N86-15157Productivity: New Challenges for the US Space Productivity issues at organizational interfaces $p 4$ N86-15167SPACE PSYCHOLOGYA review of the psychological aspects of space flight $p 2$ A86-29090

SPACE SHUTTLE MAIN ENGINE	
_ Development history of the Space Shuttle Main	
Engine [AIAA PAPER 86-1635] p 21 A86-42764 SPACE SHUTTLE MISSION 51-L	
Report of the Presidential Commission on the Space	
Shuttle Challenger Accident, volume 1 [AD-A171402] p 93 N86-24726	
Actions to implement the recommendations of the	
Presidential Commission on the Space Shuttle Challenger Accident. Report to the President p 94 N86-27352	
Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 2	
[AD-A171403] p 95 N86-28974	
Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 3	
[AD-A171403] p 95 N86-28975	
Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 4	
[AD-A171404] p 95 N86-28976	
Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 5	
[AD-A171404] p 95 N86-28977	
SPACE SHUTTLE ORBITERS Environmental management of payload processing	
facilities	
[AIAA PAPER 85-6067] p 78 A86-17602 Shuttle environment database	
[AAS 85-103] p 39 A86-28578	
SPACE SHUTTLE PAYLOADS Environmental management of payload processing	
facilities	
[AIAA PAPER 85-6067] p 78 A86-17602 Report on active and planned spacecraft and	
experiments	
[NASA-TM-87499] p 61 N86-13343 Assured access to space during the 1990's	
[GPO-53-617] p 92 N86-21453	
Shuttle-launch triangular space station [NASA-CASE-MSC-20676-1] p 93 N86-24729	
The development of a project plan for the Get Away	
Special Program p 64 N86-27306 Space Processing Applications Rocket (SPAR) project:	
SPAR 10 [NASA-TM-86548] p 76 N86-28972	
Life Sciences Space Station planning document: A	
reference payload for the Life Sciences Research Facility	
[NASA-TM-89188] p 64 N86-30302	
Historical data and analysis for the first five years of	
KSC STS payload processing	
KSC STS payload processing [NASA-TM-83105] p 77 N86-32471	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES How NASA prepared to cope with disaster p 79 A86-25866	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES How NASA prepared to cope with disaster	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES How NASA prepared to cope with disaster p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES How NASA prepared to cope with disaster p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES How NASA prepared to cope with disaster p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES How NASA prepared to cope with disaster p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES How NASA prepared to cope with disaster p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES How NASA prepared to cope with disaster p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-26725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle development p 11 A86-46425 Space shuttle descent design: From development to	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES How NASA prepared to cope with disaster p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle development p 11 A86-46425 Space shuttle design: From development to operations p 24 N86-15197	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES How NASA prepared to cope with disaster p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle development p 11 A86-46425 Space shuttle descent design: From development to operations p 24 N86-15197 National Aeronautics and Space Administration p 96 N86-31450	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES How NASA prepared to cope with disaster p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle descent design: From development to operations p 24 N86-15197 National Aeronautics and Space Administration	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES p 79 A86-25866 How NASA prepared to cope with disaster p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle p 55 A86-28725 Cost containment and KSC Shuttle facilities or cost containment and Aerospace construction The decision to develop the Space Shuttle p 58 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle development p 11 A86-46425 Space shuttle descent design: From development to operations p 24 National Aeronautics and Space Administration p 96 N86-31450 NASA Facts: Space Shuttle food systems [NF-150/1-86] p 9 N86-32102 SPACE STATION POWER SUPPLIES p 9 N86-32102	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES p 79 A86-25866 How NASA prepared to cope with disaster p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle descent design: From development to operations p 24 N86-15197 National Aeronautics and Space Administration p 96 N86-31450 NASA Facts: Space Shuttle for systems [NF-150/1-86] p 9 N86-32102	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES how NASA prepared to cope with disaster p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-25826 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle development p 11 A86-46425 Space Shuttle descent design: From development to operations p 24 N86-15197 National Aeronautics and Space Administration p 96 N86-31450 NASA Facts: Space Shuttle dosystems p 9 N86-32102 SPACE STATION POWER SUPPLIES Electric power management and distribution for air and space applications p 17 A86-24828 SPACE STATIONS p 17 A86-24828	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-268725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle deseent design: From development to operations p 24 N86-15197 National Aeronautics and Space Administration p 98 N86-31450 NASA Facts: Space Shuttle food systems [NF-150/1-86] p 9 N86-32102 SPACE STATION POWER SUPPLIES Electric power management and distribution for air and space applications p 17 A86-24828 SPACE STATIONS p 17 A86-24828 SPACE STATIONS p 17 A86-24828	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES How NASA prepared to cope with disaster p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle design: From development to operations p 24 N86-15197 National Aeronautics and Space Administration p 96 N86-31450 NASA Facts: Space Shuttle food systems [NF-150/1-86] p 9 N86-32102 SPACE STATION POWER SUPPLIES Electric power management and distribution for air and space applications p 17 A86-24828 SPACE STATIONS Automation and robotics for the Space Station - Recommendations p 27 A86-10200 The Space Station Polar Platforms - Integrating research	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-26825 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle development p 11 A86-46425 Space Shuttle descent design: From development to operations p 24 N86-15197 National Aeronautics and Space Administration p 96 N86-31450 NASA Facts: Space Shuttle food systems [NF-150/1-86] p 9 N86-312102 SPACE STATION POWER SUPPLIES P 9 N86-312102 SPACE STATION POWER SUPPLIES Automation and robotics for the Space Station - Necommendations p 27 A86-10200 The Space Station Polar Platforms - Integrating research and operational missions [AIA PAPER 85-3000] p 49 A86-12935	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES mow NASA prepared to cope with disaster p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle concept p 55 A86-2813 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle descent design: From development to operations p 11 A86-46425 Space shuttle descent design: From development to operations p 24 N86-31450 NASA Facts: Space Shuttle food systems [NF-150/1-86] p 9 N86-32102 SPACE STATION POWER SUPPLIES Electric power management and distribution for air and space applications p 17 A86-24828 SPACE STATIONS Automation and robotics for the Space Station - Recommendations p 27 A86-10200 The Space Station Polar Platforms - Integrating research and operational missions [AIA PAPER 85-3000] p 49 A86-12335	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-268725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle development p 11 A86-46425 Space Shuttle descent design: From development to operations p 24 N86-15197 National Aeronautics and Space Administration p 96 N86-31450 NASA Facts: Space Shuttle food systems [NF-150/1-86] p 9 N86-312102 SPACE STATION POWER SUPPLIES P 9 N86-312102 SPACE STATIONS p 17 A86-24828 SPACE STATIONS p 27 A86-10200 Automation and robotics for the Space Station - Recommendations p 27 A86-10200 The Space Station Polar Platforms - Integrating research and operational missions [AlA PAPER 85-3000] p 49 A86-12935	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES How NASA prepared to cope with disaster p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle Space Shuttle development p 11 A86-46425 Space shuttle development p 11 A86-46425 Space shuttle descent design: From development to operations p 96 N86-31450 NASA Facts: Space Shuttle food systems [NF-150/1-86] p 9 N86-32102 SPACE STATION POWER SUPPLES Electric power management and distribution for air and space applications p 27 A86-12828 SPACE STATIONS Automation and robotics for the Space Station - Recommendations p 27 A86-12935 The Space Station Polar Platforms - Integrating research and operational missions [AIAA PAPER 85-3000] p 49 A86-12935 The Space Station program definition and preliminary systems design - Recent developments	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle development p 11 A86-46425 Space Shuttle development p 11 A86-46425 Space Shuttle descent design: From development to operations p 24 N86-15197 National Aeronautics and Space Administration p 96 N86-31450 NASA Facts: Space Shuttle food systems [NF-150/1-86] p 9 N86-31202 SPACE STATION POWER SUPPLIES Electric power management and distribution for air and space applications p 17 A86-24828 SPACE STATIONS p 27 A86-10200 The Space Station Polar Platforms - Integrating research and operational missions [AIAA PAPER 85-3000] p 49 A86-12935 The Space Station polar Plat	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES How NASA prepared to cope with disaster p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle space Shuttle development p 11 A86-46425 Space shuttle descent design: From development to operations p 24 N86-15197 National Aeronautics and Space Administration p 96 N86-31450 SPACE STATION POYER SUPPLES Electric power management and distribution for air and space applications p 17 A86-24828 SPACE Station Poler Supplies Automation and robotics for the Space Station - Recommendations p 27 A86-12935 The Space Station Polar Platforms - Integrating research and operational missions [AIAA PAPER 85-3000] p 49 A86-12935 The Space Station Program definition and preliminary systems design - Recent developments [IAF PAPER 85-18] p 50 A86-15611 An overview of the Space Station Technology/Advanced Development Program	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-268725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle development p 11 A86-46425 Space Shuttle development p 11 A86-46425 Space Shuttle descent design: From development to operations p 24 N86-15197 National Aeronautics and Space Administration p 96 N86-31450 NASA Facts: Space Shuttle food systems [NF-150/1-86] p 9 N86-31420 SPACE STATION POWER SUPPLIES Electric power management and distribution for air and space applications p 17 A86-24828 SPACE STATIONS Automation and robotics for the Space Station - Recommentation Polar Platforms - Integrating research and operational missions [AIAA PAPER 85-3000] p 49 A86-12935 The Space Station Polar Pla	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle p 53 A86-28725 Low cost access to space - A second-generation Shuttle p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle development p 14 A86-46425 Space shuttle descent design: From development to operations p 96 N86-15197 National Aeronautics and Space Administration p 96 N86-32102 SPACE STATION POWER SUPPLIES Electric power management and distribution for air and space applications p 17 A86-24828 SPACE STATION POWER SUPPLIES Electric power management and distribution for air and space applications p 27 A86-12030 The Space Station Polar Platforms - Integrating research and operational missions [AIAA PAPER 85-3000] p 49 A86-12935 The Space Station program definition and preliminary systems design - Recent developments [IAF PAPER 85-18] p 50 A86	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle development p 11 A86-46425 Space Shuttle development p 11 A86-46425 Space Shuttle descent design: From development to operations p 24 N86-15197 National Aeronautics and Space Administration p 96 N86-31450 NASA Facts: Space Shuttle food systems [NF-150/1-86] p 9 N86-32102 SPACE STATION POWER SUPPLIES Electric power management and distribution for air and space applications p 17 A86-24828 SPACE STATIONS p 27 A86-10200 The Space Station Polar Platorms - Integrating research and operational missions [AlAA PAPER 85-300] p 49 A86-15201 [IAF PAPER 85-18] <	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-268725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle development p 11 A86-46425 Space Shuttle descent design: From development to operations p 24 N86-15197 National Aeronautics and Space Administration p 96 N86-31450 NASA Facts: Space Shuttle food systems [NF-150/1-86] p 9 N86-312102 SPACE STATION POWER SUPPLIES Electric power management and distribution for air and space applications p 27 A86-10200 The Space Station Polar Platforms - Integrating research and operational missions [A47 PAPER 85-3000] p 49 A86-15235 The Space Station program definition and preliminary systems design - Recent developments [IAF PAPER 85-45] p 72 A86-15611 An ov	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES p 79 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-25866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-44404 Space Shuttle development p 11 A86-46425 Space shuttle development p 11 A86-46425 Space shuttle descent design: From development to operations p 24 N86-15197 National Aeronautics and Space Administration p 9 N86-31450 NASA Facts: Space Shuttle food systems [NF-150/1-86] p 9 N86-32102 SPACE STATION POWER SUPPLIES Electric power management and distribution for air and space applications p 17 A86-24828 SPACE Station POWER SUPPLIES Electric power management and distribution for air and space applications p 27 A86-10200 The Space Station Polar Platforms - Integrating research and operational missions [Atomation and robotics for the Sp	
[NASA-TM-83105] p 77 N86-32471 SPACE SHUTTLES p 79 A86-2866 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Low cost access to space - A second-generation Shuttle concept p 55 A86-28725 Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989 The decision to develop the Space Shuttle p 58 A86-4404 Space Shuttle development p 11 A86-486-4869 Space Shuttle development p 14 A86-486-4809 Nasa Facts: Space Shuttle food systems [NF-150/1-86] p 9 N86-31450 SPACE STATION POWER SUPPLIES Electric power management and distribution for air and space applications p 17 A86-24828 SPACE STATION POWER SUPPLIES Electric power management and distribution for air and space applications p 27 A86-12030 The Space Station Polar Platforms - Integrating research and operational missions [AIAA PAPEH 85-300] p 49 A86-12935 [IAF PAPER 85-18] p 50 A86-15611 An overivew of the Space Station Technology/Advanced Developmen	

SPACE STATIONS

Space stations and space platforms	
infrastructure, and uses Introduction - Space Station an	p 51 A86-17301 d platform roles in
supporting future space endeavors	p 51 A86-17307
Astronomy and the Space Station	p 51 A86-17308
Space station program operations [AAS PAPER 84-112]	s - Making it work p 72 A86-17318
Future uses of machine intelligence	
Space Station and implications for the	e U.S. economy
Robotics and the space station	p 29 A86-20426 p 29 A86-20507
Have factory, will launch	p 16 A86-20507
Europe - Towards a new long-tern	
space	p 85 A86-22242
International involvement in the programme	p 85 A86-22244
Science requirements for Space	Station Laboratory
[SAE PAPER 851368] Space Station life sciences guideli	p 52 A86-23552
experiment accommodation	
[SAE PAPER 851370]	p 52 A86-23553
Automated subsystems control dev support systems of space station	eropment for the
[SAE PAPER 851379]	p 10 A86-23561
Electric power management and dis space applications	p 17 A86-24828
Space Station planning	p // //00 24020
[AAS 85-111]	p 73 A86-28581
ESA Space Station planning [AAS 85-113]	p 86 A86-28582
Japanese policy on participation in	
program [AAS 85-114]	p 86 A86-28583
Space Station - The first step	p 00 , 100 20000
[AAS 84-160]	p 87 A86-28786
Beyond the Space Station [AAS 84-161]	p 53 A86-28787
Maintainability planning for the Space	e Station
[AIAA PAPER 86-9754] Artificial intelligence - NASA ro	p 73 A86-32095
Station	p 30 A86-32538
Space Station Advanced Developm	
Threat-strategy technique - A syst	p 55 A86-32543 tern safety tool for
advanced design in Space Station	hazard analysis
Commerce Lab - A program of	p 79 A86-32947 commercial flight
opportunities	p 56 A86-34965
Internationalization of the Space Sta	ation p 56 A86-34974
Information sustants in anothe	
Information systems in space	p 39 A86-34981
Space Station design-to-cost - A m	p 39 A86-34981
Space Station design-to-cost - A m challenge	p 39 A86-34981 assive engineering
Space Station design-to-cost - A m	p 39 A86-34981 hassive engineering p 20 A86-35216 rdles
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu	p 39 A86-34981 hassive engineering p 20 A86-35216 rdles p 31 A86-37047
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 vace structures p 21 A86-37060
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 vace structures p 21 A86-37060 p 57 A86-37853
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 vace structures p 21 A86-37060 p 57 A86-37853
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 vace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 pace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 vace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000 ace Station p 59 A86-44530
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Space	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 vace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000 ace Station p 59 A86-44530
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303]	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 vace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000 ace Station p 59 A86-44530 re Station Health p 59 A86-46938
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303] Space Station operations in the	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 bace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000 ace Station p 59 A86-44530 twenty-first century
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303]	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 vace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000 ace Station p 59 A86-44530 ve Station Health p 59 A86-46938 twenty-first century p 74 A86-46951
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Space Station operations in the [AIAA PAPER 86-2328] An Operations Management Sys Station	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 bace structures p 21 A86-37060 p 57 A86-37870 sof automation and p 31 A86-37870 sof automation and p 31 A86-41000 ace Station p 59 A86-46308 twenty-first century p 74 A86-46951 tem for the Space
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2328] An Operations Management Sys Station [AIAA PAPER 86-2329]	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 vace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000 ace Station p 59 A86-44530 ve Station Health p 59 A86-46938 twenty-first century p 74 A86-46951
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Space Station operations in the [AIAA PAPER 86-2328] An Operations Management Sys Station [AIAA PAPER 86-2329] Space Station - Life sciences [AIAA PAPER 86-2346]	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 bace structures p 21 A86-37060 p 57 A86-37870 sof automation and p 31 A86-37870 sof automation and p 31 A86-41000 ace Station p 59 A86-46308 twenty-first century p 74 A86-46951 tem for the Space p 40 A86-46950
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303] Space Station operations in the [AIAA PAPER 86-2328] An Operations Management Sys Station [AIAA PAPER 86-2329] Space Station - Life sciences [AIAA PAPER 86-2346] An economics perspective of the 2	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 bace structures p 21 A86-37060 p 57 A86-37870 sof automation and p 31 A86-37870 sof automation and p 31 A86-41000 ace Station p 59 A86-46308 twenty-first century p 74 A86-46951 tem for the Space p 40 A86-46950
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Space Station operations in the [AIAA PAPER 86-2328] An Operations Management Sys Station [AIAA PAPER 86-2329] Space Station - Life sciences [AIAA PAPER 86-2346]	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 vace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-378570 s of automation and p 31 A86-41000 ace Station p 59 A86-46388 twenty-first century p 74 A86-46951 tem for the Space p 40 A86-46960 21st century Space
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303] Space Station operations in the [AIAA PAPER 86-2328] An Operations Management Sys Station [AIAA PAPER 86-2346] An economics perspective of the 2 Station [AIAA PAPER 86-2348] EOS production on the Space Station	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 bace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000 ace Station p 59 A86-46308 twenty-first century p 74 A86-46951 tem for the Space p 40 A86-46952 p 60 A86-46960 21st century Space p 70 A86-46961
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Space Maintenance Facility [AIAA PAPER 86-2328] An Operations Management Sys Station [AIAA PAPER 86-2329] Space Station - Life sciences [AIAA PAPER 86-2328] An economics perspective of the 2 Station [AIAA PAPER 86-2348] EOS production on the Space Station Operations/Space	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 vace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000 ace Station p 59 A86-44530 we Station Health p 59 A86-46988 twenty-first century p 74 A86-46952 p 40 A86-46952 p 60 A86-46960 21st century Space p 70 A86-46961 n Electrophoresis
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303] Space Station operations in the [AIAA PAPER 86-2328] An Operations Management Sys Station [AIAA PAPER 86-2346] An economics perspective of the 2 Station [AIAA PAPER 86-236] An economics perspective of the 2 Station [AIAA PAPER 86-236] An economics perspective of the 2 Station [AIAA PAPER 86-236] Automation and robotics for Spa	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 bace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000 ace Station p 59 A86-46308 twenty-first century p 74 A86-46951 tem for the Space p 40 A86-46952 p 60 A86-46960 21st century Space p 70 A86-46961 n Electrophoresis p 22 A86-46964
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Space Station operations in the [AIAA PAPER 86-2328] An Operations Management Sys Station [AIAA PAPER 86-2328] An economics perspective of the 2 Station [AIAA PAPER 86-2348] EOS production on the Space Station [AIAA PAPER 86-2348] EOS production on the Space Station Operations/Space [AIAA PAPER 86-2358] Automation and robotics for Spa twenty-first century	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 vace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000 ace Station p 59 A86-46308 twenty-first century p 74 A86-46938 twenty-first century p 74 A86-46952 p 60 A86-46960 21st century Space p 70 A86-46961 Electrophoresis p 22 A86-46964 to Station in the
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Space Station operations in the [AIAA PAPER 86-2329] Space Station - Life sciences [AIAA PAPER 86-2329] Space Station [AIAA PAPER 86-2326] An operations Management Sys Station [AIAA PAPER 86-2326] An economics perspective of the 2 Station [AIAA PAPER 86-2328] EOS production on the Space Station Operations/Space [AIAA PAPER 86-2358] Automation and robotics for Spat twenty-first century [AIAA PAPER 86-2300]	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 bace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000 ace Station p 59 A86-46308 twenty-first century p 74 A86-46951 tem for the Space p 40 A86-46952 p 60 A86-46960 21st century Space p 70 A86-46961 n Electrophoresis p 22 A86-46964
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Space Station operations in the [AIAA PAPER 86-2328] An Operations Management Sys Station [AIAA PAPER 86-2328] An Operations perspective of the 2 Station [AIAA PAPER 86-2328] An economics perspective of the 2 Station [AIAA PAPER 86-2328] An economics perspective of the 2 Station [AIAA PAPER 86-2328] An economics perspective of the 2 Station [AIAA PAPER 86-2328] Automation and robotics for Spa twenty-first century [AIAA PAPER 86-2300] Space Station in the 21st ce perspective	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 vace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000 ace Station p 59 A86-46308 twenty-first century p 74 A86-46951 tem for the Space p 40 A86-46952 p 60 A86-46960 21st century Space p 70 A86-46961 Electrophoresis p 22 A86-46964 tce Station in the p 40 A86-49552 ntury - A social
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Space Station operations in the [AIAA PAPER 86-2329] Space Station - Life sciences [AIAA PAPER 86-2329] Space Station - Life sciences [AIAA PAPER 86-2346] An economics perspective of the 2 Station [AIAA PAPER 86-2348] EOS production on the Space Statior Operations/Space [AIAA PAPER 86-2358] Automation and robotics for Spa twenty-first century [AIAA PAPER 86-2300] Space Station in the 21st ce perspective [AIAA PAPER 86-2349]	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 bace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000 ace Station p 59 A86-46530 be Station Health p 59 A86-46951 tem for the Space p 40 A86-46952 p 60 A86-46960 21st century Space p 70 A86-46961 n Electrophoresis p 22 A86-46964 toe Station in the p 40 A86-49552 ntury - A social p 11 A86-50265
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Space Station operations in the [AIAA PAPER 86-2328] An Operations Management Sys Station [AIAA PAPER 86-2329] Space Station - Life sciences [AIAA PAPER 86-2346] An economics perspective of the 2 Station [AIAA PAPER 86-2346] An economics perspective of the 2 Station [AIAA PAPER 86-2348] EOS production on the Space Station Operations/Space [AIAA PAPER 86-2368] Automation and robotics for Spa twenty-first century [AIAA PAPER 86-2300] Space Station in the 21st ce perspective [AIAA PAPER 86-2349] Computational structural mechanics the NASA Langley Research Center	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 21 A86-37047 vace structures p 21 A86-37060 p 57 A86-37870 s of automation and p 57 A86-37870 s of automation and p 57 A86-37870 s of automation and p 59 A86-46300 ace Station p 59 A86-46938 twenty-first century p 74 A86-46951 tem for the Space p 40 A86-46952 p 60 A86-46960 21 st century Space p 70 A86-46961 n Electrophoresis p 22 A86-46964 to a Station in the p 40 A86-49522 ntury - A social p 11 A86-50265 are Anew activity at
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Space Station operations in the [AIAA PAPER 86-2329] Space Station - Life sciences [AIAA PAPER 86-2329] Space Station - Life sciences [AIAA PAPER 86-2329] Space Station - Life sciences [AIAA PAPER 86-2328] An economics perspective of the 2 Station [AIAA PAPER 86-2328] An economics perspective of the 2 Station [AIAA PAPER 86-2328] Automation and robotics for Spa twenty-first century [AIAA PAPER 86-2300] Space Station in the 21st ce perspective [AIAA PAPER 86-2349] Computational structural mechanics the NASA Langley Research Center [NASA-TM-87612]	p 39 A86-34981 assive engineering p 20 A86-35216 rdles p 31 A86-37047 bace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000 ace Station p 59 A86-44530 be Station Health p 59 A86-46951 tem for the Space p 40 A86-46951 p 60 A86-46952 p 60 A86-46960 21st century Space p 70 A86-46961 n Electrophoresis p 22 A86-46964 toe Station in the p 40 A86-49552 ntury - A social p 11 A86-50265 c: A new activity at p 23 N86-11540
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Space Station operations in the [AIAA PAPER 86-2328] An Operations Management Sys Station [AIAA PAPER 86-2329] Space Station - Life sciences [AIAA PAPER 86-2346] An economics perspective of the 2 Station [AIAA PAPER 86-2346] An economics perspective of the 2 Station [AIAA PAPER 86-2346] An economics for Space Station Operations/Space [AIAA PAPER 86-2368] Automation and robotics for Spa twenty-first century [AIAA PAPER 86-2300] Space Station in the 21st ce perspective [AIAA PAPER 86-2349] Computational structural mechanics the NASA Langley Research Center [NASA-TM-87612] Government-to-government coo station development	p 39 A86-34981 lassive engineering p 20 A86-35216 rdles p 31 A86-37047 vace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000 ace Station p 59 A86-4630 es Station Health p 59 A86-46938 twenty-first century p 74 A86-46951 tem for the Space p 40 A86-46952 p 60 A86-46960 est century Space p 70 A86-46961 n Electrophoresis p 22 A86-46964 loce Station in the p 40 A86-49525 ntury - A social p 11 A86-50265 es A new activity at p 23 N86-11540 peration in space p 91 N86-15166
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Space Station operations in the [AIAA PAPER 86-2329] An Operations Management Sys Station [AIAA PAPER 86-2329] Space Station - Life sciences [AIAA PAPER 86-2328] An economics perspective of the 2 Station [AIAA PAPER 86-2328] An economics perspective of the 2 Station [AIAA PAPER 86-2328] Automation and robotics for Spa twenty-first century [AIAA PAPER 86-2358] Automation and robotics for Spa twenty-first century [AIAA PAPER 86-2300] Space Station in the 21st ce perspective [AIAA PAPER 86-2349] Computational structural mechanics the NASA Langley Research Center [NASA-TM-87612] Government-to-government coo station development Technical and management inform	p 39 A86-34981 assive engineering p 20 A86-35216 crdles p 31 A86-37047 bace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000 ace Station p 59 A86-44530 be Station Health p 59 A86-46951 tem for the Space p 40 A86-46951 tem for the Space p 40 A86-46952 p 60 A86-46960 21st century Space p 70 A86-46961 n Electrophoresis p 22 A86-46964 toe Station in the p 40 A86-49552 ntury - A social p 11 A86-50265 the A86-11540 p 23 N86-11540 p 91 N86-15166 alion system: The
Space Station design-to-cost - A m challenge [SAWE PAPER 1673] Space telerobotics - A few more hu Construction and control of large sp The U.S. Space Station program Present and future prospects of mic Evaluating Space Station application robotics Status of ESA's planning for the Sp An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] Space Station operations in the [AIAA PAPER 86-2328] An Operations Management Sys Station [AIAA PAPER 86-2329] Space Station - Life sciences [AIAA PAPER 86-2346] An economics perspective of the 2 Station [AIAA PAPER 86-2346] An economics perspective of the 2 Station [AIAA PAPER 86-2346] An economics for Space Station Operations/Space [AIAA PAPER 86-2368] Automation and robotics for Spa twenty-first century [AIAA PAPER 86-2300] Space Station in the 21st ce perspective [AIAA PAPER 86-2349] Computational structural mechanics the NASA Langley Research Center [NASA-TM-87612] Government-to-government coo station development	p 39 A86-34981 assive engineering p 20 A86-35216 crdles p 31 A86-37047 bace structures p 21 A86-37060 p 57 A86-37853 rogravity p 57 A86-37870 s of automation and p 31 A86-41000 ace Station p 59 A86-44530 be Station Health p 59 A86-46951 tem for the Space p 40 A86-46951 tem for the Space p 40 A86-46952 p 60 A86-46960 21st century Space p 70 A86-46961 n Electrophoresis p 22 A86-46964 toe Station in the p 40 A86-49552 ntury - A social p 11 A86-50265 the A86-11540 p 23 N86-11540 p 91 N86-15166 alion system: The

SPACE TECHNOLOGY EXPERIMENTS

p 90 A86-44540

p 92 N86-21453

Contractual and related agreements required for a

The broker's role in space insurance

Assured access to space during the 1990's

satellite launch

[GPO-53-617]

SPACECRAFT PERFORMANCE

SPACE TECHNOLOGY EXPERIMENTS	
Group structure and group process for effective space	Science requirements for Space Station Laboratory
station astronaut teams p 5 N86-15186	[SAE PAPER 851368] p 52 A86-23552
Space crew productivity: A driving factor in space station	Space Station life sciences guidelines for nonhuman
design p 5 N86-15187 Research and technology	experiment accommodation [SAE PAPER 851370] p 52 A86-23553
[NASA-TM-83099] p 62 N86-17265	NASA centers will stimulate industry R & D
Development of space technology for ecological	p 73 A86-24128
habitats p 63 N86-19943 Assured access to space during the 1990's	A 3M/NASA basic research program in space
[GPO-53-617] p 92 N86-21453	p 52 A86-27896 Spacelab 3 mission - Broadening horizons in space
Space station: The role of software	research p 56 A86-34967
p 43 N86-23315 A computer modeling methodology and tool for	Interactive mission planning for a Space Shuttle flight
assessing design concepts for the Space Station Data	experiment - A case history p 56 A86-37187 Present and future prospects of microgravity
Management System	p 57 A86-37870
[NASA-TM-87647] p 43 N86-24737	Electrophoresis operations in space - A promising new
Tether applications for space station p 76 N86-28418	commercial venture p 59 A86-44548 Horizon 2000 and its relation to the Columbus
Space teleoperation research. American Nuclear	Programme p 59 A86-45643
Society Executive conference: Remote operations and	Space Station - Life sciences
robotics in the nuclear industry; remote maintenance in other hostile environments	[AIAA PAPER 86-2346] p 60 A86-46960
[NASA-TM-89234] p 35 N86-29513	SPACEBORNE LASERS NASA plans for spaceborne lidar - The Earth Observing
Life Sciences Space Station planning document: A	System p 59 A86-46763
reference payload for the Life Sciences Research Facility	SPACEBORNE TELESCOPES Systems engineering - Space Telescope project
[NASA-TM-89188] p 64 N86-30302	p 16 A86-19525
Evaluating space station applications of automation and	The role of scientists in developing Hubble Space
robotics technologies from a human productivity point of	Telescope p 51 A86-19526
view p 14 N86-31412 SPACE TECHNOLOGY EXPERIMENTS	Future space telescope design concepts p 23 N86-11107
Space technology today p 60 A86-47052	SPACECRAFT COMMUNICATION
SPACE TRANSPORTATION	The space industry for communications and remote
Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725	sensing [AAS 85-136] p 52 A86-28593
National space transportation and support	SPACECRAFT COMPONENTS
study/mission requirements and architecture studies	Reliability prediction for spacecraft
[AIAA PAPER 86-1211] p 11 A86-40602 A fully reusable faunch vehicle for Europe?	[AD-A164747] p 81 N86-26359 SPACECRAFT CONSTRUCTION MATERIALS
p 59 A86-44543	The application of composites to space structures:
Regulatory aspects of commercial, space	Guidelines on important aspects for the designer
transportation p 91 N86-17409 A cost analyst's guide to satellite autonomy and	p 76 N86-30759
fault-tolerant computing	Data for selection of space materials [ESA-PSS-01-701-ISSUE-1] p 77 N86-32584
[AD-A161853] p 71 N86-23630	SPACECRAFT CONTAMINATION
A study of factors related to commercial space platform	Environmental management of payload processing
services [NASA-CR-176881] p 96 N86-30744	facilities (AIAA PAPER 85-6067) p 78 A86-17602
SPACE TRANSPORTATION SYSTEM	SPACECRAFT CONTROL
Environmental management of payload processing facilities	Expert systems for Space Station automation
[AIAA PAPER 85-6067] p 78 A86-17602	p 28 A86-14548 An Operations Management System for the Space
Future operational plans for the National Space	Station
Transportation System [AIAA PAPER 86-0090] p 72 A86-19685	[AIAA PAPER 86-2329] p 40 A86-46952 SPACECRAFT DEFENSE
National space transportation systems planning	Primer on operating and support (O and S) costs for
p 54 A86-32527	space systems
Integrated logistics support - Five key areas of engineering technology in space p 73 A86-32930	[AD-A162381] p 71 N86-24588
Logistics support economy and efficiency through	SPACECRAFT DESIGN The Space Station program definition and preliminary
consolidation and automation p 74 A86-34956	systems design - Recent developments
The U.S. civil space program: A Review of the major issues Report of an AIAA Workshop, Alexandria, VA, July	[IAF PAPER 85-18] p 50 A86-15611
22, 23, 1986 Book p 60 A86-47648	Space stations and space platforms - Concepts, design, infrastructure, and uses p 51 A86-17301
R and D Productivity: New Challenges for the US Space	How NASA prepared to cope with disaster
Program [NASA-TM-87520] p 61 N86-15157	p 79 A86-25866
The key to successful management of STS operations:	Mission strategy and spacecraft design for a Mars base program
An integrated production planning system	[AAS 84-169] p 53 A86-28795
p 12 N86-15161 Streamlining: Reducing costs and increasing STS	Spacecraft 2000
operations effectiveness p 5 N86-15194	[AIAA PAPER 86-0616] p 18 A86-29586 Space Station design-to-cost - A massive engineering
Space shuttle descent design: From development to	challenge
operations p 24 N86-15197 Research and technology	[SAWE PAPER 1673] p 20 A86-35216
[NASA-TM-83099] p 62 N86-17265	Space Station evolution - The uncertainty principle prevails p 60 A86-48373
Assured access to space during the 1990's	Actions to implement the recommendations of the
[GPO-53-617] p 92 N86-21453	Presidential Commission on the Space Shuttle Challenger
National Aeronautics and Space Administration p 96 N86-31450	Accident. Report to the President p 94 N86-27352 The suitability of various spacecraft for future space
Historical data and analysis for the first five years of	applications missions
KSC STS payload processing	[NASA-TM-88986] p 64 N86-27409
[NASA-TM-83105] p 77 N86-32471	Activities report in aerospace research [ETN-86-97190] p 64 N86-28907
SPACE TRANSPORTATION SYSTEM FLIGHTS Interactive mission planning for a Space Shuttle flight	SPACECRAFT ENVIRONMENTS
experiment - A case history p 56 A86-37187	Shuttle environment database
SPACEBORNE ASTRONOMY	[AAS 85-103] p 39 A86-28578 Group structure and group process for effective space
Astronomy and the Space Station p 51 A86-17308	station astronaut teams p 5 N86-15186
Future space telescope design concepts p 23 N86-11107	SPACECRAFT GUIDANCE Space shuttle descent design: From development to
SPACEBORNE EXPERIMENTS	sugge source rescent design: From development to
Space Station utilization for technology purposes [IAF PAPER 85-50] p 50 A86-15636	operations p 24 N86-15197 SPACECRAFT LAUNCHING Underwriters worldwide incurred \$600 million in

A design for fluid management in space [IAF PAPER ST-85-04] p 50 A86-15949 insurance

A-26

unexpected losses, signifying changes ahead in space p 85 A86-24122

Ariane and Arianespace status and capability AIAA PAPER 86-0671] p 18 A86-29668 SPACECRAFT POWER SUPPLIES Electric power management and distribution for air and p 17 A86-24828 space applications Space power systems - 'Spacecraft 2000' p 52 A86-24836 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 2 [NASA-CR-174979] p 24 N86-16452 SPACECRAFT PROPULSION Nuclear power for earth orbit and beyond p 57 A86-38623 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 2 p 24 N86-16452 [NASA-CR-174979] SPACECRAFT RELIABILITY p 90 A86-46375 Something has to change Reliability prediction for spacecraft [AD-A164747] p 81 N86-26359 Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 2 [AD-A171403] n 95 N86-28974 SPACECRAFT STRUCTURES Structures in space - Contractors adapt earth-based construction methods to microgravity p 17 A86-24106 The application of composites to space structures: Guidelines on important aspects for the designer p 76 N86-30759 SPACECRAFT SURVIVABILITY Threat-strategy technique - A system safety tool for advanced design --- in Space Station hazard analysis p 79 A86-32947 SPACECRAFT TRACKING Report on active and planned spacecraft and experiments [NASA-TM-87499] p 61 N86-13343 SPACECREWS Human roles in future space systems [AAS PAPER 84-117] p 1 A86-17320 A review of the psychological aspects of space flight p 2 A86-29090 Group structure and group process for effective space station astronaut teams p 5 N86-15186 Astronauts and cosmonauts biographical and statistical data, revised June 28, 1985 [GPO-52-498] p 7 N86-21499 SPACELAB Spacelab 3 mission - Broadening horizons in space p 56 A86-34967 research SPACELAB PAYLOADS Spacelab Hitchhiker, for rapid, low cost orbital p 56 A86-34991 resources SPARE PARTS Spare parts pricing - Impact on logistics support p 74 A86-35647 SPEECH Exploiting sequential phonetic constraints in recognizing spoken words p 34 N86-29120 [AD-A165913] SPEECH RECOGNITION Exploiting sequential phonetic constraints in recognizing spoken words [AD-A165913] p 34 N86-29120 STANDARDS Aircraft ground support equipment standardization - The ros and cons of 'functional' vs 'technical' pros and cons of standardization [SAE PAPER 851794] AE PAPER 851794] p 79 A86-38317 Testability management through MIL-STD-2165 p 80 A86-43901 Technical activities 1983, Center for Basic Standards [PB86-140043] p 81 N86-26239 Standard reference data publications, 1964-1984 p 81 N86-26409 (PB86-1555871 STATIONKEEPING Expert systems for satellite stationkeeping p 30 A86-28497 STATISTICAL ANALYSIS Managing the data analysis progress p 44 N86-26005 The group consensus problem [AD-A164064] p 7 N86-26078

STATISTICAL TESTS Significance testing of rules in rule-based models of

p 2 A86-25038 human problem solving STELLAR EVOLUTION

The great observatories for space astrophysics IASA-CR-176754] p 63 N86-24712 [NASA-CR-176754]

SUBJECT INDEX
STELLAR MASS EJECTION Extragalactic astronomy p 65 N86-31489 STORMS
NASA storm hazards research in lightning strikes to aircraft p 79 A86-37479
STRATEGIC MATERIALS Exploration for strategic materials [PB86-126463] p 75 N86-24005
STRATEGY A technique for lowering risks during contract negotiations p 57 A86-40999
STREAMLINING Streamlining: Reducing costs and increasing STS operations effectiveness p 5 N86-15194
STRESS (PSYCHOLOGY) A case study in R and D productivity: Helping the program manager cope with job stress and improve
communication effectiveness p 4 N86-15170 STRUCTURAL ANALYSIS SADDLE - A computer-aided structural analysis and
dynamic design language. I - Design system. II - Database management system p 37 A86-25999
[AIAA PAPER 86-1010] p 39 A86-38868 Computational structural mechanics: A new activity at
the NASA Langley Research Center [NASA-TM-87612] p 23 N86-11540 STRUCTURAL DESIGN
Development of a knowledge base for an expert system for design of structural parts p 20 A86-36853
ASTROS - An advanced software environment for automated design [AIAA PAPER 86-0856] p 39 A86-38807
The application of composites to space structures: Guidelines on important aspects for the designer p 76 N86-30759
STRUCTURAL DESIGN CRITERIA SADDLE - A computer-aided structural analysis and
dynamic design language. I - Design system. II - Database management system p 37 A86-25999 Next generation aircraft structures - The need for
co-ordinated Canadian R & D programs p 21 A86-39567 STRUCTURAL ENGINEERING
On a microcomputer integrated system for structural engineering practices p 21 A86-39794 STRUCTURAL WEIGHT
Starship 1 - A weight control challenge for next generation business aircraft [SAWE PAPER 1682] p 20 A86-35223
SUPERCOMPUTERS Artificial intelligence applications on supercomputers
p 40 A86-40845 SUPERNOVAE Extragalactic astronomy p 65 N86-31489
SUPERSONIC AIRCRAFT What technologies await the future airliner?
p 19 A86-31038 SUPERSONIC TRANSPORTS Tomorrow Concorde's successor?
p 17 A86-26299 SUPPORT SYSTEMS Logistics supportability considerations during conceptual
and preliminary design of aircraft [AIAA PAPER 85-3052] p 72 A86-10928
Primer on operating and support (O and S) costs for space systems
[AD-A162381] p 71 N86-24588 SURVEYS Survey of Soviet work in reliability
[AD-A167607] p 82 N86-32766 SYMBOLIC PROGRAMMING Report on the Al trip
[IR-82] p 35 N86-30397 SYMBOLS LOGMARS (logistics applications of automated marking
and reading symbols) clearinghouse, applications directory
[AD-A162327] p 75 N86-24586 SYNCHRONOUS SATELLITES Space WARC '85 - A look back p 82 A86-11023
Future world meteorological satellite systems [IAF PAPER 85-87] p 82 A86-15663 SYSTEM EFFECTIVENESS
An annotated bibliography of literature integrating organizational and systems theory [AD-A160912] p 12 N86-19249
Artificial intelligence and its use in cost type analyses with and example in cost performance measurement [AD-A161817] p 43 N86-22168
LOGMARS (logistics applications of automated marking and reading symbols) clearinghouse, applications
directory [AD-A162327] p 75 N86-24586

SYSTEMS ANALYSIS Expert systems for design and simulation [DE85-017565] p 32 p 32 N86-18053 An annotated bibliography of literature integrating organizational and systems theory [AD-A160912] p 12 N86-19249 A computer modeling methodology and tool for assessing design concepts for the Space Station Data assessing design convergis to the A Management System [NASA-TM-87647] p 43 N86-24737 Leader-follower strategies under modeling and information uncertainties p 13 N86-27950 Basic human factors considerations DE86-0081811 [DE86-000203] [DE86-008181] Information technology resources long-range plan, FY 1087.EV 1001 [DE86-010457] p 48 N86-33206 SYSTEMS ENGINEERING Requirements, development and parametric analysis for space systems division p 16 A86-10936 [AIAA PAPER 85-3078] Quality control, reliability, and engineering design -Book p 78 A86-17472 Systems engineering - Space Telescope project p 16 A86-19525 Workload measurement in system design and evaluation p 3 A86-33787 Future space telescope design concepts p 23 N86-11107 The factory of the future p 23 N86-11228 R and D Productivity: New Challenges for the US Space Program (NASA-TM-87520) NASA-TM-87520 p 61 N86-15157 The key to successful management of STS operations: An integrated production planning system p 12 N86-15161 Space crew productivity: A driving factor in space station design p 5 Expert systems for design and simulation p 5 N86-15187 [DE85-017565] p 32 N86-18053 Information Systems development aids [DE85-018161] p 42 N86-18246 Automation and the allocation of functions between human and automatic control: General method p 6 N86-20013 [AD-A161072]
 Maintenance planning for the 1990's (initial planning)

 [PB86-106010]
 p 75
 p 75 N86-22065 Computer-aided engineering [AD-A162811] p 81 N86-24256 The design and analysis of a network interface for the multi-lingual database system [AD-A1647561 p 44 N86-27121 Aeropropulsion opportunities for the 21st century [NASA-TM-88817] SYSTEMS INTEGRATION p 26 N86-31585 The blackboard model - A framework for integrating multiple cooperating expert systems [AIAA PAPER 85-5045] p 27 A86-11407 SYSTEMS MANAGEMENT Information systems in space p 39 A86-34981 A computer modeling methodology and tool for assessing design concepts for the Space Station Data Management System [NASA-TM-87647] p 43 N86-24737 SYSTEMS SIMULATION Data collection via a quasi-experimental simulation technology. Part 1: Multiple measurement of performance excellence in complex and uncertain managerial tasks [AD-A1679491 p 9 N86-32969

Ŧ

TACTILE DISCRIMINATION Sharpening the senses of industrial robots p 31 A86-40831 TASK COMPLEXITY Automation in the cockpit - Who's in charge? [SAE PAPER 841534] p 37 A86-26005 Predicted versus experienced workload and

performance on a supervisory control task p 2 A86-29879 The functional age profile - An objective decision criterion

for the assessment of pilot performance capacities and capabilities p 3 A86-31823 Data collection via a quasi-experimental simulation technology. Part 1: Multiple measurement of performance excellence in complex and uncertain managerial tasks [AD-A167949] p 9 N86-32969 Knowledge-based load leveling and task allocation in p 9 N86-32985 human-machine systems TASKS

The effects of type of knowledge upon human problem solving in a process control task p1 A86-17771

TECHNOLOGY ASSESSMENT

An analysis of the application of Al	to the c	levelopment
of intelligent aids for flight crew tasks [NASA-CR-3944]	р4	N86-12212
Allocation of tasks to robots for imp	proved	safety
[DE86-002366] Basic human factors considerations	р 33	N86-22955
[DE86-008181]	p 8	N86-31223
TDR SATELLITES The National Aeronautics and Spa	ace Ad	ministration
(NASA) Tracking and Data Relay Satell	ite Syst	em (TDRSS)
program Economic and programm [IAF PAPER 85-422]		A86-15895
TECHNICAL WRITING		
Standard generalized markup langua document interchange	age: A t	echnique for
[DE86-011504]	p 48	N86-31777
TECHNOLOGICAL FORECASTING Future U.S. meteorological satellite	evetor	e
[IAF PAPER 84-96]	p 49	A86-12361
Future world meteorological satellite [IAF PAPER 85-87]	e syster p 82	ns A86-15663
Planning for Telesat Canada's		generation
satellites [IAF PAPER 85-354]	- 10	A86-15849
Pilots of the future - Human or com	p 10 puter?	A00-15649
	p 1	A86-18541
Future of remote sensing - A viewp	p 16	A86-19489
Next-generation computers Book	р 37	A86-21317
Space power systems - 'Spacecraft	2000'	
One man and 3,000 million ope	p 52 rations	A86-24836
Preparing for the LHX cockpit	p 17	A86-24988
Tomorrow Concorde's successo	or? p17	A86-26299
2010 - The symbionic cockpit	p 18	A86-28455
Global interconnectivity in the nex scenario	t two c	lecades - A
[AIAA PAPER 86-0605]	p 54	A86-29581
Spacecraft 2000 [AIAA PAPER 86-0616]	p 18	A86-29586
What technologies await the future	airliner p 19	A86-31038
Enabling technologies for transition	n to u	
space-based resources and operation	s p 56	A86-34992
Prescription for profits	p 56	A86-35526
Which transport technologies will fly	/? p69	A86-41037
Space Station operations in the [AIAA PAPER 86-2328]		first century A86-46951
Space Station on-orbit operations f		
Century (AIAA PAPER 86-2331)	p 74	A86-46954
An economics perspective of the 2		
Station [AIAA PAPER 86-2348]		
	70 מ	A86-46961
Projections of space systems	p 70 opport	
	opport	unities and
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the	opport e perio p 60 e 1990's	unities and d A86-48451
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the [GPO-53-617] TECHNOLOGIES	opporti e perio p 60 e 1990's p 92	unities and d A86-48451 s N86-21453
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the [GPO-53-617] TECHNOLOGIES New technology implementation: T	opporte e perio p 60 e 1990's p 92 echnica	unities and d A86-48451 s N86-21453 al, economic
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the [GPO-53-617] TECHNOLOGIES New technology implementation: T and political factors TECHNOLOGY ASSESSMENT	opporte e perio p 60 9 1990's p 92 echnica p 24	unities and d A86-48451 S N86-21453 al, economic N86-15172
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the [GPO-53-617] TECHNOLOGIES New technology implementation: T and political factors	opporta e perio p 60 1990's p 92 echnica p 24 p 51	unities and d A86-48451 S N86-21453 al, economic N86-15172 A86-17672
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the [GPO-53-617] TECHNOLOGIES New technology implementation: T and political factors TECHNOLOGY ASSESSMENT Identifying technical innovations Remote sensing research - The pas	opports e period p 60 9 1990's p 92 echnica p 24 p 51 st as pro p 10	unities and d A86-48451 s N86-21453 al, economic N86-15172 A86-17672 olog A86-19487
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the [GPO-53-617] TECHNOLOGIES New technology implementation: T and political factors TECHNOLOGY ASSESSMENT Identifying technical innovations Remote sensing research - The pas Assessing the artificial intelligen decision technology	opporta e perior p 60 e 1990's p 92 echnica p 24 p 51 st as pro p 10 nce co p 29	unities and d A86-48451 s N86-21453 al, economic N86-15172 A86-15172 A86-17672 olog A86-19487 ntribution to A86-25033
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the [GPO-53-617] TECHNOLOGIES New technology implementation: T and political factors TECHNOLOGY ASSESSMENT Identifying technical innovations Remote sensing research - The pas Assessing the artificial intelliger	opporta e perio p 60 e 1990's p 92 echnica p 24 p 51 st as pri p 10 nce co p 29 i technica	unities and A86-48451 S N86-21453 at, economic N86-15172 A86-17672 olog A86-19487 ntribution to A86-25033 ology
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the [GPO-53-617] TECHNOLOGIES New technology implementation: T and political factors TECHNOLOGY ASSESSMENT Identifying technical innovations Remote sensing research - The pas Assessing the artificial intelliger decision technology Artificial intelligence - The emerging Spacecraft 2000	opport e period p 60 9 1990's p 92 echnica p 24 p 51 st as pri p 10 nce co p 29 j technic p 29 j technic	unities and d A86-48451 S N86-21453 al, economic N86-15172 A86-15172 A86-19487 ntribution to A86-25033 ology A86-26070
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the [GPO-53-617] TECHNOLOGIES New technology implementation: T and political factors TECHNOLOGY ASSESSMENT Identifying technical innovations Remote sensing research - The pas Assessing the artificial intelliger decision technology Artificial intelligence - The emerging Spacecraft 2000 [AIAA PAPER 86-0616]	opports e period p 60 e 1990's p 92 echnica p 24 p 51 st as pro- p 10 nce co p 29 j technic p 29 j technic p 29 p 18	unities and A86-48451 S N86-21453 al, economic N86-15172 A86-17672 olog A86-19487 ntribution to A86-25033 ology A86-26070 A86-29586
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the [GPO-53-617] TECHNOLOGIES New technology implementation: T and political factors TECHNOLOGY ASSESSMENT Identifying technical innovations Remote sensing research - The pas Assessing the artificial intelliger decision technology Artificial intelligence - The emerging Spacecraft 2000 [AIAA PAPER 86-0616] Selecting interrelated R&D projects i planning	opporti e perio p 60 9 1990's p 92 ecchnica p 24 p 51 st as pr p 10 nce co p 29 1 technic p 29 1 technic p 29 1 technic p 51 51 51 51 51 51 51 52 54	unities and d A86-48451 S N86-21453 al, economic N86-15172 A86-17672 olog A86-19487 ntribution to A86-29033 ology A86-29586 at chonology
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the [GPO-53-617] TECHNOLOGIES New technology implementation: T and political factors TECHNOLOGY ASSESSMENT Identifying technical innovations Remote sensing research - The pas Assessing the artificial intelliger decision technology Artificial intelligence - The emerging Spacecraft 2000 [AIAA PAPER 86-0616] Selecting interrelated R&D projects i	opporta e perio p 60 p 1990's p 92 echnica p 24 p 51 st as pro p 10 nce co p 29 j technic p 29 j technic p 29 j technic p 29 d technic p 29 d technic p 24 p 10 st as pro p 2 st as pro st as pro p 2 st as pro p 3 st as pro p 3 st as pro p 4 st as pro p 4	unities and d A86-48451 3 N86-21453 al, economic N86-15172 A86-15172 A86-15172 A86-15172 A86-15172 A86-2033 ology A86-26070 A86-29586 a technology A86-29750 ed concepts
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the [GPO-53-617] TECHNOLOGIES New technology implementation: T and political factors TECHNOLOGY ASSESSMENT Identifying technical innovations Remote sensing research - The pas Assessing the artificial intelliger decision technology Artificial intelligence - The emerging Spacecraft 2000 [AIAA PAPER 86-0616] Selecting interrelated R&D projects i planning Aerospace and electronic systems -	opporta e perio p 60 p 1990's p 92 echnica p 24 p 51 st as pri p 10 nce co p 29 j technic p 29 j technic p 29 p 18 in space p 54 Advanc (4, 15,	unities and d A86-48451 S N86-21453 al, economic N86-15172 A86-17672 olog A86-19487 ntribution to A86-29038 ology A86-29580 A86-29580 Stechnology A86-29750 ed concepts of the Sixth 1984
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the [GPO-53-617] TECHNOLOGIES New technology implementation: T and political factors TECHNOLOGY ASSESSMENT Identifying technical innovations Remote sensing research - The pas Assessing the artificial intelliger decision technology Artificial intelligence - The emerging Spacecraft 2000 [AIAA PAPER 86-0616] Selecting interrelated R&D projects i planning Aerospace and electronic systems - and pioneering perspectives; Procee	opport:	unities and d A86-48451 3 N86-21453 A86-12453 A86-15172 A86-17672 olog A86-17672 olog A86-19487 ntribution to A86-2930 ology A86-29586 a technology A86-29586 a technology A86-29586 a technology A86-29586 a technology A86-29586 a technology A86-29586 a technology A86-29586 a technology A86-29586 a technology A86-29586 a technology A86-29588 a technology A86-29588 a technology A86-31253 a technology A86-31
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the [GPO-53-617] TECHNOLOGIES New technology implementation: T and political factors TECHNOLOGY ASSESSMENT Identifying technical innovations Remote sensing research - The pas Assessing the artificial intelliger decision technology Artificial intelligence - The emerging Spacecraft 2000 [AIAA PAPER 86-0616] Selecting interrelated R&D projects i planning Aerospace and electronic systems - and pioneering perspectives; Procee Symposium, Dayton, OH, November 1	opporti p p 60 p 900'; p 92 echnicc p 24 p 51 st as pr p 10 cc co p 29 p 18 n space p 52 p 24 p 51 st as pr p 20 p 24 p 24 p 24 p 24 p 25 p 24 p 29 p 29 p 20 p 24 p 29 p 20 p 24 p 29 p 20 p 30 p 51 p 51 p 51 p 51 p 50 p 51 p 51 p 51 p 51 p 51 p 54 Advanc p 19 p 19 p 70 p 19 p 19 p 10 p 10	unities and d A86-48451 3 N86-21453 al, economic N86-15172 A86-17672 olog A86-19487 ntribution to A86-25033 ology A86-26070 A86-29586 etechnology A86-29750 ed concepts of the Sixth 1984 A86-31253 :s A86-31330 uctivity
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the [GPO-53-617] TECHNOLOGIES New technology implementation: T and political factors TECHNOLOGY ASSESSMENT Identifying technical innovations Remote sensing research - The past Assessing the artificial intelliger decision technology Artificial intelligence - The emerging Spacecraft 2000 [AIAA PAPER 86-0616] Selecting interrelated R&D projects i planning Aerospace and electronic systems - and pioneering perspectives; Procee Symposium, Dayton, OH, November f X-aircraft for world leadership in aei The role of the technologist in space	opporti p eportion p 60 p 990's p 92 echnicc p 24 p 51 st as prin p 10 nce co p 52 p 18 n space p 54 p 29 p 18 n space p 59 p 19 n space p 59 n sp	unities and d A86-48451 3 N86-21453 N86-21453 A86-15172 A86-17672 olog A86-19487 ntribution to A86-29386 a technology A86-29586 a technology A86-29586 a technology A86-29586 a technology A86-31320 ctivity A86-31330 uctivity A86-34983
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the [GPO-53-617] TECHNOLOGIES New technology implementation: T and political factors TECHNOLOGY ASSESSMENT Identifying technical innovations Remote sensing research - The pas Assessing the artificial intelliger decision technology Artificial intelligence - The emerging Spacecraft 2000 [AIAA PAPER 86-0616] Selecting interrelated R&D projects i planning Aerospace and electronic systems - and pioneering perspectives; Procee Symposium, Dayton, OH, November 1 X-aircraft for world leadership in aei The role of the technologist in space The human role in space: Technolo optimization Book	opporti e perioù p 60 p 90'; p 92 echnicz p 24 p 51 st as pri p 10 c e co c p 29 p 18 an space dings c 4, 15, p 19 p 50 st as pri p 24 p 29 t echnic p 30 t	unities and d A86-48451 S N86-21453 al, economic N86-15172 A86-17672 olog A86-19487 ntribution to A86-29380 A86-29580 d technology A86-29750 ed concepts of the Sixth 1984 A86-31253 S A86-34983 shomics and A86-37037
Projections of space systems technologies for the 2000 to 2030 tim Assured access to space during the [GPO-53-617] TECHNOLOGIES New technology implementation: T and political factors TECHNOLOGY ASSESSMENT Identifying technical innovations Remote sensing research - The past Assessing the artificial intelliger decision technology Artificial intelligence - The emerging Spacecraft 2000 [AIAA PAPER 86-0616] Selecting interrelated R&D projects i planning Aerospace and electronic systems - and pioneering perspectives; Procee Symposium, Dayton, OH, November 1 X-aircraft for world leadership in aer The role of the technologist in space	opporti p e periodo p 60 p 90 p 92 echnica p 92 echnica p 24 p 51 st as pr p 92 echnica p 24 p 51 st as pr p 92 echnica p 24 p 51 st as pr p 92 echnica p 29 p 10 echnica p 39 echnica p 30 echnica p 30 echnica ec	unities and d A86-48451 3 N86-21453 N86-21453 al, economic N86-15172 A86-17672 olog A86-19487 ntribution to A86-25033 ology A86-25033 ology A86-25033 ology A86-29586 a technology A86-32950 ed concepts A86-31253 is A86-31330 uctivity A86-314330 nomics and A86-37037 ent robotic A86-37037

co-ordinated Canadian R & D programs

Space technology and resource management

p 21 A86-39567

p 58 A86-41981

TECHNOLOGY TRANSFER

Development history of the Space Shuttle Main
Engine
[AIAA PAPER 86-1635] p 21 A86-42764 State of the art in intelligent/brilliant robots
p 32 A86-43884
Tough composite materials: Recent developments Book p 22 A86-45300
Space technology today p 60 A86-47052
The role of laser technology in materials processing and nondestructive testing in the 21st century
p 75 A86-47139
Space Station in the 21st century - A social perspective
[AIAA PAPER 86-2349] p 11 A86-50265
Fifth generation computers: Concepts, implementations and uses Book p 41 A86-50280
USSR report: Machine tools and metalworking
equipment [JPRS-UMM-85-010] p 23 N86-11394
Aeronautical technology 2000: A projection of advanced
vehicle concepts [NASA-CR-176322] p 23 N86-13235
Assessment of US industry's technology trends and new technology requirements
[NASA-CR-176479] p 24 N86-17227
Technology achievements and projections for communication satellites of the future
[NASA-TM-87201] p 62 N86-17595
Report on the AI trip [IR-82] p 35 N86-30397
Support for global science: Remote sensing's
challenge p 14 N86-32864 TECHNOLOGY TRANSFER
Commercialization of the land remote sensing system:
An examination of mechanisms and issues [E86-10008] p 24 N86-14710
The role of technical information in US competitiveness with Japan
[GPO-51-564] p 91 N86-16152
Assessment of US industry's technology trends and new technology requirements
[NASA-CR-176479] p 24 N86-17227
Technology transfer is opportunity transfer [DE85-016622] p 62 N86-17230
Technology transfer
[GPO-49-539] p 92 N86-20177 Information for the developing world: NTIS's (National
Technical Information Services's) role in information
transfer to developing countries [PB85-243269] p 92 N86-21434
Technology transfer
[GPO-49-539] p 92 N86-21458 Use of broker organizations in technology transfer and
research utilization for the buildings industry
[DE86-004674] p 25 N86-26262 Technology transfer and artificial intelligence
[AD-A166035] p 36 N86-30581 Transfer of high-technology to the Soviet Union. A
predicament for the US
[AD-A166469] p 96 N86-30582 Spinoff 1985
[NASA-TM-89240] p 65 N86-31451
TECHNOLOGY UTILIZATION An overview of the Space Station Technology/Advanced
Development Program
[IAF PAPER 85-28] p 10 A86-15619 Planning for Space Station utilization
[IAF PAPER 85-48] p 10 A86-15635
Space Station utilization for technology purposes [IAF PAPER 85-50] p 50 A86-15636
Introduction - Space Station and platform roles in supporting future space endeavors p 51 A86-17307
National and international cooperation in remote sensing
and applications [AIAA PAPER 86-0412] p 84 A86-19861
The needs of developing countries in the application
of satellite technology for disaster management p 84 A86-21123
Washington broadens its efforts to aid small business
p 67 A86-24102 Space remote sensing systems: An introduction
Book p 73 A86-26525
The space industry for communications and remote sensing
[AAS 85-136] p 52 A86-28593
Management of outer space for the benefit of mankind p 54 A86-31218
Commerical use of space - Status and prospects
Research and technology Fiscal Year 1985 report
[NASA-TM-86532] p 62 N86-17225 Assessment of US industry's technology trends and new
technology requirements
[NASA-CR-176479] p 24 N86-17227 NASA: 1986 long-range program plan
[NASA-TM-87560] p 63 N86-21420

Technology transfer [GPO-49-539] p 92 N86-21458 The great observatories for space astrophysics NASA-CR-176754] p 63 N86-24712 Evaluating R and D and new product development [NASA-CR-176754] ventures: An overview of assessment methods \$12 00/MF A01 [PB86-110806] p 13 N86-25289 Spinoff 1985 [NASA-TM-89240] p 65 N86-31451 TELECOMMUNICATION Intelsat and the challenge of competitive systems p 84 A86-18394 Satellite commuications for developing countries - From conjecture to reality p 52 A86-24672 International space law and direct broadcast satellites p 85 A86-24675 The space industry for communications and remote sensing [AAS 85-136] p 52 A86-28593 Satellite communications basics - A colloquium lecture p 18 A86-29680 A chronicle of policy and procedure - The formulation of the Reagan administration policy on international satellite telecommunications n 87 A86-30290 Future directions in mobile teleoperation DE85-014308] p 61 N86-12976 Telecommunications alternatives for federal users: [DE85-014308] Market trends and decisionmaking criteria p 13 N86-25687 (PB86-153764) TELEOPERATORS Space telerobotics - A few more hurdles p 31 A86-37047 Automation and robotics for Space Station in the twenty-first century [AIAA PAPER 86-2300] p 40 A86-49552 Future directions in mobile teleoperation p 61 N86-12976 [DE85-014308] Robot end effector p 34 N86-27663 [PB86-166042] Application of teleoperator expertise to robotics [DE86-003659] p 35 N86-29229 Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 TELEPHONES Worldwide report: Telecommunications policy, research and development [JPRS-TTP-86-011] p 95 N86-30064 TELEPHONY Global interconnectivity in the next two decades - A scenario [AIAA PAPER 86-0605] n 54 A86-29581 TEMPERATURE Technical activities 1983, Center for Basic Standards [PB86-140043] p 81 N86-26239 TERRAIN Computer techniques for producing color maps p 42 N86-19955 [AD-A161159] TEST FACILITIES Sensor driven robot systems testbed [DE86-005892] p 35 N86-30412 TETHERLINES Tether applications for space station p 76 N86-28418 TEXTS Standard generalized markup language: A technique for document interchange p 48 N86-31777 [DE86-011504] THERMONUCLEAR POWER GENERATION Nuclear power for earth orbit and beyond p 57 A86-38623 THESAURI NASA Thesaurus supplement: A 4-part cumulative supplement to the 1985 edition of the NASA Thesaurus [NASA-SP-7053(SUPP-1)] p 47 N86-29720 Design of a master lexicon

[AD-A165999]

[PB86-140043]

[AD-A158921]

accuracy [AD-A161257]

TIME OPTIMAL CONTROL

TIME SERIES ANALYSIS

places for point to point tasks

TIME

THREE DIMENSIONAL BODIES

A study on robot path planning from a solid model

Problem solving under time-constraints

Technical activities 1983, Center for Basic Standards

Time optimal robotic manipulator motions and work

The bootstrap method for assessing statistical

p 47 N86-29721

p 32 A86-43061

p 81 N86-26239

p6 N86-15957

p 31 A86-42983

p 81 N86-20047

SUBJECT INDEX

TIN COMPOUNDS The qualification and procurement or	f two o	idad printad
circuit boards (fused tin-lead or gold		
European Space Agency [ESA-PSS-01-710-ISSUE-1]	p 82	N86-32660
TORNADOES Tomorrow's weather - New accuracy		
TRAINING ANALYSIS	p 54	A86-32450
In-house CAD training: A realistic ap [DE86-008926]	proach p8	N86-31251
Human Factors Review Plan	•	
[DE86-010561] TRAJECTORY CONTROL	р9	N86-33023
Time optimal robotic manipulator places for point to point tasks TRANSATMOSPHERIC VEHICLES	motion p 31	
Can we develop the 1.5 million p plane?	ound p 55	
High speed aeronautics [GPO-51-341]	p 91	N86-19284
TRANSONIC WIND TUNNELS Cryogenic wind tunnels for high	Reync	ilds number
testing [NASA-TM-87743]	p 26	N86-29872
TRANSPORT AIRCRAFT Advanced concepts transport aircraft		
[SAE PAPER 851808] Which transport technologies will fly	p 20	A86-35438
which transport technologies will hy		A86-41037
Thirty years with the jets: Commerce		
management systems - Past, present, [AIAA PAPER 86-2289]	p 22	A86-47402
An analysis of the application of Al to of intelligent aids for flight crew tasks		evelopment
[NASA-CR-3944] Alerted monitors: Human operators a	p4 jided b	N86-12212 vautomated
detectors		yautomateu
[PB85-222750] TRAVELING SALESMAN PROBLEM	p 4	N86-13906
Time optimal robotic manipulator m places for point to point tasks		
TROPICAL METEOROLOGY The overall plan: A scientific strategy	•	
Global Atmosphere (TOGA) program	p 64	N86-29463
Shuttle-launch triangular space station		
[NASA-CASE-MSC-20676-1] TURBOMACHINERY	p 93	N86-24729
Future directions in aeropropulsion t	echnol	ogy A86-11602
TURBOPROP AIRCRAFT Turboprop airliners get bigger -	Will th	
market? TURNAROUND (STS) Future operational plans for the	•	
Transportation System		
[AIAA PAPER 86-0090]	μız	A86-19685
U		
U.S.S.R.		
Some comparisons of US and US developments	SR air	craft design
[AIAA PAPER 85-3060] Astronauts and cosmonauts biograp	p 15 bical a	
data, revised June 28, 1985	ncar a	
[GPO-52-498] USSR report: Cybernetics, compute	p7	N86-21499
technology [JPRS-UCC-86-004]	p 45	N86-28694
Survey of Soviet work in reliability [AD-A167607]	p 82	
U.S.S.R. SPACE PROGRAM	•	
The USSR and satellite communica and cooperation	p 84	Competition A86-18389
US-Soviet intergovernmental agreen	nent on	cooperative
space activities - Should it be re-estat	p 87	? A86-29698
Soviet spaceflight comes of age	р 88	A86-36449
Developing the final frontier: International	ational	
in the peaceful uses of outer space	Book p88	A86-42236
Missions to Mars	p 60	
UK SATELLITES History of British space science I	Book	
-	p 87	A86-33604
UK SPACE PROGRAM Hotol spaceplane is designed to sla		
80 percent ULTRALIGHT AIRCRAFT	p 54	A86-29496
Long endurance aircraft performance		
	p 80	A86-49478

ULTRASONIC TESTS	
Assessment of US industry's technol technology requirements	ogy trends and new
[NASA-CR-176479]	p 24 N86-17227
Nondestructive techniques fo mechanical properties of structura overview	
[NASA-TM-87203] UNITED KINGDOM	p 80 N86-19636
Spacecab II - A low-cost small shut	tle for Britain p 53 A86-28725
Comparison of scientific and technic in the United States, France, West Gerr	
Kingdom since 1970 {PB86-133030]	p 7 N86-24554
UNITED NATIONS Space law in the United Nations	
UNITED STATES Some comparisons of US and US	p 85 A86-26546 SB aircraft design
developments [AIAA PAPER 85-3060]	p 15 A86-10930
Status of space commercialization i	•
National space transportation	and support
study/mission requirements and archit [AIAA PAPER 86-1211]	p 11 A86-40602
Aspects of law and practice in the U space commercialization	nited States and p 89 A86-43349
Government-to-government coo	, peration in space
station development The role of technical information in L	p 91 N86-15166 JS competitiveness
with Japan [GPO-51-564]	p 91 N86-16152
Astronauts and cosmonauts biograp data, revised June 28, 1985	•
[GPO-52-498]	p 7 N86-21499
Guide to programs, fiscal year 1986 National Science Foundation Progra	
[PB86-125184]	p 93 N86-23484
Comparison of scientific and technic in the United States, France, West Gern	
Kingdom since 1970 [PB86-133030]	p7 N86-24554
Managing federal information resou the Paperwork Reduction Act of 1980	rces: Report under
[PB86-247682]	p 13 N86-25299
Freedom of Information Act: Nor affirmative disclosure provisions [AD-A168589]	p 96 N86-33204
UNIVERSE Extragalactic astronomy	p 65 N86-31489
UNIVERSITIES Aerospace guidance and control	in the university -
Anticipated trends [AAS PAPER 85-001A]	p 19 A86-31777
NASA-universities relationships engineering: A review of NASA's proc	in aero/space
[NASA-CR-176307]	p61 N86-12158
Academic science/engineering: R year 1983 (detailed statistical tables) [PB86-120706]	p 25 N86-23482
University funding. Assessing mechanisms for university research	federal funding
[AD-A165721] University funding: Federal funding	p95 N86-28806 mechanisms in
support of university research [AD-A168023]	p 66 N86-33212
UPGRADING	•
Productivity enhancement planning management concepts	p 6 N86-15202
USER MANUALS (COMPUTER PROGR Information Systems development a	
[DE85-018161] USER REQUIREMENTS	p 42 N86-18246
Planning for Space Station utilization [IAF PAPER 85-48]	
Computer systems measures	p10 A86-15635 p41 N86-15173
ENVIROSAT-2000 report: Feder requirements	al agency satellite
[NASA-TM-88752]	p 63 N86-26355
The Value of Information as an Aerospace and Defence R and D Prog	rammes
[AGARD-CP-385] A programme manager's needs for i	p 45 N86-28793
	p 45 N86-28795
The information needs of scientists aerospace	p 45 N86-28796
Information resources managemen environment	p 46 N86-28803
Technology transfer and artificial inte [AD-A166035]	
-	

X-29 AIRCRAFT

VALUE Measuring the value of information and information systems, services and products p 45 N86-28799 VARIABLE SWEEP WINGS

Optimum wing - For all flight conditions?

p 16 A86-11961 VARIATIONS Balancing production level variations and inventory

variations in complex production systems p 77 N86-32329 [THE/BDK/84] VEGETATION GROWTH

Development of space technology for ecological p 63 N86-19943 habitats VIBRATION TESTS

Nondestructive techniques for characterizing mechanical properties of structural materials: overview

[NASA-TM-87203] p 80 N86-19636 Reconfigurable work station for a video display unit and

keyboard [NASA-CASE-MFS-26009-1SB] p 92 N86-22114

VOICE DATA PROCESSING

Method and apparatus for operating on companded PCM voice data

[NASA-CASE-KSC-11285-1] p 94 N86-27513

w

WALL FLOW

Adaptive wall wind tunnels: A selected, annotated bibliography (NASA-TM-87630)

p 26 N86-29871 WARNING SYSTEMS Use of satellite data in international disaster

management The view from the U.S. Department of p 85 A86-21126 State WASTE TREATMENT

Program Management System manual [DE86-0053961 0

p 76 N86-28012 WATER VAPOR

ground-based measurements Systematic mesospheric water vapor p 55 A86-33544 WEATHER FORECASTING Plan for the implementation of the World Climate

Research Programme esearch Programme p 49 A86-10403 Future operational plans for the National Space Transportation System

p 72 A86-19685 LAIAA PAPER 86-00901 Tomorrow's weather - New accuracy in forecasting p 54 A86-32450

WEIGHT ANALYSIS

Rapid sizing methods for airplanes [AIAA PAPER 85-4031] p 16 A86-10960 WEIGHT REDUCTION

Assessing cost-effective weight saving in aircraft operations p 16 A86-20039 SADDLE - A computer-aided structural analysis and

dynamic design language. I - Design system. II - Database p 37 A86-25999 management system WEIGHTLESSNESS

Research and competition: Best partners p 76 N86-25321 [NASA-TM-87313] WEST GERMANY

Comparison of scientific and technical personnel trends in the United States, France, West Germany and the United Kingdom since 1970

[PB86-133030] p 7 N86-24554 WIND SHEAR Tomorrow's weather - New accuracy in forecasting

p 54 A86-32450 WIND TUNNEL TESTS

Langley aerospace test highlights, 1985 p 81 N86-26276 [NASA-TM-87703] Adaptive wall wind tunnels: A selected, annotated bibliography [NASA-TM-87639] p 26 N86-29871 WIND TUNNEL WALLS

- Adaptive wall wind tunnels: A selected, annotated bibliography p 26 N86-29871 [NASA-TM-87639]
- WING CAMBER Optimum wing - For all flight conditions?

p 16 A86-11961 WORDS (LANGUAGE) Central On-Line Data Directory p 46 N86-29294 WORKLOADS (PSYCHOPHYSIOLOGY)

Subjective workload and individual differences in information processing abilities [SAE PAPER 841491] p 2 A86-26011

Predicted versus experienced workload and performance on a supervisory control task p 2 A86-29879

Workload measurement in system design and p 3 A86-33787 evaluation The psychophysics of workload - A second look at the relationship between subjective measures and performance p 3 A86-33804 Workload assessment - Progress during the last

decade [SAE PAPER 851877] p 3 A86-35440 Space crew productivity: A driving factor in space station

design esign p 5 N86-15187 Influence of complexity of control task on level of activation of operators physiological functions when working with waiting Basic human factors considerations p 7 N86-23260

[DE86-008181] p 8 N86-31223

Knowledge-based load leveling and task allocation in human-machine systems p 9 N86-32985 WORKSTATIONS

Considerations for the implementation of intelligent workstation networks

[AIAA PAPER 85-4001] p 36 A86-10948 Time optimal robotic manipulator motions and work places for point to point tasks p 31 A86-42983 Reconfigurable work station for a video display unit and keyboard

[NASA-CASE-MFS-26009-1SB] p 92 N86-22114 WORLD METEOROLOGICAL ORGANIZATION

Meteorological services of the world [WMO-2] p 63 N86-23184

First implementation plan for the World Climate Research program [WCRP-5]

p 64 N86-29477

X

X-29 AIRCRAFT

X-aircraft for world leadership in aeronautics p 19 A86-31330

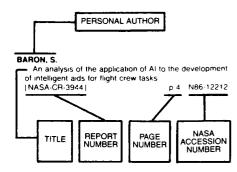
PERSONAL AUTHOR INDEX

MANAGEMENT / A Bibliography for NASA Managers

APRIL 1987

AUTHOR

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document listed (e.g., NASA report, translation, NASA contractor report). The page and accession numbers are located beneath and to the right of the title. Under any one author's name the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

Δ

ABELES. F. J.

The roles of astronauts and machines for future space operations

[SAE PAPER 851332] p 1 A86-23521 ABRAHAMSON, L.

- User systems guidelines for software projects [DE86-010490] p 48 N86-33048
- ACHESON, D. C. Report of the Presidential Commission on the Space
- Shuttle Challenger Accident, volume 1 [AD-A171402] p 93 N86-24726 ADAMS, G. B. III

White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-893881 p 46 N86-29569

ADELMAN, L.

Human factors in rule-based systems [AD-A165309] p 8 N86-26840

ADRION, J.

- Symposium on Aviation Psychology, 3rd, Columbus, OH, April 22-25, 1985, Proceedings p 2 A86-29851 ADRION, W. R.
- Computer networking for scientists p 37 A86-27166 AFANASEV, IU. A.

Future world meteorological satellite systems

[IAF PAPER 85-87] p 82 A86-15663 AKIN, D. L.

Construction and control of large space structures

	104 404 011	und .	0011001	U 1	iaiyo	space	Ju	0010103	
						p	21	A86-3706	Э
ALDRIC	DGE. J.								

Expert systems for design and	simulation	
[DE85-017565]	p 32	N86-18053
Expert assistants for design		

- [DE86-003679] p 35 N86-29557 ALEXANDER, J. J.
- Helicopter customer support Are we aware of how great it can be p 20 A86-35644 ALLARD, R.

Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072

ALLER, R. O.

- The National Aeronautics and Space Administration (NASA) Tracking and Data Relay Satellite System (TDRSS) program Economic and programmatic, considerations [IAF PAPER 85-422] p 67 A86-15895 ALTMANN, G.
- Status of ESA's planning for the Space Station p 59 A86-44530
- AMBRUS, J. H. An overview of the Space Station Technology/Advanced Development Program
- [IAF PAPER 85-28] p 10 A86-15619 ANDERSON, B. M.
- Knowledge engineering for a flight management expert evetem p 30 A86-28498 ANDERSON, J. L
- Space Station utilization for technology purposes [IAF PAPER 85-50] p 50 A86-15636
- ANDERSON, R. E. A shared satellite system would satisfy many future aviation needs p 51 A86-20921
- ARCHER, H. S., III Digital avionics for modern aircraft - A case study into the problems and promise of aircraft electronics
- p 18 A86-28346 ARMSTRONG, N. A. Report of the Presidential Commission on the Space
- Shuttle Challenger Accident, volume 1 p 93 N86-24726 [AD-A171402] ARNO, R.
- Space Station life sciences guidelines for nonhuman experiment accommodation
- SAE PAPER 851370] p 52 A86-23553 ARNOLD. J. R. Robotics for the United States Space Station

p 29 A86-28073 ARZI. N.

The psychophysics of workload - A second look at the relationship between subjective measures and p 3 A86-33804 performance ASHFORD, D. M.

Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 ATKINS, H. L.

- Commerce Lab A program of commercial flight p 56 A86-34965 opportunities AUGUSTA, J.
- Risk assessment preprocessor (RAPP) p 43 N86-24278 [AD-A161914]
- AVANT. L. Mentoring as a communication channel: Implications p 4 N86-15164 for innovation and productivity

В

- BAGWELL, J. W.
- Technology achievements and projections for communication satellites of the future [NASA-TM-87201] p 62 N86-17595
- BARD, J. F. Evaluating Space Station applications of automation and p 31 A86-41000 robotics Evaluating space station applications of automation and
- robotics technologies from a human productivity point of p 14 N86-31412 BARON, S.
- An analysis of the application of AI to the development of intelligent aids for flight crew tasks p 4 N86-12212 [NASA-ČR-3944]
- BARRETT, A. J. The costs of not having refined information p 45 N86-28798
- BARTO, J. J., JR.
- p 20 A86-35660 Robotics in aircraft manufacturing BASHENKO, V. V.
- In-process inspection of the parameters of the electron p 19 A86-34124 beam in electron beam welding BASHFORD, D. P.
- The application of composites to space structures: Guidelines on important aspects for the designer p 76 N86-30759

DAGUL V. D
BASILI, V. R. Quantitative evaluation of software methodology
[NASA-CR-176522] p 42 N86-19022
BASKIN, O. W. Bland D. Braduativity: New Challenges for the U.S. Sassa
R and D Productivity: New Challenges for the US Space Program
[NASA-TM-87520] p 61 N86-15157
BATTISTE, V.
Predicted versus experienced workload and performance on a supervisory control task
p 2 A86-29879
BAUER, A.
Insurance - Forms of coverage and current market situation p 89 A86-43344
situation p 89 A86-43344 BEAL, J. M.
Knowledge engineering for a flight management expert
system p 30 A86-28498
BEARDSLEY, A. C.
Space Station on-orbit operations for the Twenty First
Century [AIAA PAPER 86-2331] p 74 A86-46954
BEATTY, M.
Optical processing for future computer networks
p 37 A86-21973
BEKEY, I.
Space stations and space platforms - Concepts, design, infrastructure, and uses p 51 A86-17301
infrastructure, and uses p 51 A86-17301 BENKO, M.
Space law in the United Nations p 85 A86-26546 BENNETT, G. R.
Space Station operations in the twenty-first century
[AIAA PAPER 86-2328] p 74 A86-46951
BEREITER, S. R.
A comparison of a manual and computer-integrated production process in terms of process control
decision-making
[AD-A168037] p 14 N86-32750
BERKA, R. B. Shuttle-launch triangular space station
[NASA-CASE-MSC-20676-1] p 93 N86-24729
BERKOWITZ, B.
Artificial intelligence and its use in cost type analyses
with and example in cost performance measurement [AD-A161817] p 43 N86-22168
BERNSTEIN, R.
The suitability of various spacecraft for future space
applications missions
[NASA-TM-88986] p 64 N86-27409
BERNSTEIN, W. M. Management behavior, group climate and performance
appraisal at NASA p 4 N86-15163
BERTA, M. A.
A commercial communications satellite system for
Japan [AIAA PAPER 86-0680] p 18 A86-29674
BERTENYI, E.
Planning for Telesat Canada's next generation

next generation satellites [IAF PAPER 85-354] p 10 A86-15849

- BERTRAND, J. W. M. Production and inventory control with the base stock /stem
- EUT/BDK/121 o 77 N86-32328 Balancing production level variations and inventory
- variations in complex production systems [THE/BDK/84] p 77 N86-32329 Calculating workload norms for job shops
- p 26 N86-32330 [BDK/KBS/84-04] p 26 Ni The structuring of production control systems
- p 26 N86-32332 [THE/BDK/ORS/84/10] BHATTL M. A.
- SADDLE A computer-aided structural analysis and dynamic design language. I - Design system. II - Database management system p 37 A86-25999 BIANCHI, G.
- The space industry for communications and remote sensing
- [AAS 85-136] p 52 A86-28593 BINDER. T. G.
 - Productivity impacts of software automation p 68 A86-28418
 - **B-1**

BISHOP, M.

BISHOP, M.

Access control and privacy in large distributed systems

[NASA-TM-89397]	p 46	N86-29568
BISHOP, P.		
Eith annuties computers Cono	onte impl	omontations

- Fifth generation computers: Concepts, implei p 41 A86-50280 and uses BISHOP, W. P.
- Optimum management strategies for the NOAA (National Oceanic and Atmospheric Administration) operational environmental satellites. polar-orbiting 1985-2000. Volume 1

p 14 N86-28007 [AD-A165143] BISSERET. A.

- Expert computer aided decision in supervisory control p 30 A86-33188 BLAKE. N
- ENVIROSAT-2000 report: Federal agency satellite requirements
- [NASA-TM-88752] p 63 N86-26355 BLANKENSHIP, C. P.
- Tough composite materials: Recent developments p 22 A86-45300
- BI ANKENSHIP D
- PASSCAL Field Data Management Plan (PFDMP) p 43 N86-24285 [DE86-003192]
- BLAUSTEIN, B. T. System architecture for partition-tolerant distributed databases p 37 A86-17769
- BLEAU, R. O. Developing a maintenance concept for future electronic
- svstems [ÁIAA PAPER 86-1145] p 74 A86-43333
- BLOCK. R. F. Automated subsystems control development
- [SAE PAPER 851379] p 10 A86-23561 BLUBAUGH, T. D.
- Time optimal robotic manipulator motions and work places for point to point tasks p 31 A86-42983 BLUMBERG, R.
- Experience with a software engineering environment tramework p 47 N86-30365 BLUME, S.
- Evaluation of research: Experiences and perspectives in the Netherlands
- [ESA-86-96709] p 65 N86-31461 BLUTH, B. J.
- Space Station in the 21st century - A socia perspective
- AIAA PAPER 86-2349 p 11 A86-50265 BOBROW, D. G.
- Perspectives on artificial intelligence programming p 29 A86-27167 BODENSTEINER, W. D.
- A case study in R and D productivity: Helping the
- program manager cope with job stress and improve communication effectiveness p 4 N86-15170 BOECKSTIEGEL, K.-H.
- Space stations: Legal aspects of scientific and commercial use in a framework of transatlantic cooperation; Proceedings of the International Colloquium, Hamburg, West Germany, October 3, 4, 1984 p 88 A86-43335
- Applicable law and dispute settlement p 89 A86-43343
- BOGDANOV, V.
- Development and implementation of the Future Global Maritime Distress and Safety System (FGMDSS) [IAF PAPER 85-338] p 77 A86-15839 BOHON, H. L.
- Composites in today's and tomorrow's U.S. airliners p 22 A86-47603
- BOISSIN, J. PH. Economic equity and international cooperation - The example of E.S.A.

[IAF PAPER 85-499]	p 83	A86-15943
BOLDON, P.		

- Technical and management information system: The tool for professional productivity on the space station p 41 N86-15171 program BOND. A.
- A fully reusable launch vehicle for Europe? p 59 A86-44543
- BOOTHROYD, G.
- Economic applications of assemply robots. Economic analysis and classification systems for robot assembly [PB86-154465] p 34 N86-25808 BOOZER, R. W.
- Mentoring as a communication channel: Implications for innovation and productivity p 4 N86-15164 BOSTON, P. J.
- Scientific program for a Mars base [AAS 84-166] p 53 A86-28792

- BOUDREAU, P. M.
- The Canadian mobile satellite service and its ocio-economic assessment [IAF PAPER 85-364] n 66 A86-15857
- BOURELY, M. G.
- Agreements between states and with international organizations p 88 A86-43340 BRACHET, G.
- Earth observation satellites From technology push to p 68 A86-26465 market pull
- BRACKENREED JOHNSTON, M. W Countertrade - A necessary part of marketing, or an
- p 69 A86-44537 expensive diversion? BRADEN, J. H. C. The Canadian mobile satellite service and its
- socio-economic assessment
- [IAF PAPER 85-364] p 66 A86-15857 BRAHAM, H. S.
- Improved system cost and performance ACTS using multi-beam processing satellites [AIAA PAPER 86-0645] p 69 A86-29607
- BRAHNEY, J. H. Optimum wing - For all flight conditions?
- p 16 A86-11961
- BRAUNE, R.
- The functional age profile An objective decision criterion for the assessment of pilot performance capacities and p 3 A86-31823 capabilities BRAZEE M
- An engineering approach to the use of expert systems technology in avionics applications
- [NASA-TM-88263] p 34 N86-24687 BRIDGES, M. C.
- A proven software project audit methodology A86-28427 p 39
- BROCK, G. H. Office automation: The administrative window into the integrated DBMS p 41 N86-15174
- BROOKS R A A robust lavered control system for a mobile robot [AD-A160833] p 33 N86-18736
- BROOKS, S. L. Knowledge-based systems: How will they affect manufacturing in the 80's
- p 32 N86-13027 [DE85-010601] BROWN, D. A.
- Hotol spaceplane is designed to slash launch costs by 80 percent p 54 A86-29496 BROWN, J. A.
- Cost containment and KSC Shuttle facilities or cost containment and aerospace construction p 19 A86-34989
- BROWN. P. W.
- NASA storm hazards research in lightning strikes to p 79 A86-37479 aircraft BROWN, R. A.
- The role of scientists in developing Hubble Space p 51 A86-19526 Telescone BROWN, R. L.
- White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569
- BROWNLOW, W. J. p 38 A86-28416 Software automation BRUMBAUGH, R. W.
- An engineering approach to the use of expert systems technology in avionics applications p 34 N86-24687 [NASA-TM-88263]
- BRUN. O. Legislation for software rights protection at last
- p 96 N86-32343 [SNIAS-861-422-114] BRYANT, R.
- Information Systems development aids [DE85-018161] p 42 N86-18246 BUERK. K.
- Information resources management in the R and D environment p 46 N86-28803 BULLOCH, C.
- Space Station evolution The uncertainty principle orevails p 60 A86-48373 BUNNER, A. N.
- Future space telescope design concepts p 23 N86-11107 BUONTEMPO, V. An example of integrated logistic support applied also to production testing p 77 N86-30898 BURBIDGE, E. M. Extragalactic astronomy p 65 N86-31489
- BURCHAM, F. W., JR. Summary of results of NASA F-15 flight research program [NASA-TM-86811] p 25 N86-26277
- BURKE, W. W. Management behavior, group climate and performance
- appraisal at NASA p 4 N86-15163

PERSONAL AUTHOR INDEX

BUTOW, S. J.

- The development of a project plan for the Get Away Special Program p 64 N86-27306 BYMAN J. F. The factory of the future p 23 N86-11228 BYRNE, F.
- Method and apparatus for operating on companded PCM voice data
 - [NASA-CASE-KSC-11285-1] p 94 N86-27513

С

CAMPISANO, F.

A	rapid	evaluation	approach	for	configuration
dev	elopmen	t of new aircr	aft		
[Al/	A PAPE	R 85-3068]		p 15	A86-10932
- A A 14				•	

- Robotics for the United States Space Station p 29 A86-28073
- CAPITANO J I Innovative stimulus testing at the lowest level of
- assembly to reduce costs and induce reliability p 78 A86-22185

CAPONIO, J. F.

CARTER, W. D., JR.

CASSIDY, D. E.

activities

CAVE. J.

CERUTTI, J.

CAULEY, J. K.

[E86-10008]

versus organic repair [AD-A162071]

[DE86-0036791

CHAMBERS, A. B.

CHANDLER, P. P.

[AAS 84-153]

[AD-A164064]

CHEESEMAN, P. C.

[AD-A161014]

CHIGNELL, M. H.

CHEN. H. S.

CHEN, P.-C.

А

[SAE PAPER 851808]

development of new aircraft

[AIAA PAPER 85-3068]

human-machine systems

CHAPPELL, S. L.

perspective

CHANG, K.

- Information for the developing world: NTIS's (National Technical Information Services's) role in information transfer to developing countries p 92 N86-21434 [PB85-243269] CARBONELL, J. G.
- Derivational analogy: A theory of reconstructive problem solving and expertise acquisition [AD-A156817]
- p 12 N86-10899 CARD. M. F.
- Construction and control of large space structures p 21 A86-37060
- CARLISLE, R. F. An overview of the Space Station Technology/Advanced
- Development Program [IAF PAPER 85-28] p 10 A86-15619
- Space Station Advanced Development Program p 55 A86-32543 CARR. D. B.
- Managing the data analysis progress p 44 N86-26005
- CARTER. G. L. Socio-technical integration of the workplace

Space insurance - A resource for commercial space

Commercialization of the land remote sensing system:

Depot maintenance of aviation components: Contractor

The civilian space program - A Washington

US-Soviet intergovernmental agreement on cooperative

Recent developments in aviation case law

An examination of mechanisms and issues

Expert systems for design and simulation [DE85-017565] p 32

Pilots of the future - Human or computer?

space activities - Should it be re-established?

Advanced concepts transport aircraft of 1995

Modeling and planning robotic manufacturing

rapid evaluation approach for

Space remote sensing systems: An introduction

Knowledge-based load leveling and task allocation in

The group consensus problem

Expert assistants for design

p 5 N86-15182

p 84 A86-18848

p 87 A86-32562

p 24 N86-14710

p 75 N86-23556

p 32 N86-18053

p 35 N86-29557

p 1 A86-18541

p 86 A86-28779

p 87 A86-29698

p 7 N86-26078

p 20 A86-35438

p 24 N86-19620

p 73 A86-26525

p 15 A86-10932

p 9 N86-32985

configuration

PERSONAL AUTHOR INDEX CHILLAG. N. The psychophysics of workload - A second look at the relationship between subjective measures performance p 3 A86-33804 CHRISTENSEN, J. M. A review of the psychological aspects of space flight p 2 A86-29090 CLARK. L. M. Computing Services Software Library [DE86-009491] p 48 N86-32340 CLARK. L. P. Management behavior, group climate and performance appraisal at NASA p 4 N86-15163 CLARK, L. R. Acoustics Division recent accomplishments and research plans p 65 N86-31340 [NASA-TM-89012] CLIEF B Robotics for the United States Space Station p 29 A86-28073 CLOUGH, D. R. Motivational contracting in space programs -Government and industry prospectives p 55 A86-34963 COHEN. A. Automation and robotics - Key to productivity p 28 A86-15623 [IAF PAPER 85-32] Future uses of machine intelligence and robotics for the Space Station and implications for the U.S. economy p 29 A86-20426 Robotics for the United States Space Station p 29 A86-28073 Space technology today p 60 A86-47052 COLEMAN, H. J. Underwriters worldwide incurred \$600 million in unexpected losses, signifying changes ahead in space p 85 A86-24122 insurance COLINO, R. R. A chronicle of policy and procedure - The formulation of the Reagan administration policy on international satellite telecommunications p 87 A86-30290 COLLET J ESA Space Station planning [AAS 85-113] p 86 A86-28582 CONDOM: P. What technologies await the future airliner? p 19 A86-31038 CONTANT. J. M. Economic equity and international cooperation - The example of E.S A [IAF PAPER 85-499] p 83 A86-15943 COOK. R. H. Artificial intelligence applications in manufacturing [AD-A161161] p 33 N86-20014 COOPER, R. S. X-aircraft for world leadership in aeronautics p 19 A86-31330 COPENHAVER, E. D. Use of broker organizations in technology transfer and research utilization for the buildings industry p 25 N86-26262 DE86-004674] CORCORAN, M. L. NASA Workshop on Animal Gravity-Sensing Systems [NASA-TM-88249] p 66 N86-32950 CORMERY, G. Tomorrow . . . Concorde's successor? p 17 A86-26299 CORT. G. Los Alamos software development tools [DE86-006024] p 48 N86-31248 COTTER D ENVIROSAT-2000 report: Federal agency satellite requirements [NASA-TM-88752] p 63 N86-26355 COVERT, E. E. Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 1 [AD-A171402] p 93 N86-24726

- COWLEY, P. J. Managing the data analysis progress p 44 N86-26005 CRABTREE, M. S. Workload measurement in system design and evaluation p 3 A86-33787 CRAIG. D. K.
- The airline engineering role in the management of safety p 80 A86-49084 CRISWELL, D. R.
- Robotics for the United States Space Station p 29 A86-28073 CROSKEY, C. L. Systematic ground-based measurements of
- mesospheric water vapor p 55 A86-33544 CRUCIAN, F. T. Computer systems measures p 41 N86-15173

CRULL, T. J. Space shuttle descent design: From development to operations p 24 N86-15197 CUCCIA, C. L. Global interconnectivity in the next two decades - A scenario [AIAA PAPER 86-0605] p 54 A86-29581 CULBERTSON, P. E. The U.S. Space Station program p 57 A86-37853 CULP, R. D. Aerospace guidance and control in the university -Anticipated trends [AAS PAPER 85-001A] p 19 A86-31777 CUMMING, S. Design of a master lexicon [AD-A165999] p 47 N86-29721 CURRAN, R. J. NASA plans for spaceborne lidar - The Earth Observing System p 59 A86-46763 CUSTER, J. D.

- Logistics support economy and efficiency through consolidation and automation p 74 A86-34956 CZAJKOWSKI, A. F. Selecting interrelated R&D projects in space technology
- planning p 54 A86-29750

D

DAFT. R.

- Organizations as information processing systems: Environmental characteristics, company performance and chief executive scanning, an empirical study [AD-A168035] n 15 N86-33201 DÀFT. R. L. Organization as information processing systems: Toward a model of the research factors associated with significant research outcomes [AD-A168018] p 48 N86-33200 DALTON, G. R. Standard reference data publications, 1964-1984 [PB86-155587] p 81 N86-26409 DAMOS. D. L. Subjective workload and individual differences in information processing abilities [SAE PAPER 841491] p 2 A86-26011 DARWIN, C. R. National space transportation and support study/mission requirements and architecture studies [AIAA PAPER 86-1211] p 11 A86-40602 DAVID L. p 90 A86-49454 The search for common ground DAVIS. E. G. An annotated bibliography of literature integrating organizational and systems theory p 12 N86-19249 [AD-A160912] DAVIS, R. A. Technology base for the future of space p 59 A86-45709 DE GRAAFF, W. Space law in the United Nations p 85 A86-26546 DEAN, J. W., JR. New technology implementation: Technical, economic p 24 N86-15172 and political factors DENNING, P. J. Towards a science of expert systems p 40 A86-49488 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 DERRICK, W. L. Workload assessment - Progress during the last decade [SAE PAPER 851877] p 3 A86-35440 DESAUSSURE, G. Real-time production system for intelligent robot control [DE86-008501] p 36 N86-31271 DETSIK, N. N. In-process inspection of the parameters of the electron beam in electron beam welding p 19 A86-34124 DEVILLIERS, J. N. ESA and its Earth observation programs p 66 N86-32849 DEVITT, B. Using automated tools to reduce software costs and insure system integrity
- [AIAA PAPER 85-6013] p 36 A86-11445 DHILLON, B. S. Quality control, reliability, and engineering design
- p 78 A86-17472 DICKERSON, B. F.
- Exploration for strategic materials [PB86-126463] p 75 N86-24005

DITS, H. Evaluation of research: Experiences and perspectives in the Netherlands [ESA-86-96709] p.65 N86-31461 DONDI. G. Economic equity and international cooperation - The example of F.S.A [IAF PAPER 85-499] p 83 A86-15943 DOOLING. D. NASA centers will stimulate industry R & D p 73 A86-24128 DORFMAN, G. A. Procedures for cause oriented analysis and consequence oriented analysis [DOT/FAA/PM-86/21] p 44 N86-28067 DOUGLASS, R. J. Artificial intelligence applications on supercomputers p 40 A86-40845 DOVER. S. A. Options for operational risk assessments [DF85-014904] p 70 N86-12390 DOWNING, J. D. H. The USSR and satellite communications - Competition and cooperation p 84 A86-18389 DOYLE, J. Expert systems and the 'myth' of symbolic reasoning p 28 A86-14850 DRAISIN, W. Expert systems for design and simulation p 32 N86-18053 [DE85-017565] Expert assistants for design [DE86-003679] p 35 N86-29557 DRAKE, J. M. Integrated logistics support - Five key areas of engineering technology in space p 73 A86-32930 DREYFUS, H. Why computers may never think like people p 31 A86-41648 DREYFUS, S. Why computers may never think like people p 31 A86-41648 DUBOWSKY, S. Time optimal robotic manipulator motions and work p 31 A86-42983 places for point to point tasks DUCHOSSOIS, G. ERS-1 - Mission objectives and system description p 49 A86-13823 Space station: ESA views on requirements for experimental and operational Earth observation missions p 62 N86-18379

- DUKE, E. L. Expert systems development and application [NASA-TM-86746] p 32 N86-11194
- Description of an experimental expert system flight status monitor [NASA-TM-86791] p 32 N86-11195
- An engineering approach to the use of expert systems technology in avionics applications [NASA-TM-88263] p 34 N86-24687
- DULA, A. Capitalism and democracy on the high frontier
- p 86 A86-27881 DUMBLETON, J. H. Management of high-technology research and
- development p 57 A86-37428 DUROCHER, C. L. National space transportation and support
- study/mission requirements and architecture studies [AIAA PAPER 86-1211] p 11 A86-40602

E

EDWARDS, K. C.
Software management for integrated avionics systems
p 38 A86-28425
EFRON, B.
The bootstrap method for assessing statistical
accuracy
[AD-A161257] p 81 N86-20047
EGAN, G. R.
Maintainability planning for the Space Station
[AIAA PAPER 86-9754] p 73 A86-32095
EGAN, J. J.
More precious than gold - The economics of materials
processing in space p 70 A86-44549
EGGÉMEIER, F. T.
Workload measurement in system design and
evaluation p 3 A86-33787
ELSEN, M. F.
Report on active and planned spacecraft and
experiments
[NASA-TM-87499] p 61 N86-13343
ELSTON, J. R.
Software automation p 38 A86-28416

ELSTON, J. R.

EMBRY, L. B.

EMBRY, L. B.	
Depot maintenance of aviation comp	onents: Contractor
versus organic repair	
[AD-A162071]	p 75 N86-23556
EMRICH, M. L.	
Information Systems development a	
[DE85-018161]	p 42 N86-18246
ENGLERT, P. J.	
Sharpening the senses of industrial	
	p 31 A86-40831
ENTRIKIN, D. M.	••••••••••••••••••••••••••••••••••••••
Maintenance planning for the 199	
[PB86-106010]	p 75 N86-22065
EPSTEIN, A. H.	
'Smart' engine components - A mic	
	p 17 A86-21896
ERICKSON, J. D.	
Future uses of machine intelligence	
Space Station and implications for the	
	p 29 A86-20426
Artificial intelligence - NASA	p 30 A86-32538
ERICKSON, W. K.	
The blackboard model - A framew	vork for integrating
multiple cooperating expert systems	- 07 400 44407
[AIAA PAPER 85-5045]	p 27 A86-11407
ESCH, K.	
How NASA prepared to cope with c	
	p 79 A86-25866
ESKEY, M. A.	
Expert systems and their use in a optimization	ugmenting design
[AIAA PAPER 85-3095]	- 00 400 14404
ESKITE, W. H.	p 28 A86-14434
Optimum management strategies	
(National Oceanic and Atmosphere	
polar-orbiting operational environ	
1985-2000. Volume 1	mentai satellites,
[AD-A165143]	p 14 N86-28007
ESTES, J. E.	p 14 1100-20007
	Remote sensing's
challenge	p 14 N86-32864
ETHELL, J. L.	
NASA and general aviation	
[NASA-SP-485]	
	p 26 N86-30720

EVANS, T. M. Is there life after 10,000 flight hours? 79 A86-22402

F

FAGAN, M. E.		
Advances in software inspections	p 40	A86-45470
FAGG, M. F.		
Reconfigurable work station for a vice	deo dis	play unit and
keyboard		
[NASA-CASE-MFS-26009-1SB]	p 92	N86-22114
FARBER, D. J.		
Computer networking for scientists	p 37	A86-27166
FARRELL, S. M.		
An updated model for a Space	ce Sta	tion Health
Maintenance Facility		
[AIAA PAPER 86-2303]	p 59	A86-46938
FAYMON, K. A.	•	
Space power systems - 'Spacecraft	2000'	
		A86-24836
Spacecraft 2000	F	
[AIAA PAPER 86-0616]	n 18	A86-29586
FEAR, J. L.	P	/100 20000
Inmarsat role in the future global ma	aritime	distress and
safety system	unanno	distress and
[IAF PAPER 85-339]	n 78	A86-15840
FEEHRER, C.	p / 0	A00-100+0
An analysis of the application of Al	to the r	lovelopment
of intelligent aids for flight crew tasks		evelopment
[NASA-CR-3944]	D 4	N86-12212
FEHLING, M. R.	P 4	100-12212
The Crew Station Information Man	200r -	
expert system		A86-28515
FEYNMAN, R. P.	p 30	A00-20010
Report of the Presidential Commis		the Seese
Shuttle Challenger Accident, volume 1		i the Space
[AD-A171402]		N86-24726
FEYOCK, S.	p 93	100-24/20
Implementation of artificial intelliger		o in a data
base management system	ice rui	es in a uata
[NASA-CR-178048]	- 22	NOC 01000
• • • • • • • • • • • • • • • • • • • •	p 33	N86-21220
FICHTL, G. H.		
Spacelab 3 mission - Broadening		
research	p 56	A86-34967
FILEP, R.		
Satellite communications - A		expanding
market?	p 68	A86-26464
FILLMORE, D. L.		
Regio human featare considerations		

Basic human	factors considerations		
[DE86-008181]		р 8	N86-31223

Human factors management [DE86-008184]

FINKELSTEIN, J. M. Planning and monitoring reliability growth in accordance with MIL-STDs and handbooks p 79 A86-23009

p 8 N86-31226

- FINNEY, B. R. Anthropology and the humanization of space [IAF PAPER 85-497] p 83 A86-15941 FIRSCHEIN. O.
- Expert systems for Space Station automation p 28 A86-14548 FISHER, B. D.
- NASA storm hazards research in lightning strikes to aircraft p 79 A86-37479 FISHER, D. F.
- Summary of results of NASA F-15 flight research program [NASA-TM-86811] p 25 N86-26277
- FISHMAN, J. Evaluation of spacecraft technology programs (effects
- on communication satellite business ventures), volume 1 [NASA-CR-174978] p 70 N86-16451 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 2 [NASA-CR-174979] p 24 N86-16452
- FITZGERALD, S.

 Risk assessment preprocessor (RAPP)

 [AD-A161914]
 p 43

 N86-24278
- FLETCHER, J. C. Space Shuttle development p 11 A86-46425 FLORINI, A.
- Developing the final frontier: International cooperation in the peaceful uses of outer space p 88 A86-42236 FONG, H. H.
- Computer-aided engineering
- [AD-A162811] p 81 N86-24256 FONTANA, C. J.
- Logistics support economy and efficiency through consolidation and automation p 74 A86-34956 FOSTER, G. D.
- An annotated bibliography of literature integrating organizational and systems theory [AD-A160912] p 12 N86-19249
- FRASER, T. L. Engineering flight simulation - A revolution of change
- [SAE PAPER 851901] p 20 A86-36941 FREEDY, A. Intelligent interfaces for human control of advanced
- automation and smart systems p 29 A86-21889 FREITAG, R. F.
- The Space Station program definition and preliminary systems design - Recent developments [IAF PAPER 85-18] p 50 A86-15611 NASA develops Space Station p 51 A86-21519 Space Station planning
- [AAS 85-111]
 p 73
 A86-28581

 FRIED, S. P.
 Using automated tools to reduce software costs and insure system integrity

 [AIAA PAPER 85-6013]
 p 36
 A86-11445
- [AIAA PAPER 85-6013] p 36 A86-11445 FRIES, S. D. Function, form, and technology - The evolution of Space
- Station in NASA [IAF PAPER 85-454] p 50 A86-15914 FRISCH, H. L.
- Starship I A weight control challenge [SAWE PAPER 1682] p 20 A86-35223 FROBERG, K. W.
- Establishing software QA An exercise in frustration p 39 A86-35657 FROHBIETER, J. A.
- Advanced Communications Technology Satellite p 55 A86-32530
- FRUSH, N. W. Systems modeling and DBMS application in test assets
- management p 74 A86-43881 FUCHS, I. H. Computer networking for scientists p 37 A86-27166
- FULLER, C. R. Integrated structural analysis for rapid design support
- [AIAA PAPER 86-1010] p 39 A86-38868 FURNISS, T.
- Prescription for profits p 56 A86-35526

G

- GAELICK, C.
 - Commercialization of the land remote sensing system: An examination of mechanisms and issues [E86-10008] p 24 N86-14710
 - [Edo-Tovos] p 24 N86-14/10 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174978] p 70 N86-16451

PERSONAL AUTHOR INDEX

GALLO, R. L. CAD/CAM designer - Jack of all trades
p 29 A86-21895
GALLOWAY, E. Government in action - The role of political science in
outer space activities
[IAF PAPER 85-498] p 83 A86-15942 GARRIGAN, S. R.
Robot software: Current state-of-the-art, and future
challenges p 42 N86-19630 GEORGEFF, M. P.
Expert systems for Space Station automation
p 28 A86-14548 GERLOFF, E. A.
A case study in R and D productivity: Helping the
communication effectiveness p 4 N86-15170
GIBSON, R.
Europe - Towards a new long-term programme p 85 A86-22242
GILMORE, J. F.
Applications of artificial intelligence; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984
[SPIE-485] p 28 A86-15278 GINSBERG, M. I.
Decision procedures
[AD-A163049] p 34 N86-25173
GLASSMAN, A. J. Future directions in aeropropulsion technology
p 49 A86-11602 GLEASON, M.
EOS production on the Space Station
[AIAA PAPER 86-2358] p 22 A86-46964
GLIMM, J. Numerical analysis and the scientific method
[DE86-005404] p 47 N86-29591 GOLDMAN, N. C.
The Mars base - International cooperation
[AAS 84-154] p 87 A86-28780 GOODMAN, B. A.
Communication and miscommunication
[AD-A162843] p 7 N86-24257 GOPALA RAO, U. V.
Future world meteorological satellite systems
[IAF PAPER 85-87] p 82 A86-15663 GOPHER, D.
The psychophysics of workload - A second look at the
relationship between subjective measures and
performance p 3 A86-33804
GORDON, A.
Considerations for the implementation of intelligent
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G.
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N.
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G.
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H.
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GREELEY, B. M., JR.
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GRELEY, B. M., JR. Commercial marketing of Landsat data begins
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GREELEY, B. M., JR. Commercial marketing of Landsat data begins p 68 A86-24123 GREENBERG, J. S.
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GRELEY, B. M., JR. Commercial marketing of Landsat data begins p 68 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GREELEY, B. M., JR. Commercial marketing of Landsat data begins p 68 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GRELEY, B. M., JR. Commercial marketing of Landsat data begins p 68 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 Communications satellite business ventures
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GREELEY, B. M., JR. Commercial marketing of Landsat data begins p 68 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 Communications satellite business ventures - Measuring the impact of technology programmes and related policies p 68 A86-24969
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GREELEY, B. M., JR. Commercial marketing of Landsat data begins p 68 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 Communications satellite business ventures - Measuring the impact of technology programmes and related policies p 69 A86-29699 Commercialization of the land remote sensing system:
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GREELEY, B. M., JR. Commercial marketing of Landsat data begins p 68 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 Communications satellite business ventures [IAF PAPER 85-433] p 69 A86-29699 Commercialization of the land remote sensing system: An examination of mechanisms and issues [E86-10008] p 24 N86-14710
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GREELEY, B. M., JR. Commercial marketing of Landsat data begins p 68 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-43] p 82 A86-15903 Communications satellite business ventures - Measuring the impact of technology programmes and related policies p 69 A86-29699 Commercialization of the land remote sensing system: An examination of mechanisms and issues [E86-10008] p 24 N86-14710 GREENBURG, J. S.
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GREELEY, B. M., JR. Commercial marketing of Landsat data begins p 68 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 Communication satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 Communication satellite business ventures [AF PAPER 85-433] p 82 A86-15903 Commercialization of the land remote sensing system: An examination of mechanisms and issues [E86-10008] p 24 N86-14710 GREENBURG, J. S.
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GRELEY, B. M., JR. Commercial marketing of Landsat data begins p 68 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 Commercialization of the land remote sensing system: An examination of mechanisms and issues [E86-10008] p 24 N86-14710 GREENBURG, J. S. Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-17/4978] p 70 N86-16451
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GREELEY, B. M., JR. Commercial marketing of Landsat data begins p 68 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 Communication satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 Commercialization of the land remote sensing system: An examination of mechanism and issues [E86-10008] p 24 N86-14710 GREENBURG, J. S. Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174978] p 70 N86-16451
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GRELEY, B. M., JR. Commercial marketing of Landsat data begins p 68 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 Commercialization of the land remote sensing system: An examination of mechanisms and issues [E86-10008] p 24 N86-14710 GREENBURG, J. S. Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174978] p 24 N86-16451 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174979] p 24 N86-16451
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GREELEY, B. M., JR. Commercial marketing of Landsat data begins p 68 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 Communications satellite business ventures - Measuring the impact of technology programmes and related policies p 69 A86-24999 Commercialization of the land remote sensing system: An examination of mechanisms and issues [E86-10008] p 24 N86-14710 GREENBURG, J. S. Evaluation of spacecraft technology programs (effects on communication satellite business ventures}, volume 1 [NASA-CR-174978] p 70 N86-16451 Evaluation of spacecraft technology programs (effects on communication satellite business ventures}, volume 1 [NASA-CR-174979] p 24 N86-16452 GREENSTEIN, J. S. Application of a mathematical model of human
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GREELEY, B. M., JR. Commercial marketing of Landsat data begins p 68 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 Communications satellite business ventures - Measuring the impact of technology programmes and related policies p 69 A86-24710 GREENBURG, J. S. Evaluation of mechanisms and issues [E66-10008] p 70 N86-14710 GREENBURG, J. S. Evaluation of spacecraft technology programs (effects on communication satellite business ventures) volume 1 [NASA-CR-174978] p 70 N86-16451 Evaluation of spacecraft technology programs (effects on communication satellite business ventures) volume 1 [NASA-CR-174978] p 24 N86-16452 GREENSTEIN, J. S. Application of a mathematical model of human decisionmaking for human-computer communication
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GRELLEY, B. M., JR. Commercial marketing of Landsat data begins p 68 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 Commercialization of the land remote sensing system: An examination of mechanism and issues [E66-10008] p 24 N86-14710 GREENBURG, J. S. Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174978] p 70 N86-16452 GREENSTEIN, J. S. Application of a mathematical model of human decisionmaking for human-computer communication p 1 A86-25036 Development and validation of a mathematical model
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GREELEY, B. M., JR. Commercial marketing of Landsat data begins p 68 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 Commercialization of the land remote sensing system: An examination of mechanisms and issues [E66-10008] p 24 N86-14710 GREENBURG, J. S. Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174978] p 24 N86-14710 GREENBURG, J. S. Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174979] p 24 N86-16451 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174979] p 24 N86-16451 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 2 [NASA-CR-174979] p 24 N86-16452 GREENSTEIN, J. S. Application of a mathematical model of human decisionmaking for human-computer communication p 1 A86-25036 Development and validation of a mathematical model of human decisionmaking for human-computer
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GREELEY, B. M., J.R. Commercial marketing of Landsat data begins p 66 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 Communication satellite business ventures. [IAF PAPER 85-433] p 24 N86-14710 GREENBURG, J. S. Evaluation of mechanisms and issues [E86-10008] p 24 N86-14710 GREENBURG, J. S. Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174978] p 70 N86-16451 Evaluation of a pacecraft technology programs (effects on communication satellite business ventures), volume 2 [NASA-CR-174978] p 24 N86-16451 EVAIUATION SPACER-174979] p 24 N86-16451 EVAIUATION of a mathematical model of human decisionmaking for human-computer communication p 1 A86-25036 Development and validation of a mathematical model of human decisionmaking for human-computer of human-computer ommunication for pace for the statematical model of human decisionmaking for human-computer fundation of a mathematical model of human decisionmaking for human-computer fundation of pace for human-computer of human decisionmaking for human-computer fundation of pace for human-computer fundation of pace for human-computer fundation of a mathematical model of human decisionmaking for human-computer fundation of a mathematical model of human for human-computer fundation for human-computer fundatio
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GREELEY, B. M., JR. Commercial marketing of Landsat data begins p 68 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-43] p 82 A86-15903 Commercialization of the land remote sensing system: An examination of mechanisms and issues [E86-10008] p 24 N86-14710 GREENBURG, J. S. Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174978] p 70 N86-16451 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174979] p 24 N86-16452 GREENSTEIN, J. S. Application of a mathematical model of human decisionmaking for human-computer communication p 1 A86-25036 Development and validation of a mathematical model of human decisionmaking for human-computer communication is actioned for human-computer communication of pacesionmaking for human-computer
Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 GOTTSCHALK, G. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 GOUDGE, B. Something has to change p 90 A86-46375 GOWDY, J. N. Robotics and the space station p 29 A86-20507 GRAFF, G. Tomorrow's weather - New accuracy in forecasting p 54 A86-32450 GRAY, R. H. Space Station operations [IAF PAPER 85-45] p 72 A86-15632 GREELEY, B. M., J.R. Commercial marketing of Landsat data begins p 66 A86-24123 GREENBERG, J. S. Technology programs and related policies - Impacts on communications satellite business ventures [IAF PAPER 85-433] p 82 A86-15903 Communication satellite business ventures. [IAF PAPER 85-433] p 24 N86-14710 GREENBURG, J. S. Evaluation of mechanisms and issues [E86-10008] p 24 N86-14710 GREENBURG, J. S. Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174978] p 70 N86-16451 Evaluation of a pacecraft technology programs (effects on communication satellite business ventures), volume 2 [NASA-CR-174978] p 24 N86-16451 EVAIUATION SPACER-174979] p 24 N86-16451 EVAIUATION of a mathematical model of human decisionmaking for human-computer communication p 1 A86-25036 Development and validation of a mathematical model of human decisionmaking for human-computer of human-computer ommunication for pace for the statematical model of human decisionmaking for human-computer fundation of a mathematical model of human decisionmaking for human-computer fundation of pace for human-computer of human decisionmaking for human-computer fundation of pace for human-computer fundation of pace for human-computer fundation of a mathematical model of human decisionmaking for human-computer fundation of a mathematical model of human for human-computer fundation for human-computer fundatio

B-4

PERSONAL AUTHOR INDEX

GRIFFIN. R. W.

Organization as information processing systems: Toward a model of the research factors associated with significant research outcomes p 48 N86-33200 [AD-A168018] **GRIFFITHS, J. M.** Measuring the value of information and information systems, services and products p 45 N86-28799 GRIMSON, W. E. L. Sensing strategies for disambiguating among multiple objects in known poses [AD-A165912] p 34 N86-29220 GRISHAM. D. L. Application of teleoperator expertise to robotics p 35 N86-29229 [DE86-003659] GRITSEVSKIY, M. A. Influence of complexity of control task on level of activation of operators physiological functions when p 7 N86-23260 working with waiting GROENEWEGEN, P. Evaluation of research: Experiences and perspectives in the Netherlands p 65 N86-31461 [ESA-86-96709] GROSS, V. E. Intelligent N/C controllers [DE86-003132] p 35 N86-30387 GROSSMAN, R. L. Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 GURSKY, H. Astronomy and the Space Station p 51 A86-17308

Н

HAANAPPEL, P. P. C. Possible models for specific space agreements D 88 A86-43339 HAGAFORS. R. Management of organizational operations in dynamic environments. Towards a frame of reference. p 12 N86-11072 [FOA-C5-85-0003-H2] HAGGERTY, J. J. Spinoff 1985 [NASA-TM-89240] p 65 N86-31451 HALE, L. C. Systematic ground-based measurements p 55 A86-33544 mesospheric water vapor HALL. D. Space station: The role of software p 43 N86-23315 HALL, D. L. An overview of the Space Station Technology/Advanced Development Program TIAF PAPER 85-281 p 10 A86-15619 HALL, R. B. Human factors in rule-based systems [AD-A165309] p 8 N86-26840 Mental models and problem solving with a knowledge-based expert system p 8 N86-26843 (AD-A1653981 HALL S. B. The human role in space: Technology, economics and p 3 A86-37037 optimization HALLETT, H. R. Automation requirements derived from space anufacturing p 11 A86-40526 manufacturing HAMEL, W. R. Future directions in mobile teleoperation p 61 N86-12976 [DE85-014308] HÅMMER. J. M. Significance testing of rules in rule-based models of p 2 A86-25038 human problem solving HAMMON. C. Risk assessment preprocessor (RAPP) [AD-A161914] p 43 N86-24278 HAMMOND, K. R. A theoretically based review of theory and research in judgment and decision making AD-A1649141 p 13 N86-27113 HÀNCOCK, J. K. Spare parts pricing - Impact on logistics support p 74 A86-35647 HANCOCK, P. A. Knowledge-based load leveling and task allocation in human-machine systems p 9 N86-32985 HARLOW, F. Creativity in Science - a symposium [DE86-003289] p 63 N86-27109 HÀRRIGAN, R. W.

Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 Sensor driven robot systems testbed

[DE86-005892] p 35 N86-30412 HARRIS. H. M. Interactive mission planning for a Space Shuttle flight experiment - A case history p 56 A86-37187 HARRISON, F. L. Advanced project management (2nd edition) p 57 A86-38959 HART, S. G. Predicted versus experienced workload and performance on a supervisory control task p 2 A86-29879 HARTLE, R. E. The earth observing system [AAS PAPER 85-397] p 58 A86-43229 HARTMANN, M. J. Advanced instrumentation for aeronautical propulsion research [NASA-TM-88853] p 27 N86-32703 HARVEY, W. T. An updated model for a Space Station Health Maintenance Facility [AIAA PAPER 86-2303] p 59 A86-46938 HARWIT, M. The great observatories for space astrophysics [NASA-CR-176754] p 63 N8 p 63 N86-24712 HASINSKI, J. P. The policy maker looks at information p 45 N86-28794 HAUGEN, P. R. Optical processing for future computer networks p 37 A86-21973 HAWKS, K. B. A new perspective on software management p 38 A86-28424 HEACOCK, E. L. Future world meteorological satellite systems (IAF PAPER 85-87) p 82 A p 82 A86-15663 HEARD, W. L., JR. Construction and control of large space structures p 21 A86-37060 HECHT. H. Reliability prediction for spacecraft [AD-A164747] p 81 N86-26359 HECHT. M. Reliability prediction for spacecraft [AD-A164747] p 81 N86-26359 **HEMPENIUS, S. A.** Human development and the conquest of space p 83 A86-18381 HENDERSON, D. E. Reconfigurable work station for a video display unit and keyboard [NASA-CASE-MFS-26009-1SB] p 92 N86-22114 HENDERSON, E. Electric power management and distribution for air and p 17 A86-24828 space applications HENDRIX, W. G. Planning design and implementation of a statewide p 40 A86-46104 geographic information system HEPPNER, D. B. Automated subsystems control development p 10 A86-23561 [SAE PAPER 851379] HERENDEEN, D. L. ASTROS - An advanced software environment for automated design p 39 A86-38807 [AIAA PAPER 86-0856] HERMAN, D. Space stations and space platforms - Concepts, design, p 51 A86-17301 infrastructure, and uses HERMAN, D. H. Introduction - Space Station and platform roles in p 51 A86-17307 supporting future space endeavors HERNDON, C. F. CAD/CAM designer - Jack of all trades p 29 A86-21895 HEYDON, D. A. Ariane and Arianespace status and capability [AIAA PAPER 86-0671] p 18 A86-29668 HILCHEY, J. Space Station life sciences guidelines for nonhuman experiment accommodation (SAE PAPER 851370) p 52 A86-23553 HILL, C. K. Spacelab 3 mission - Broadening horizons in space p 56 A86-34967 research HITE, R. E., III Space shuttle descent design: From development to operations p 24 N86-15197 HO. Y. S. Economic applications of assemply robots. Economic

analysis and classification systems for robot assembly [PB86-154465] p 34 N86-25808 p 34 N86-25808 HOEKSTRA, B. L.

Growth of electronic materials in microgravity p 75 A86-46963 [AIAA PAPER 86-2356]

HOERNIG, O. W., JR. Encryption protection for communica	ition sa p 78	itellites A86-21878
HOESLY, R. L. ASTROS - An advanced softwar		
automated design [AIAA PAPER 86-0856]		A86-38807
HOFFMAN, P. J. Man-machine systems of the 1990	deced	e: Coopitive
factors and human interface issues [AD-A163865]	p 7	N86-25123
HOFFMAN, S. J.		
Concepts for the early realization of to Mars	a man	ned mission
[AAS 84-170]	p 53	A86-28796
HOGARTH, R. M. Generalization in decision research - models		le of formal A86-41385
HOH, Y. S. Procedures for cause orientee	d ana	alysis and
consequence oriented analysis [DOT/FAA/PM-86/21]	p 44	N86-28067
HOLLAND, A. W. Productivity issues at organizational		ces N86-15167
HOLLAND, J. E., JR.		
Transfer of high-technology to the predicament for the US	Sovie	t Union. A
[AD-A166469] HOLT, D. J.	p 96	N86-30582
Can we develop the 1.5 million plane?		aerospace A86-34195
HONG, R.		
State of the art in intelligent/brilliant HONVAULT, C.		A86-43884
Future world meteorological satellite [IAF PAPER 85-87]		ns A86-15663
HOPKINS, C. Evaluation of spacecraft technology	progra	ms (effects
on communication satellite business v [NASA-CR-174978]), volume 1 N86-16451
Evaluation of spacecraft technology	progra	ims (effects
on communication satellite business v [NASA-CR-174979]		N86-16452
HOSENBALL, S. N. The Space Station - Past, present an		
	that r p 89	leed to be A86-43346
The Space Station - Past, present an thoughts on some legal questions addressed	that r p 89	leed to be A86-43346
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commen- services [NASA-CR-176881] HOTZ, R. B.	that r p 89 cial spa p 96	eed to be A86-43346 ace platform N86-30744
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commen- services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1	that r p 89 cial spa p 96 sion on	aeed to be A86-43346 ace platform N86-30744 the Space
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commer services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1 [AD-A171402] HOWARD, A. J.	that r p 89 cial spa p 96 sion on p 93	heed to be A86-43346 ace platform N86-30744 the Space N86-24726
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commer services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1 [AD-A171402] HOWARD, A. J. An updated model for a Spac Maintenance Facility	that r p 89 cial spa p 96 sion on p 93 e Stat	eed to be A86-43346 ace platform N86-30744 the Space N86-24726 tion Health
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commen- services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1 [AD-A171402] HOWARD, A. J. An updated model for a Space	that r p 89 cial spa p 96 sion on p 93	heed to be A86-43346 ace platform N86-30744 the Space N86-24726
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commen- services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1 [AD-A171402] HOWARD, A. J. An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303] HSU, K. H. Computer-aided engineering [AD-A162811]	that r p 89 cial spa p 96 sion on p 93 e Stat	eed to be A86-43346 ace platform N86-30744 the Space N86-24726 tion Health
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commer services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1 [AD-A171402] HOWARD, A. J. An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303] HSU, K. H. Computer-aided engineering [AD-A162811] HSU, S. Systems modeling and DBMS applic	that r p 89 cial spa p 96 sion on p 93 e Stat p 59 p 81 ation ir	eed to be A86-43346 ace platform N86-30744 the Space N86-24726 tion Health A86-46938 N86-24256 a test assets
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commer services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1 (AD-A171402] HOWARD, A. J. An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303] HSU, K. H. Computer-aided engineering [AD-A162811] HSU, S. Systems modeling and DBMS applic management HU, R.	that r p 89 cial spa p 96 sion on p 93 e Sta p 59 p 81 ation ir p 74	eed to be A86-43346 ace platform N86-30744 the Space N86-24726 tion Health A86-46938 N86-24256 test assets A86-43881
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commer services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1 [AD-A171402] HOWARD, A. J. An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303] HSU, K. H. Computer-aided engineering [AD-A162811] HSU, S. Systems modeling and DBMS applic management	that r p 89 cial spa p 96 sion on p 93 e Sta p 59 p 81 ation ir p 74	eed to be A86-43346 ace platform N86-30744 the Space N86-24726 tion Health A86-46938 N86-24256 test assets A86-43881
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commer services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1 [AD-A171402] HOWARD, A. J. An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] HSU, K. H. Computer-aided engineering [AD-A162811] HSU, S. Systems modeling and DBMS applic management HU, R. Chinese space and aviation indus breakthroughs [NASA-TM-87973]	that r p 89 cial spa sion on p 93 e Sta p 59 p 81 ation ir p 74 tries s	eed to be A86-43346 ace platform N86-30744 the Space N86-24726 tion Health A86-46938 N86-24256 test assets A86-43881
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commer services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1 [AD-A171402] HOWARD, A. J. An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303] HSU, K. H. Computer-aided engineering [AD-A162811] HSU, S. Systems modeling and DBMS applic management HU, R. Chinese space and aviation indus breakthroughs [NASA-TM-87973] HUBBARD, H. H. Sonic-boom research: Selected	that r p 89 cial spa p 96 sion or p 93 e Stai p 59 p 81 ation ir p 74 tries s p 25	eed to be A86-43346 to e platform N86-30744 the Space N86-24726 tion Health A86-46938 N86-24256 test assets A86-43881 core major N86-23749
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commer services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1 [AD-A171402] HOWARD, A. J. An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303] HSU, K. H. Computer-aided engineering [AD-A162811] HSU, S. Systems modeling and DBMS applic management HU, R. Chinese space and aviation indus breakthroughs [NASA-TM-87973] HUBBARD, H. H. Sonic-boom research: Selected annotation [NASA-TM-87685]	that r p 89 cial spa p 96 sion on p 93 e Stai p 59 p 81 ation ir p 74 tries s p 25 bibliog	eed to be A86-43346 to e platform N86-30744 the Space N86-24726 tion Health A86-46938 N86-24256 test assets A86-43881 core major N86-23749
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commer services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1 [AD-A171402] HOWARD, A. J. An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303] HSU, K. H. Computer-aided engineering [AD-A162811] HSU, S. Systems modeling and DBMS applic management HU, R. Chinese space and aviation indus breakthroughs [NASA-TM-87973] HUBBARD, H. H. Sonic-boom research: Selected annotation [NASA-TM-87685] HUDSON, H. E. Satellite communications for developin conjecture to reality	that r p 89 sion or p 93 e Star p 59 p 81 ation ir p 74 tries s p 25 bibliog p 65 ng coui	eed to be A86-43346 to platform N86-30744 the Space N86-24726 tion Health A86-46938 N86-24256 test assets A86-43881 core major N86-23749 graphy with N86-30470
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commer services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1 [AD-A171402] HOWARD, A. J. An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303] HSU, K. H. Computer-aided engineering [AD-A162811] HSU, S. Systems modeling and DBMS applic management HU, R. Chinese space and aviation indus breakthroughs [NASA-TM-87973] HUBBARD, H. H. Sonic-boom research: Selected annotation [NASA-TM-87685] HUDSON, H. E. Satellite communications for developi	that r p 89 p 96 sion or p 93 e Star p 59 p 81 ation ir p 74 tries s p 25 bibliog p 65 ng coul p 52	eed to be A86-43346 to platform N86-30744 the Space N86-24726 tion Health A86-46938 N86-24256 test assets A86-43881 core major N86-23749 graphy with N86-30470 ntries - From A86-24672
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commer services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1 [AD-A171402] HOWARD, A. J. An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303] HSU, K. H. Computer-aided engineering [AD-A162811] HSU, S. Systems modeling and DBMS applic management HU, R. Chinese space and aviation indus breakthroughs [NASA-TM-87973] HUBBARD, H. H. Sonic-boom research: Selected annotation [NASA-TM-87685] HUDSON, H. E. Satellite communications for developi conjecture to reality HUDSON, N. R. Automation in the cockpit - Who's in [SAE PAPER 841534] HUNT, E. Problem solving under time-constrai	that r p 89 p 96 sion or p 93 e Star p 59 p 81 ation ir p 74 tries s p 25 bibliog p 65 ng coul p 52 coharg p 37 nts	eed to be A86-43346 ice platform N86-30744 ithe Space N86-24726 ition Health A86-46938 N86-24256 itest assets A86-43881 icore major N86-23749 graphy with N86-30470 intries - From A86-24672 e? A86-26005
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commer services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1 [AD-A171402] HOWARD, A. J. An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303] HSU, K. H. Computer-aided engineering [AD-A162811] HSU, S. Systems modeling and DBMS applic management HU, R. Chinese space and aviation indus breakthroughs [NASA-TM-87973] HUBBARD, H. H. Sonic-boom research: Selected annotation [NASA-TM-87685] HUBSON, H. E. Satellite communications for developi conjecture to reality HUDSON, N. R. Automation in the cockpit - Who's ir [SAE PAPER 841534] HUNT, E. Problem solving under time-constrai [AD-A158921] HUNT, V. D.	that r p 89 p 96 ision or p 93 e Stai p 59 p 81 tries s p 25 bibliog p 65 ng coul p 52 charg p 37 nts p 6	eed to be A86-43346 to platform N86-30744 the Space N86-24726 tion Health A86-46938 N86-24256 test assets A86-43881 core major N86-23749 graphy with N86-30470 ntries - From A86-24672 e? A86-26005 N86-15957
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commer services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1 [AD-A171402] HOWARD, A. J. An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303] HSU, K. H. Computer-aided engineering [AD-A162811] HSU, S. Systems modeling and DBMS applic management HU, R. Chinese space and aviation indus breakthroughs [NASA-TM-87973] HUBBARD, H. H. Sonic-boom research: Selected annotation [NASA-TM-87685] HUDSON, N. R. Automation in the cockpit - Who's ir [SAE PAPER 841534] HUNT, E. Problem solving under time-constrai [AD-A158921] HUNT, V. D. Smart robots: A handbook of systems	that r p 89 p 96 ision or p 93 e Stai p 59 p 81 tries s p 25 bibliog p 65 ng coul p 52 charg p 37 nts p 6	eed to be A86-43346 ice platform N86-30744 ithe Space N86-24726 ition Health A86-46938 N86-24256 itest assets A86-43881 icore major N86-23749 graphy with N86-30470 intries - From A86-24672 e? A86-26005
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commer services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1 [AD-A171402] HOWARD, A. J. An updated model for a Space Maintenance Facility [AIAA PAPER 86-2303] HSU, K. H. Computer-aided engineering [AD-A162811] HSU, S. Systems modeling and DBMS applic management HU, R. Chinese space and aviation indus breakthroughs [NASA-TM-87973] HUBBARD, H. H. Sonic-boom research: Selected annotation [NASA-TM-87685] HUDSON, N. R. Automation in the cockpit - Who's ir [SAE PAPER 841534] HUNT, E. Problem solving under time-constrai [AD-A158921] HUNT, V. D. Smart robots: A handbook of systems	that r p 89 cial space p 96 sion or p 93 e Stat p 59 p 81 ation irr p 74 tries s p 25 bibliog p 65 ng could p 52 p 65 ng could p 52 n charg p 93 tries s ng could p 53 p 54 p 59 p 74 tries s p 59 p 74 tries s p 75 p 74 tries s p 75 p 75 p 75 p 75 p 75 p 75 p 75 p 75	eed to be A86-43346 to platform N86-30744 in the Space N86-24726 tion Health A86-46938 N86-24256 in test assets A86-43881 core major N86-23749 graphy with N86-30470 ntries - From A86-24672 e? A86-26005 N86-15957 ent robotic A86-37624
The Space Station - Past, present an thoughts on some legal questions addressed A study of factors related to commer- services [NASA-CR-176881] HOTZ, R. B. Report of the Presidential Commiss Shuttle Challenger Accident, volume 1 [AD-A171402] HOWARD, A. J. An updated model for a Spac Maintenance Facility [AIAA PAPER 86-2303] HSU, K. H. Computer-aided engineering [AD-A162811] HSU, S. Systems modeling and DBMS applic management HU, R. Chinese space and aviation indus breakthroughs [NASA-TM-87973] HUBBARD, H. H. Sonic-boom research: Selected annotation [NASA-TM-87685] HUBSON, H. E. Satellite communications for developi conjecture to reality HUDSON, N. R. Automation in the cockpit - Who's ir [SAE PAPER 841534] HUNT, E. Problem solving under time-constrai [AD-A158921] HUNT, V. D. Smart robots: A handbook of systems	that r p 89 cial space p 96 sion or p 93 e Stat p 59 p 81 ation irr p 74 tries s p 25 bibliog p 65 ng could p 52 p 65 ng could p 52 n charg p 93 tries s tries s p 25 bibliog p 33 tries s p 25 bibliog p 33 tries s p 34 tries s p 35 bibliog p 35 p 35 p 35 bibliog p 35 p 35 p 35 p 35 p 35 p 35 p 35 p 35	eed to be A86-43346 to platform N86-30744 in the Space N86-24726 tion Health A86-46938 N86-24256 in test assets A86-43881 core major N86-23749 graphy with N86-30470 ntries - From A86-24672 e? A86-26005 N86-15957 ent robotic A86-37624 works A86-21973

improvement p 80 N86-15160

HUTCHINSON, D. H.

HUTTENLOCHER, D. P.

HUTTENLOCHER, D. P.

- Exploiting sequential phonetic constraints in recognizing spoken words
- [AD-A165913] p 34 N86-29120 HYDE, R. A.

Toward a permanent lunar settlement in the coming decade: the Columbus Project [DE86-006709] p 14 N86-29874

I

IDESAWA, M.

- A study on robot path planning from a solid model p 32 A86-43061
- IGENBERG, E.
- Economic equity and international cooperation The example of E.S.A p 83 A86-15943 [IAF PAPER 85-499] ISAAC, I. E.
- Guide on selecting ADP (Automatic Data Processing)backup processing alternatives p 44 N86-26241 (PB86-154820)
- ISHIKAWA, M. Y. Toward a permanent lunar settlement in the coming decade: the Columbus Project
- [DE86-006709] p 14 N86-29874 ITOH, Y.
- A study on robot path planning from a solid model p 32 A86-43061

J

JACOBSON, H. Considerations for the implementation of intelligent workstation networks [AIAA PAPER 85-4001] p 36 A86-10948 JAMES, E. Spacelab Hitchhiker, for rapid, low cost orbital resources p 56 A86-34991 JARMAN, J. ENVIROSAT-2000 report: Federal agency satellite requirements [NASA-TM-88752] p 63 N86-26355 JENNINGS, D. M. Computer networking for scientists p 37 A86-27166 JENSEN. R. S. Symposium on Aviation Psychology, 3rd, Columbus, OH, p 2 A86-29851 April 22-25, 1985, Proceedings JOHNSON, C. PASSCAL Field Data Management Plan (PFDMP) [DE86-003192] p 43 N86-24285 JOHNSON, E. H. ASTROS - An advanced software environment for automated design p 39 A86-38807 [AIAA PAPER 86-0856] JOHNSON, L. L. Telecommunications alternatives for federal users: Market trends and decisionmaking criteria p 13 N86-25687 [PB86-153764] JOHNSON, W. A. The key to successful management of STS operations: An integrated production planning system p 12 N86-15161 JOHNSTON, D. M. Establishing a successful management information system for project management [DE85-018543] p 42 N86-19251 JOHNSTON, N. J. Tough composite materials: Recent developments p 22 A86-45300 JOHNSTON, P. H. Budget effects of the Challenger accident p 92 N86-20464 JOHNSTON, W. A., JR. Economic considerations of space manufacturing p 67 A86-21886 JONES, S. Selecting interrelated R&D projects in space technology planning p 54 A86-29750 JONES, W. H. Computing Services Software Library [DE86-009491] p 48 N86-32340 JONES, W. R. A computer modeling methodology and tool for assessing design concepts for the Space Station Data Management System [NASA-TM-87647] p 43 N86-24737 JURGENS, P. Robot end effector [PB86-166042] p 34 N86-27663

- KAGAN, R. S.
- Group structure and group process for effective space p 5 N86-15186 station astronaut teams KAISER, J.
- Satellite communications basics A colloquium lecture p 18 A86-29680 KAMMER. D.
- Real-time production system for intelligent robot control p 36 N86-31271
- [DE86-008501] KANAYAMA, Y.
- Computer architecture for intelligent robots p 28 A86-13529
- KANDEBO, S. W. Structures in space - Contractors adapt earth-based construction methods to microgravity p 17 A86-24106 Manufacturers seek reduced costs through new fabrication techniques p 22 A86-49448
- KANERVA, P.
 - Parallel structures in human and computer memory [NASA-TM-89402] p 46 N86-29535 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 KANOK-NUKULCHAI, W.
- On a microcomputer integrated system for structural engineering practices p 21 A86-39794 KAPLAN. M.
- Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume [NASA-CR-174978] p 70 N86-16451 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 2
- p 24 N86-16452 [NASA-CR-174979] KARSH. B. PASSCAL Field Data Management Plan (PFDMP)
- [DE86-003192] p 43 N86-24285 KAUFMAN. C. W.
- System architecture for partition-tolerant distributed databases p 37 A86-17769 KAVANAUGH. C.
 - Shuttle-launch triangular space station
- p 93 N86-24729 [NASA-CASE-MSC-20676-1] KEATING, R. J.
- National and international cooperation in remote sensing and applications [AIAA PAPER 86-0412]
- p 84 A86-19861 KEINER, W. L.
- Testability management through MIL-STD-2165 p 80 A86-43901
- KELLEHER, K. J. P. Low cost access to space - A second-generation Shuttle concept p 55 A86-32913 KELLY, B. J.
- Results of innovative communication processes on productivity gains in a high technology environment p 6 N86-15203
- KENNEY, S. C. Airline indemnity agreements - Will the contracts shift your risks? p 88 A86-34228 KEREN, G. B.
- Risk propensity, action readiness and the roles of societal and individual decision makers [IZF-1984-27] p 12 N86-11077
- KERNER, A. Maintenance planning for the 1990's (initial planning) [PB86-106010] p 75 N86-22065 KERSTEN, M. L.
- A relational database environment for software development [IR-86]
- p 47 N86-30398 KESSEL, D. S. Allocation of tasks to robots for improved safety
- [DE86-002366] p 33 N86-22955 KÈSSLER, K. G.
- Technical activities 1983, Center for Basic Standards [PB86-140043] p 81 N86-26239 KIDWELL G H
- Expert systems and their use in augmenting design optimization [AIAA PAPER 85-3095] p 28 A86-14434
- KIERULFF, H. Financing applied R and D in smaller companies [PB86-196987] p 71 N86-28783
- KIESLING, J. D. A shared satellite system would satisfy many future
- aviation needs p 51 A86-20921 KILGORE, R. A. Cryogenic wind tunnels for high Reynolds number
- testing [NASA-TM-87743] p 26 N86-29872

KILLINGSWORTH, P. S.
A cost analyst's guide to satellite autonomy and fault-tolerant computing
[AD-A161853] p 71 N86-23630 KING, D. C.
Efficiency and innovation: Steps toward collaborative interactions p 62 N86-15168
KING, D. W.
Measuring the value of information and information systems, services and products p 45 N86-28799
KING, E. H.
Aviation maintenance management p 72 A86-21055
KING, M. S. Knowledge-based systems: How will they affect
manufacturing in the 80's
[DE85-010601] p 32 N86-13027 KING, S.
Europe goes independent p 52 A86-21524 KIRCHNER-DEAN, E.
An annotated bibliography of literature integrating organizational and systems theory
[AD-A160912] p 12 N86-19249
KLIMA, S. J. Nondestructive techniques for characterizing
mechanical properties of structural materials: An overview
[NASA-TM-87203] p 80 N86-19636 KNIBB, R. R.
Maintenance planning for the 1990's (initial planning)
[PB86-106010] p 75 N86-22065 KNIGHT, J.
Software management tools: Lessons learned from use p 47 N86-30360
KNIGHT, N. F., JR.
Computational structural mechanics: A new activity at the NASA Langley Research Center
[NASA-TM-87612] p 23 N86-11540 KOLCUM, E. H.
Space Station manager's next big job is to drum up business p 67 A86-24110
KOLLER, A. M., JR. Earth based approaches to enhancing the health and
safety of space operations [IAF PAPER 85-330] p 77 A86-15833
KONVALINKA, M. J.
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program
KONVALINKA, M. J. Discounted cash flow model for the industrial
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 KOOTER, M. A. A. Developments in quality control
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 KOOTER, M. A. A. Developments in quality control [REPT-186] p 81 KOREN, Y.
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 KOOTER, M. A. A. Developments in quality control [REPT-186] p 81 ROBCEN, Y. Robotics for engineers p 27 A86-10560 KRUMPE, P. F.
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 NOOTER, M. A. A. Developments in quality control [REPT-186] p 81 KOREN, Y. Robotics for engineers p 27
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 KOOTER, M. A. A. Developments in quality control [REPT-186] p 81 N86-19638 KOREN, Y. Robotics for engineers p 27 A86-10560 KRUMPE, P. F. Use of satellite data in international disaster management The view from the U.S. Department of State p 85 A86-21126
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 KOOTER, M. A. A. Developments in quality control [REPT-186] p 81 N86-19638 KOREN, Y. Robotics for engineers p 27 A86-10560 KRUMPE, P. F. Use of satellite data in international disaster management The view from the U.S. Department of State p 85 A86-21126 KUGATH, D. A. Developments of the term of term of the term of the term of
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 KOOTER, M. A. A. Developments in quality control [REPT-186] p 81 N86-19638 KOREN, Y. Robotics for engineers p 27 A86-10560 KRUMPE, P. F. Use of satellite data in international disaster management The view from the U.S. Department of State p 85 A86-21126 KUGATH, D. A. Developments of the task of the task of the task of the task of task
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 KOOTER, M. A. A. Developments in quality control [REPT-186] p 81 N86-19638 KOREN, Y. Robotics for engineers p 27 A86-10560 KRUMPE, P. F. Use of satellite data in international disaster management The view from the U.S. Department of State p 85 A86-21126 KUGATH, D. A. Automation requirements derived from space manufacturing p 11 A86-40526 KUIPER, H. Due-date reliability in a repair shop: Implications for
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 KOOTER, M. A. A. Developments in quality control [REPT-186] p 81 N86-19638 KOREN, Y. Robotics for engineers p 27 A86-10560 KRUMPE, P. F. Use of satellite data in international disaster management The view from the U.S. Department of State p 85 A86-21126 KUGATH, D. A. Automation requirements derived from space manufacturing molater enlability in a repair shop: Implications for organizational and work design [THE/BDK/KBS/84-14]
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 KOOTER, M. A. A. Developments in quality control [REPT-186] p 81 N86-19638 KOREN, Y. Robotics for engineers p 27 A86-10560 KRUMPE, P. F. Use of satellite data in international disaster management The view from the U.S. Department of State VGATH, D. A. Automation requirements derived from space manufacturing Due-date reliability in a repair shop: Implications for organizational and work design [THE/BDK/KBS/84-14] p 27 N86-32333 KUKLA, J. C. Productivity enhancement planning using participative
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 KOOTER, M. A. A. Developments in quality control [REPT-186] p 81 N86-19638 KOREN, Y. Robotics for engineers p 27 A86-10560 KRUMPE, P. F. Use of satellite data in international disaster management The view from the U.S. Department of State KUGATH, D. A. Automation requirements derived from space manufacturing p 11 A86-40526 KUIPER, H. Due-date reliability in a repair shop: Implications for organizational and work design [THE/BDK/KBS/84-14] p 27 N86-32333 KUKLA, J. C. Productivity enhancement planning using participative management concepts p 6 N86-15202 KUTYNA, D. J. Litter to the space provide the s
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 NBCOTER, M. A. A. Developments in quality control [REPT-186] p 81 NBCOTER, M. A. A. Developments in quality control [REPT-186] p 81 NBCOTER, M. A. A. Developments in quality control [REPT-186] p 81 NBCOTER, Y. Robotics for engineers p 27 ABC-19538 KUMPE, P. F. Use of satellite data in international disaster management The view from the U.S. Department of State p 85 Automation requirements derived from space manufacturing p 11 Due-date reliability in a repair shop: Implications for organizational and work design [THE/BDK/KBS/84-14] p 27 N86-32333 KUKLA, J. C. Productivity enhancement planning using participative management concepts p 6 N86-15202 KUTYNA, D. J. Report of the Presidential Commission on the Space <
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 KOOTER, M. A. A. Developments in quality control [REPT-186] p 81 N86-19638 KOREN, Y. Robotics for engineers p 27 A86-10560 KRUMPE, P. F. Use of satellite data in international disaster management The view from the U.S. Department of State p 85 A86-21126 KUGATH, D. A. Automation requirements derived from space manufacturing p 11 A86-40526 KUIPER, H. Due-date reliability in a repair shop: Implications for organizational and work design [THE/BDK/KBS/84-14] p 27 N86-32333 KUKLA, J. C. Productivity enhancement planning using participative management concepts p 6 N86-15202 KUTYNA, D. J. Kutya, D. J. Kutya, D. Kutya, D. Kutya, D.
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 KOOTER, M. A. A. Developments in quality control [REPT-186] p 81 N86-19638 KOREN, Y. Robotics for engineers p 27 A86-10560 KRUMPE, P. F. Use of satellite data in international disaster management The view from the U.S. Department of State p 85 A86-21126 KUGATH, D. A. Automation requirements derived from space manufacturing material and work design [THE/BDK/KBS/84-14] p 27 N86-32333 KUKLA, J. C. Productivity enhancement planning using participative management concepts p 6 N86-15202 KUTYNA, D. J. Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 1
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 KOOTER, M. A. A. Developments in quality control [REPT-186] p 81 N86-19638 KOREN, Y. Robotics for engineers p 27 A86-10560 KRUMPE, P. F. Use of satellite data in international disaster management The view from the U.S. Department of State p 85 A86-21126 KUGATH, D. A. Automation requirements derived from space manufacturing material and work design [THE/BDK/KBS/84-14] p 27 N86-32333 KUKLA, J. C. Productivity enhancement planning using participative management concepts p 6 N86-15202 KUTYNA, D. J. Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 1
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 N86-24589 KOOTER, M. A. A. Developments in quality control [REPT-186] p 81 N86-19638 KOREN, Y. Robotics for engineers p 27 A86-10560 KRUMPE, P. F. Use of satellite data in international disaster Use of satellite data in international disaster p 85 A86-21126 KUGATH, D. A. Automation requirements derived from space manufacturing Due-date reliability in a repair shop: Implications for organizational and work design [THE/BDK/KBS/84-14] Due-date reliability in a repair shop: Implications for organizational and work design [THE/BDK/KBS/84-14] P of outivity enhancement planning using participative management concepts p 6 N86-15202 KUTYNA, D. J. Report of the Presidential Commission on the Space shuttle Challenger Accident, volume 1 [AD-A171402] p 93 N86-24726
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 NBCOTER, M. A. A. Developments in quality control [REPT-186] p 81 N86-19638 KOREN, Y. Robotics for engineers p 27 A86-10560 KRUMPE, P. F. Use of satellite data in international disaster management The view from the U.S. Department of State KUGATH, D. A. Automation requirements derived from space manufacturing mucdate reliability in a repair shop: Implications for organizational and work design [THE/8DK/KBS/84-14] CHE/BDK/KBS/84-14] P 70 N86-32333 KUKLA, J. C. Productivity enhancement planning using participative management concepts p 6 N86-15202 KUTYNA, D. J. Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 1 [AD-A171402] p 93 N86-24726
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 NBCOTER, M. A. A. Developments in quality control [REPT-186] p 81 NBCOTER, M. A. A. Developments in quality control [REPT-186] p 81 NBCOTER, Y. Robotics for engineers p 27 A86-10560 KUMPE, P. F. Use of satellite data in international disaster management The view from the U.S. Department of State KUGATH, D. A. Automation requirements derived from space manufacturing p 11 A86-40526 KUIPER, H. Due-date reliability in a repair shop: Implications for organizational and work design [THE/BDK/KBS/84-14] p 27 NRCLA, J. C. Productivity enhancement planning using participative management concepts p 6 N86-15202 KUTYNA, D. J. Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 1 [AD-A171402] p 93 N86-24726 L
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 NBCOTER, M. A. A. Developments in quality control [REPT-186] p 81 N86-19638 KOREN, Y. Robotics for engineers p 27 A86-10560 KRUMPE, P. F. Use of satellite data in international disaster management The view from the U.S. Department of State KUGATH, D. A. Automation requirements derived from space manufacturing matcuturing p 11 A86-40526 KUIPER, H. Due-date reliability in a repair shop: Implications for organizational and work design [THE/BDK/KBS/84-14] p 27 NREASUME, F. Productivity enhancement planning using participative management concepts p 6 N86-15202 KUTYNA, D. J. Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 1 [AD-A171402] p 93 N86-24726 L L L LABRUNE, F. Depot maintenance of aviation components: Contractor versus organic repair [AD-A162071]
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 NBCOTER, M. A. A. Developments in quality control [REPT-186] p 81 NBCOTER, M. A. A. Developments in quality control [REPT-186] p 81 NBCOTER, Y. Robotics for engineers p 27 A86-10560 KUMPE, P. F. Use of satellite data in international disaster management The view from the U.S. Department of State p 85 A86-21126 KUGATH, D. A. Automation requirements derived from space manufacturing p 11 A86-40526 KUIPER, H. Due-date reliability in a repair shop: Implications for organizational and work design [THE/BDK/KBS/84-14] p 27 N86-32333 KURLA, J. C. Productivity enhancement planning using participative management concepts p 6 N86-15202 KUTYNA, D. J. Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 1 [AD-A171402] [AD-A171402] p 93 N86-24726 L L
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 NBCOTER, M. A. A. Developments in quality control [REPT-186] p 81 NBCOTER, M. A. A. Developments in quality control [REPT-186] p 81 NBCOTER, Y. Robotics for engineers p 27 A86-10560 KUMPE, P. F. Use of satellite data in international disaster management The view from the U.S. Department of State KUGATH, D. A. Automation requirements derived from space manufacturing p 11 A86-40526 KUIPER, H. Due-date reliability in a repair shop: Implications for organizational and work design [THE/BDK/KBS/84-14] p 27 N86-32333 KUKLA, J. C. Productivity enhancement planning using participative management concepts p 6 N86-15202 KUTYNA, D. J. Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 1 [AD-A171402] p 93 N86-24726 L L L LABERUNE,
KONVALINKA, M. J. Discounted cash flow model for the industrial modernization incentives program [AD-A162968] p 25 NBCOTER, M. A. A. Developments in quality control [REPT-186] p 81 NBCOTER, M. A. A. Developments in quality control [REPT-186] p 81 NBCOTER, M. A. A. Developments in quality control [REPT-186] p 81 NBCOTER, Y. Robotics for engineers p 27 A86-10560 KRUMPE, P. F. Use of satellite data in international disaster management The view from the U.S. Department of State p 85 A86-21126 KUGATH, D. A. Automation requirements derived from space manufacturing mutacturing p 11 Due-date reliability in a repair shop: Implications for organizational and work design [THE/BDK/KBS/84-14] p 27 N86-32333 KUKLA, J. C. Productivity enhancement planning using participative management concepts p 6 N86-15202 KUTYNA, D. J. Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 1 <

p 17 A86-24988 Preparing for the LHX cocknit What technologies await the future airliner? p 19 A86-31038

LAMONTAGNE, R. H.

Primer on operating and support (O and S) costs for space systems [AD-A162381] p 71 N86-24588

B-6

PERSONAL AUTHOR INDEX

LANCE, N., JR. Automated subsystems control development [SAE PAPER 851379] p 10 A86-23561 LANDGREBE, D. A. Remote sensing research - The past as prolog p 10 A86-19487 LANDWEBER, L. H. Computer networking for scientists p 37 A86-27166 LANGE, R. H. A review of unconventional aircraft design concepts p 22 A86-48995 LANGEREUX, P. Europe aims for space independence p 88 A86-35562 LAPORTE-WEYWADA, H. Ariane 5 - A new launcher for Europe p 18 A86-28596 (AAS 84-2261 LAURIA, R. International space law and direct broadcast satellites p 85 A86-24675 LAURIENTE. M. Shuttle environment database p 39 A86-28578 [AAS 85-103] LAWING, P. L. Cryogenic wind tunnels for high Reynolds number testing [NASA-TM-87743] p 26 N86-29872 LAWLER, A. Future space goals - National commission defines U.S. options for the 21st century p 85 A86-24127 LEHMAN, D. H. A technique for lowering risks during contract egotiations p 57 A86-40999 negotiations LEHNER, P. E. Human factors in rule-based systems [AD-A165309] p 8 N86-26840 LEINER. B. M. Access control and privacy in large distributed systems INASA-TM-893971 p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures p 46 N86-29569 [NASA-TM-89388] LENGNICK-HALL, C. A. Efficiency and innovation: Steps toward collaborative p 62 N86-15168 interactions LENNOX, R. C. Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 LERNER, E. J. A self-repairing aircraft? p 16 A86-14243 LEUNG. J. Y. Computer-aided engineering AD-A162811] p 81 N86-24256 LEVINSON. T. M. Technology transfer is opportunity transfer [DE85-016622] p 62 N86-17230 LEVY. D. M. Trends in industrial R and D activities in the United States, Europe and Japan, 1963-83 [PB86-141371] p 63 N86-25290 LEWIS, C. M. Significance testing of rules in rule-based models of human problem solving p 2 A86-25038 LEYDESDORFF, L. Evaluation of research: Experiences and perspectives in the Netherlands [ESA-86-96709] p 65 N86-31461 LEZNIAK, T. W. The engineering data management and analysis system (EDMAS) p 39 A86-28482 LICHTENBERG, B. Science requirements for Space Station Laboratory [SAE PAPER 851368] p 52 A86-23552 p 52 A86-23552 LICHTENSTEIN, S. Risk propensity, action readiness and the roles of societal and individual decision makers p 12 N86-11077 [IZF-1984-27] LICHY, D. ENVIROSAT-2000 report: Federal agency satellite requirements [NASA-TM-88752] p 63 N86-26355 LIEBESMAN, B. S. Reliability requirements and contractual provisions p 78 A86-22377 LIM, J. J. Framework for generating expert systems to perform computer security risk analysis [DE85-014134] p 41 N86-10841 LINSENMANN, K. Database capacity planning and management [DE86-009076] p 48 N86-32338 LITTLEFIELD, R. G. Report on active and planned spacecraft and

experiments [NASA-TM-87499] p 61 N86-13343 LITTY, J. D. Enabling technologies for transition to utilization of space-based resources and operations p 56 A86-34992

LIU. W. K. Computer-aided engineering [AD-A162811] p 81 N86-24256 LIVESAY, H. C.

Financing applied R and D in smaller companies p 71 N86-28783 (PB86-196987) LLEWELLYN-JONES. D. T.

ERS-1 - Our new window on the oceans for the 1990s p 57 A86-38718 LOGSDON, J.

Space Shuttle development p 11 A86-46425 Commercialization of the land remote sensing system: An examination of mechanisms and issues [E86-10008] p 24 N86-14710

- LOGSDON, J. M. International involvement in the US space station programme p 85 A86-22244 Status of space commercialization in the USA
- p 87 A86-29696 The decision to develop the Space Shuttle p 58 A86-44404

LOHMAN, R. L. Spacelab Hitchhiker, for rapid, low cost orbital p 56 A86-34991 resources

- LOTTMANN, R. V. Internationalization of the Space Station p 56 A86-34974
- LOVELL. R. Global interconnectivity in the next two decades - A scenario
- [AIAA PAPER 86-0605] p 54 A86-29581 LUCAS, W. R.
- National space transportation systems planning p 54 A86-32527 LUGER. G. F.
- Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954 LUNDQUIST, C. A.
- Commerical use of space Status and prospects p 58 A86-41154

LUXENBERG, B. Aspects of law and practice in the United States p 89 A86-43349

Μ

MACAULEY. M. K. An economics perspective of the 21st century Space Station [AIAA PAPER 86-2348] p 70 A86-46961 MACCREADY, P. Long endurance aircraft performance p 80 A86-49478 MACHON, J. J. Aircraft ground support equipment standardization - The and cons of 'functional' vs pros 'technical . standardization [SAE PAPER 851794] p 79 A86-38317 MACK, O., JR. Planning for cost/schedule control in a software p 38 A86-28422 development project MACKALL, D. A. Development experience with a simple expert system demonstrator for pilot emergency procedures [NASA-TM-85919] p 33 N86-23603 MACKIE, R. R. Technology transfer and artificial intelligence [AD-A166035] p 36 N86-30581 MACLELLAN, D. C. The suitability of various spacecraft for future space applications missions [NASA-TM-88986] p 64 N86-27409 MACMILLIAN. M. New job for NASA is marketing management p 69 A86-41681 MADNI, A. M. Intelligent interfaces for human control of advanced p 29 A86-21889 automation and smart systems MAEHL, R. Satellite leasing - Cheap access to space p 72 A86-22267 MAEHL, R. C. Commercialization of space - A comprehensive approach [IAF PAPER 85-431] p 50 A86-15902 MAGLIERI, D. J. Sonic-boom research: Selected bibliography with annotation [NASA-TM-87685] p 65 N86-30470

MALONE, S. PASSCAL Field Data Management Plan (PFDMP) [DE86-003192] p 43 N86-24285 MANDAKOVIC, T. Estimating - The input into good project planning p 67 A86-17673 MANDELL, H. C., JR. Space Station - The first step [AAS 84-160] p 87 A86-28786 MANDERLINK, G. Management behavior, group climate and performance appraisal at NASA p 4 N86-15163 MANN. P. Washington broadens its efforts to aid small business p 67 A86-24102 MANNO. V. Horizon 2000 and its relation to the Columbus Programme p 59 A86-45643 MARINO, P. P. Improved productivity through interactive p 12 N86-15181 communication MARKS. P. S. The Crew Station Information Manager - An avionics p 30 A86-28515 expert system MARSHALL, H. R., JR. US space commercialization - Effects on space law and p 84 A86-18384 domestic law US space programs: Cooperation and competition from Europe [BPA-CP-695] p 90 N86-12163 MARTELLO, N. V. Development of space technology for ecological p 63 N86-19943 habitats MARUMO, M. A commercial communications satellite system for Japan [AIAA PAPER 86-0680] p 18 A86-29674 MÀSARATI, P. The space industry for communications and remote sensina AAS 85-1361 p 52 A86-28593 MASON-SMITH I A programme manager's needs for information p 45 N86-28795 MASON, J. D. Standard generalized markup language: A technique for document interchange [DE86-011504] p 48 N86-31777 MÁSSEY. H. History of British space science p 87 A86-33604 MATHEWŚ. C. W. The suitability of various spacecraft for future space applications missions [NASA-TM-88986] p 64 N86-27409 MCARDLE, R. ENVIROSAT-2000 report: Federal agency satellite requirements [NASA-TM-88752] p 63 N86-26355 MCBEATH, J. W. Satellite system operations - A view from the trenches [AIAA PAPER 86-0705] p 11 A86-29652 MCCLENON, P. R. Discounted cash flow model for the industrial modernization incentives program (AD-A1629681 p 25 N86-24589 MCCLOY, T. M. Workload assessment - Progress during the last decade [SAE PAPER 851877] p 3 A86-35440 MCDOUGALL, W. A. The heavens and the earth: A political history of the pace age p 87 A86-34134 space age MCELROY, J. H. The Space Station Polar Platforms - Integrating research and operational missions [AIAA PAPER 85-3000] p 49 A86-12935 MCFARLAND, A. L. Procedures for cause oriented analysis and consequence oriented analysis [DOT/FAA/PM-86/21] p 44 N86-28067 MCGARRY, F. E. Software productivity improvement through software p 42 N86-15180 engineering technology MCGRATH, C. M. An application of cost risk in incentive contracts [AD-A165177] p 71 N86-27115 MCGUIRE, P. D. Cryogenic wind tunnels for high Reynolds number testing [NASA-TM-87743] p 26 N86-29872 MCKEE. K. E. The role of the technologist in space productivity p 3 A86-34983 MCNULTY, C.

Knowledge engineering for a flight management expert p 30 A86-28498

MEHL, B. Electric power management and distribution for air and space applications p 17 A86-24828
MEINTEL, A. J., JR. Space teleoperation research. American Nuclear
Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in
other hostile environments [NASA-TM-89234] p 35 N86-29513 MEKARU, M. M.
Expert systems for satellite stationkeeping p 30 A86-28497
MELARY, M. F. Large airplane derivative development methodology
[AIAA PAPER 85-3043] p 15 A86-10926 MERKORD, D. L.
Is there life after 10,000 flight hours? p 79 A86-22402
MEYER, S. A. Logistics supportability considerations during conceptual and preliminary design
[AlAA PAPER 85-3052] p 72 A86-10928 MIGLICCO, G.
Shuttle launches of satellites are making space a bottomline business p 67 A86-24104
MILEVSKI, S. N. Public laws of the 98th Congress relating to information
policy [CRS-TK-7885-F] p 94 N86-27130 MILLER, D. B.
Future U.S. meteorological satellite systems [IAF PAPER 84-96] p 49 A86-12361
MILLER, P. A. Space Station polar orbiting platform - Mission analysis
and planning [AIAA PAPER 86-2178] p 60 A86-47960
MILLER, S. M. A comparison of a manual and computer-integrated
production process in terms of process control decision-making
[AD-A168037] p 14 N86-32750 MILLS, J.
Concurrent and sequential networks - Implications for project management p 52 A86-28055 MINECK, R. E.
Adaptive wall wind tunnels: A selected, annotated bibliography
[NASA-TM-87639] p 26 N86-29871 MINTZES, J.
Comparison of scientific and technical personnel trends in the United States, France, West Germany and the United Kingdom since 1970
[PB86-133030] p 7 N86-24554 MITCHELL, B. M.
Telecommunications alternatives for federal users: Market trends and decisionmaking criteria
[PB86-153764] p 13 N86-25687 MITCHELL, C. M.
A discrete control model of PLANT p 47 N86-31220 MITKEVICH, E. A.
In-process inspection of the parameters of the electron beam in electron beam welding p 19 A86-34124
MOJA, D. C. Artificial intelligence - New tools for aerospace project
managers p 30 A86-34986 MONHEMIUS, W. Production and inventory control with the bace stack
Production and inventory control with the base stock system [EUT/BDK/12] p 77 N86-32328
MONK, T. Commercialization of the land remote sensing system:
An examination of mechanisms and issues [E86-10008] p 24 N86-14710
MONTGOMERY, B. G. Economic considerations of space manufacturing
p 67 A86-21886 MONTOYA, G. Technical and management information system: The
tool for professional productivity on the space station program p 41 N86-15171 MOORE, A. L.
Space WARC '85 - A look back p 82 A86-11023 MOORE, D. H.
Budget effects of the Challenger accident p 92 N86-20464
MOORE, J. D. Enhanced maintenance and explanation of expert
systems through explicit models of their development p 28 A86-14847
MOORE, J. M. Scientific program for a Mars base [AAS 84-166] 0.53 A86-28792

Scientific program for a Mars base		
[AAS 84-166]	p 53	A86-28792

MOORE, N. Y.	
Depot maintenance of aviation con versus organic repair	
[AD-A162071] MOORHEAD, M. E.	p 75 N86-23556
Implications of new aircraft performance	avionics reliability p 78 A86-22178
MORAIS, B. G. Requirements, development and p	oromotrio analysis for
space systems division [AIAA PAPER 85-3078]	p 16 A86-10936
WOREL, P. Plan for the implementation o	•
Research Programme MORGAN, H. G.	p 49 A86-10403
Acoustics Division recent ac research plans	complishments and
[NASA-TM-89012] WORI, T.	p 65 N86-31340
Japanese policy on participation program	in the Space Station
[AAS 85-114] WORRIS, N. M.	p 86 A86-28583
The effects of type of knowledge solving in a process control task MOSER, P. J.	upon human problem p 1 A86-17771
	measurements of p 55 A86-33544
 Automation in the cockpit - Who's 	
[SAE PAPER 841534] 2010 - The symbionic cockpit	p 37 A86-26005 p 18 A86-28455
MOTZ, H. Institutional supporting research	and development,
1985 [DE86-008580]	p 65 N86-30583
WUELLER, E. Planning for minimum overhaul tir	
NUESER, R.	p 75 A86-47616
Identifying technical innovations MUGNIER, D.	p 51 A86-17672
The economics of space launch	
[IAF PAPER 85-420] MURPHY, M. F.	p 66 A86-15893
Legislation for software rights pro [SNIAS-861-422-114] WURPHY, W. J.	tection at last p 96 N86-32343
Managing cooperative researc ventures	h and development p 62 N86-15165
UURRAY, N. Optical processing for future com	puter networks p 37 A86-21973
WYERS, M. G. Discounted cash flow model	for the industrial
modernization incentives program [AD-A162968]	p 25 N86-24589
N	
NAGEL, D. C.	
Pilots of the future - Human or co	mputer? p 1 A86-18541
NAGEL, R. N. Robot software: Current state-o challenges	f-the-art, and future p 42 N86-19630
NAGY, K. Shuttle-launch triangular space st	ation
[NASA-CASE-MSC-20676-1]	p 93 N86-24729

NAPOLITANO, L. G.

Present and future prospects of microgravity p 57 A86-37870 NARIN, F.

Linking science, technology and economics data p 44 N86-26006 NASSIFF, S. H.

Government-to-government cooperation in space station development p 91 N86-15166 NEAL, V.

The great observatories for space astrophysics [NASA-CR-176754] p 63 N86-24712 NEBEN, B.

Ada instructional techniques for managers and programmers p 38 A86-28409 programmers NECHES, R.

Enhanced maintenance and explanation of expert systems through explicit models of their development p 28 A86-14847 NELSON, R. O.

Los Alamos software development tools [DE86-006024] p 48 N86-31248 NEOGY, R.

Decision making in product assurance p 78 A86-22394

PERSONAL AUTHOR INDEX

NERTNEY, R. J. Basic human factors considerations
[DE86-008181] p 8 N86-31223 Human factors management
[DE86-008184] p 8 N86-31226 NEUBAUER, C. H., JR.
Future operational plans for the National Space
Transportation System
[AIAA PAPER 86-0090] p 72 A86-19685
NICHOLAS, J. M.
Group structure and group process for effective space
station astronaut teams p 5 N86-15186
NICHOLSON, W. L.
Managing the data analysis progress
p 44 N86-26005
NILES, J. R.
Guide to Canadian aerospace related industries
[AD-A167794] p 26 N86-32327
NILSON, M. C.
Insurance and commercial satellite systems
0 90 A86-44541
NOBLE, D. F.
Schema-based theory of information presentation for
distributed decision making
[AD-A163150] p 13 N86-25992
NOBLES. W.
Tether applications for space station
p 76 N86-28418
NOLLEY, B.
Nuclear power for earth orbit and beyond
p 57 A86-38623
NORDLUND, R. M.
Productivity improvement in engineering at
Rocketdyne p 5 N86-15178
NOTON, B.R.
Airframe design to achieve minimum cost
p 17 A86-22141
0

OBRIEN, C. A. Exploration for strategic materials [PB86-126463] p 75 N86-24005 OLIVERO, J. J. Systematic ground-b mesospheric water vapor ground-based measurements of ter vapor p 55 A86-33544 OLONE, R. G. Entrepreneurial spirit combines with hard-headed p 10 A86-24116 business sense OLSEN, R. E. The roles of astronauts and machines for future space operations [SAE PAPER 851332] p 1 A86-23521 **OOSTERLINCK, R.** The evolution of the agency's patent policy p 85 A86-24598

Ρ

DANCHUDH T
PANGBURN, T. ENVIROSAT-2000 report: Federal agency satellite
requirements
[NASA-TM-88752] p 63 N86-26355
PARAMORE, B.
Human Factors Review Plan
[DE86-010561] p 9 N86-33023
PARISH, R. C.
Shuttle-launch triangular space station
[NASA-CASE-MSC-20676-1] p 93 N86-24729
PARK, A. B. Future of remote sensing - A viewpoint from industry
p 16 A86-19489
F
PARK, W. T.
Modeling and planning robotic manufacturing [AD-A161014] p 24 N86-19620
PARKER, G. R.
Space station program operations - Making it work [AAS PAPER 84-112] p 72 A86-17318
PARKS, D. Organizations as information processing systems:
Environmental characteristics, company performance and
Environmental characteristics, company performance and chief executive scanning, an empirical study
Environmental characteristics, company performance and chief executive scanning, an empirical study [AD-A168035] p 15 N86-33201
Environmental characteristics, company performance and chief executive scanning, an empirical study [AD-A168035] p 15 N86-33201 PATRI, G.
Environmental characteristics, company performance and chief executive scanning, an empirical study [AD-A168035] p 15 N86-33201 PATRI, G. Tomorrow Concorde's successor?
Environmental characteristics, company performance and chief executive scanning, an empirical study [AD-A168035] p 15 N86-33201 PATRI, G. Tornorrow Concorde's successor? p 17 A86-26299
Environmental characteristics, company performance and chief executive scanning, an empirical study [AD-At68035] p 15 N86-33201 PATRI, G. Tomorrow Concorde's successor? p 17 A86-26299 PATROVIC, R. P.
Environmental characteristics, company performance and chief executive scanning, an empirical study [AD-A168035] p 15 N86-33201 PATRI, G. Tomorrow Concorde's successor? p 17 A86-26299 PATROVIC, R. P. The impact of fifth generation technology on test
Environmental characteristics, company performance and chief executive scanning, an empirical study [AD-A168035] p 15 N86-33201 PATRI, G. Tomorrow Concorde's successor? p 17 A86-26299 PATROVIC, R. P. The impact of fifth generation technology on test software p 40 A86-43905
Environmental characteristics, company performance and chief executive scanning, an empirical study [AD-At68035] p 15 N86-33201 PATRI, G. Tomorrow Concorde's successor? p 17 A86-26299 PATROVIC, R. P. The impact of fifth generation technology on test software p 40 A86-43905 PAUL, C.
Environmental characteristics, company performance and chief executive scanning, an empirical study [AD-A160035] p 15 N86-33201 PATRI, G. Tomorrow Concorde's successor? p 17 A86-26299 PATROVIC, R. P. The impact of fifth generation technology on test software p 40 A86-43905 PAUL, C. ENVIROSAT-2000 report: Federal agency satellite
Environmental characteristics, company performance and chief executive scanning, an empirical study [AD-At68035] p 15 N86-33201 PATRI, G. Tomorrow Concorde's successor? p 17 A86-26299 PATROVIC, R. P. The impact of fifth generation technology on test software p 40 A86-43905 PAUL, C.

PERSONAL AUTHOR INDEX

PAULES, G. Space Station overall management approach for operations [AIAA PAPER 86-2322] p 11 A86-49558 PAVLIS, G. PASSCAL Field Data Management Plan (PFDMP) p 43 N86-24285 [DE86-003192] PEARLMAN, F. C. An updated model for a Space Station Health Maintenance Facility p 59 A86-46938 [AIAA PAPER 86-2303] PEARSON, D. J. Guide to Canadian aerospace related industries p 26 N86-32327 [AD-A167794] PECK, B. L. Robotic simulation p 35 N86-30390 [DE86-006517] PECK. D. G. Assessing cost-effective weight saving in aircraft p 16 A86-20039 operations PEERCY, R. L., JR. Threat-strategy technique - A system safety tool for advanced design p 79 A86-32947 PELTON, J. N. Intelsat and the challenge of competitive systems p 84 A86-18394 PENNINGTON, J. E. Space telerobotics - A few more hurdles p 31 A86-37047 PEREK, L. Management of outer space p 84 A86-19261 PESAVENTO, P. Soviet spaceflight comes of age p 88 A86-36449 PETERS, W. The selection and acquisition of commercial aircraft fleets p 74 A86-44935 PETERSBURG, R. K. Streamlining: Reducing costs and increasing STS p 5 N86-15194 operations effectiveness PETERSON, L. R. Human Factors Review Plan [DE86-010561] p 9 N86-33023 PETERSON. T. J. Development history of the Space Shuttle Main Engine [AIAA PAPER 86-1635] p 21 A86-42764 PHILLIPS, C. E. Engineering flight simulation - A revolution of change [SAE PAPER 851901] p 20 A86-36941 PHILLIPS. J. A. Creativity in Science - a symposium p 63 N86-27109 [DE86-003289] PHINNEY, R. PASSCAL Field Data Management Plan (PFDMP) [DE86-003192] p 43 N86-24285 PHOA, Y. T. rapid evaluation approach for configuration Α development of new aircraft [AIAA PAPER 85-3068] p 15 A86-10932 PIASECKI, M. T. Data collection via a quasi-experimental simulation technology. Part 1: Multiple measurement of performance excellence in complex and uncertain managerial tasks p 9 N86-32969 [AD-A167949] PIVIROTTO, D. L. Automation and robotics for Space Station in the twenty-first century [AIAA PAPER 86-2300] p 40 A86-49552 PLUMER, J. A. NASA storm hazards research in lightning strikes to ircraft p 79 A86-37479 aircraft PODSIADLY, C. J. A 3M/NASA basic research program in space p 52 A86-27896 POGASH, R. M. Data collection via a quasi-experimental simulation technology. Part 1: Multiple measurement of performance excellence in complex and uncertain managerial tasks AD-A167949 p 9 N86-32969 POHLMANN, L. D. The Crew Station Information Manager - An avionics expert system p 30 A86-28515 POMALAZA, J. C. Satellite communications planning and equipment manufacturing in Latin America POOLE, R. W., JR. p 19 A86-30187 Cost in space - The price of government control p 68 A86-27885 POORMAN, R. Space Processing Applications Rocket (SPAR) project: SPAR 10

[NASA-TM-86548] p 76 N86-28972 POPOV, Y. P.

Role of robotics in solving production, social problems p 34 N86-26062

PORTER, P. S.

PURIER, P. S.			
New technology implementation: Technical, economic			
and political factors p 24 N86-15172			
PRICE, H. E.			
Automation and the allocation of functions between			
human and automatic control: General method			
[AD-A161072] p 6 N86-20013			
PRINS, A.			
Evaluation of research: Experiences and perspectives			
in the Netherlands			
[ESA-86-96709] p 65 N86-31461			
PROTHERO, W.			
PASSCAL Field Data Management Plan (PFDMP)			
[DE86-003192] p 43 N86-24285			
PRUETT, N. J.			
State of the art of geoscience libraries and information			
services			
[DE86-011188] p 49 N86-33207			
PULLIAM, R.			
Automation and the allocation of functions between			
human and automatic control: General method			
[AD-A161072] p.6 N86-20013			
PUTNAM, T. W.			
Summary of results of NASA F-15 flight research			
program			
[NASA-TM-86811] p 25 N86-26277			

Q

QUIROS, J. Power sensing device [AD-D012171] p 94 N86-26529

R

RAASCH. R. F.

- Threat-strategy technique A system safety tool for advanced design p 79 A86-32947 RACER, R. I.
- Maintenance planning for the 1990's (initial planning) [PB86-106010] p 75 N86-22065 RADIN. H.
- Space WARC '85 A look back p 82 A86-11023 RAGUSA. J. M.
- Historical data and analysis for the first five years of KSC STS payload processing [NASA-TM-83105] p 77 N86-32471
- RAHN, D.
- Mission adaptive wing soars at NASA Facility [P86-10182] p 26 N86-31563
- RAHN, D. J. NASA supercomputer system to become available nationally
- [NASA-ŃEWS-RELEASE-86-92] p 44 N86-28628 RAILLON, E.
- Ariane 5 A new launcher for Europe [AAS 84-226] p 18 A86-28596 RAITT. D. I.
- The information needs of scientists and engineers in aerospace p 45 N86-28796 RAJAN, S. D.
- SADDLE A computer-aided structural analysis and dynamic design language. I - Design system. II - Database management system p 37 A86-25999 RAJU, M. R.
- Creativity in Science a symposium [DE86-003289] p 63 N86-27109
- RAMSEUR, A. Financing applied R and D in smaller companies
- [PB86-196987] p 71 N86-28783 RANEY, W.
- Planning for Space Station utilization
- [IAF PAPER 85-48] p 10 A86-15635 RANFTL, R. M.
- Training managers for high productivity: Guidelines and a case history p 5 N86-15184 RASKIN. A.
- DEASEL: An expert system for software engineering p 47 N86-30361
- RAUGH, M. R. White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures [NASA-TM-89388] p 46 N86-29569 REEDY. A.
- Experience with a software engineering environment framework p 47 N86-30365 REEVES, A. S.
- International information exchange programmes are necessary p 95 N86-28800 REGENIE, V. A.
- Expert systems development and application [NASA-TM-86746] p 32 N86-11194

Description of an experimental expert system flight status monitor
[NASA-TM-86791] p 32 N86-11195
An engineering approach to the use of expert systems technology in avionics applications
[NASA-TM-88263] p 34 N86-24687
REGISTER, M. Have factory, will launch p 16 A86-20591
REIFER, D. J.
Software management tools: Lessons learned from use p 47 N86-30360
REIJNEN, G. C. M. Space law in the United Nations p 85 A86-26546
REINERTSON, L.
Mission adaptive wing soars at NASA Facility [P86-10182] p 26 N86-31563
REINKING, P.
Due-date reliability in a repair shop: Implications for organizational and work design
[THE/BDK/KBS/84-14] p 27 N86-32333
REISING, J. M. Automation in the cockpit - Who's in charge?
[SAE PAPER 841534] p 37 A86-26005
2010 - The symbionic cockpit p 18 A86-28455 REK, B.
Turboprop airliners get bigger - Will they have a
market? p 66 A86-10568 REVESMAN, M. E.
Application of a mathematical model of human decisionmaking for human-computer communication
p 1 A86-25036
Development and validation of a mathematical model of human decisionmaking for human-computer
communication p 2 A86-25037
RHODES, D. D. Systems modeling and DBMS application in test assets
management p 74 A86-43881
RICHARDSON, M. Problem solving under time-constraints
[AD-A158921] p 6 N86-15957 RIDE, S. K.
Report of the Presidential Commission on the Space
Shuttle Challenger Accident, volume 1 [AD-A171402] p 93 N86-24726
ROBERTSON, J.
Commerce Lab - A program of commercial flight opportunities p 56 A86-34965
ROBINS, M. O. History of British space science p 87 A86-33604
ROBINSON, D. E.
Alerted monitors: Human operators aided by automated detectors
[PB85-222750] p 4 N86-13906
ROBINSON, D. L. Large airplane derivative development methodology
[AIAA PAPER 85-3043] p 15 A86-10926 ROBINSON, G. S.
Space Law - The disillusioned maiden in the military
Garden of Eden p 86 A86-27883 ROE, F. D.
Reconfigurable work station for a video display unit and
keyboard [NASA-CASE-MFS-26009-1SB] p 92 N86-22114
ROEDERER, J. G. The participation of developing countries in space
research p 84 A86-18392
Management of outer space for the benefit of mankind p 54 A86-31218
ROGERS, T. F.
Four important issues in the civil space area p 68 A86-27886
ROGERS, W. P. Report of the Presidential Commission on the Space
Shuttle Challenger Accident, volume 1
[AD-A171402] p 93 N86-24726 ROMERO, J.
Space Station utilization for technology purposes
[IAF PAPER 85-50] p 50 A86-15636 RORKE, M. L.
Financing applied R and D in smaller companies [PB86-196987] p 71 N86-28783
ROSE, J. T.
Electrophoresis operations in space - A promising new commercial venture p 59 A86-44548
ROSE, L. A.
Use of satellite data in international disaster management The view from the U.S. Department of
Ciata - 05 A96 01106

- management The view from the U.S. Department of State p 85 A86-21126 ROSENTHAL, H. G.
- An Operations Management System for the Space Station
- [AIAA PAPER 86-2329] p 40 A86-46952 ROSKAM, J.
- Rapid sizing methods for airplanes [AIAA PAPER 85-4031] p 16 A86-10960

B-9

ROUSE, W. B.

- ROUSE, W. B.
- The effects of type of knowledge upon human problem solving in a process control task p 1 A86-17771 RUDA. R. R.

SCHOFIELD, J. M.

propulsion systems

SCHOFIELD, N. J., JR.

AIAA PAPER 86-1134]

The competitive and cooperative outlook for aircraft

Report on active and planned spacecraft and

p 23 A86-49571

- Implementing quality/productivity improvement initiatives in an engineering environment p 80 N86-15158
- RUDWICK, B. H. Aids in validating a contractor's cost estimate [AD-A161871] p 71 N86-24574
- [AD-A161871] p 71 N86-24574 RUKHIN, A. L. Survey of Soviet work in reliability
- [AD-A167607] p 82 N86-32766 RUMMEL, R. W.
- Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 1 [AD-A171402] p 93 N86-24726
- RUNGE, F. C. EOS production on the Space Station
- [AIAA PAPER 86-2358] p 22 A86-46964
- S SABOE, C. US space programs: Cooperation and competition from Europe [BPA-CP-695] p 90 N86-12163 SADIN. S. R. Enabling technologies for transition to utilization of space-based resources and operations p 56 A86-34992 SAMONSKI, F. H., JR. Automated subsystems control development [SAE PAPER 851379] p 10 p 10 A86-23561 SANNEN. A. Semimanufactured products made of copper and copper alloys: An analysis of production and sale in a world perspective [EUT/BDK/15] p 71 N86-31758 SARH. B. Robotic applications to automated composite aircraft component manufacturing [SME PAPER MF85-506] p 17 A86-24667 SARIN, S. K. System architecture for partition-tolerant distributed databases p 37 A86-17769 SAUERWEIN, J. C. Standard reference data publications, 1964-1984 [PB86-155587] p 81 N86-26409 SAUNDERS, N. T. Future directions in aeropropulsion technology p 49 Å86-11602 SAVAGE, G. R. Logistics support economy and efficiency through consolidation and automation p 74 A86-34956 SCHAEFER, R. H. The roles of astronauts and machines for future space operations [SAE PAPER 851332] p 1 A86-23521 Space Station on-orbit operations for the Twenty First Century [AIAA PAPER 86-2331] p 74 A86-46954 SCHAEFER, R. M. Knowledge-based systems: How will they affect manufacturing in the 80's [DE85-010601] p 32 N86-13027 SCHEIMER, J. PASSCAL Field Data Management Plan (PFDMP) [DE86-003192] p 43 N86-24285 SCHLIESING, J. A. Shuttle-launch triangular space station p 93 N86-24729 [NASA-CASE-MSC-20676-1] SCHMID. L. C. Technology transfer is opportunity transfer [DE85-016622] p 62 N86-17230 SCHMIDT, H. R. Regulatory aspects of commercial. space transportation p 91 N86-17409 SCHMITT, H. H. A millennium project - Mars 2000 [AAS 84-151] p 53 A86-28777 SCHNEIDER, S. R. The Space Station Polar Platforms - Integrating research and operational missions [AIAA PAPER 85-3000] p 49 A86-12935 SCHNEIDER, W. C. Shuttle-launch triangular space station [NASA-CASE-MSC-20676-1] p 93 N86-24729 SCHOENMAN, R. L. Thirty years with the jets: Commercial transport flight
- management systems Past, present, and future [AIAA PAPER 86-2289] p 22 A86-47402

experiments	,		
[NASA-TM-87499]	p 61	N86-13343	
SCHRAGE, D. P. Logistics supportability consideration	ns durin	conceptual	s
and preliminary design			
[AIAA PAPER 85-3052] SCHULTZ, E. R.	p /2	A86-10928	s
Robotic refueling system for tac	ctical a	nd strategic	
aircraft [AD-D011980]	p 92	N86-21540	
SCOTT-WILSON, J. B.			S
The policy maker looks at information		N86-28794	
SEARBY, N. E.	p 45	100-20734	S
A design for fluid management in sp		496 16040	
[IAF PAPER ST-85-04] SERRANO, A.	p 50	A86-15949	s
Satellite communications plannin			
manufacturing in Latin America SETZER, R.	p 19	A86-30187	
Spacecraft software cost estimation			S
excellence through parametric models [SAE PAPER 851907]	s (Arev p 31	iew) A86-38556	
SEXTON, G. A.	p 31	A00-30330	
Advanced concepts transport aircra			
[SAE PAPER 851808] SHAFFER, L.	p 20	A86-35438	S
ENVIROSAT-2000 report: Federa	l agen	cy satellite	_
requirements [NASA-TM-88752]	n 62	N86-26355	S
SHAH, J. J.	μ 03	100-20355	
Development of a knowledge base for			~
for design of structural parts SHARP, D. H.	p 20	A86-36853	S
Numerical analysis and the scientific			_
[DE86-005404]	p 47	N86-29591	S
SHARP, G. W. Shuttle environment database			
[AAS 85-103]	р 39	A86-28578	-
SHAW, J. M. Boscarch and competition: Bost on	deara		S
Research and competition: Best par [NASA-TM-87313]	p 76	N86-25321	
SHAW, R. J.	•		S
NASA's Aircraft Icing Analysis Progr [NASA-TM-88791]	p 82	N86-31548	
SHEINBERG, B. M.	P 02	1100-01040	
The role of laser technology in mater		cessing and	S
nondestructive testing in the 21st cent		A86-47139	S
SHENOY, R. P.	-		
Artificial intelligence - The emerging		ology A86-26070	S
SHIELDS, N. L.	P 40	100 20070	
Reconfigurable work station for a vid	leo disp	olay unit and	S
keyboard [NASA-CASE-MFS-26009-1SB]	p 92	N86-22114	3
SHINGLEDECKER, C. A.	•		
Workload measurement in sys evaluation		lesign and A86-33787	S
SIMON, M. C.	pЗ	A00-33707	
Space Station design-to-cost - A m	assive	engineering	S
challenge [SAWE PAPER 1673]	n 20	A86-35216	
SIMPSON, J.			
The world aircraft industry SIRBU, M. A.	p 17	A86-26114	S
Telecommunications alternatives	for fe	deral users:	
Market trends and decisionmaking crit			S
[PB86-153764] SKALAK, F. M.	p 13	N86-25687	
Computer-aided engineering			
[AD-A162811] SLOCOM, A.	p 81	N86-24256	
Robot end effector			S
[PB86-166042]	p 34	N86-27663	
SMEENK, J. W. Evaluation of research: Experiences	e and r	erspectives	
in the Netherlands	sanu F	erspectives	S
[ESA-86-96709] SMITH, D. D.	p 65	N86-31461	
Space law challenged	p 83	A86-18368	
SMITH, F. L., JR.			_
Learning from the past - Bringing	Adam		S
		196.27007	
orbit SMITH, G. S.	p 10	A86-27887	
SMITH, G. S. Planning design and implementat	p 10 ion of	a statewide	S
SMITH, G. S.	p 10		S
SMITH, G. S. Planning design and implementat geographic information system SMITH, L. A.	p 10 ion of p 40	a statewide A86-46104	S
SMITH, G. S. Planning design and implementat geographic information system	p 10 ion of p 40	a statewide A86-46104	S

Concurrent and sequential networks - Implications for project management p 52 A86-28055 SMITH. P. D. Shuttle-launch triangular space station [NASA-CASE-MSC-20676-1] p 93 N86-24729 SMITH. S. T. Framework for generating expert systems to perform computer security risk analysis [DE85-014134] p 41 N86-10841 SNODDY, W. C. Commerical use of space - Status and prospects p 58 A86-41154 SOLDNER, J. K. Concepts for the early realization of a manned mission to Mars (AAS 84-170) p 53 A86-28796 SOMA. T. A study on robot path planning from a solid model p 32 A86-43061 SOOD, D. R. Encryption protection for communication satellites p 78 A86-21878 SORKIN, R. D. Alerted monitors: Human operators aided by automated detectors [PB85-222750] p 4 N86-13906 SÖRMUNEN, J. Organizations as information processing systems: Environmental characteristics, company performance and chief executive scanning, an empirical study [AD-A168035] p 15 N86-33201 OWTER, R. S. Financial structure for participation in industrial space projects p 69 A86-44538 PAAPEN. J. Evaluation of research: Experiences and perspectives in the Netherlands p 65 N86-31461 [ESA-86-96709] PARKMAN, J. K. Future U.S. meteorological satellite systems p 49 A86-12361 [IAF PAPER 84-96] PEARMAN, M. L. Some comparisons of US and USSR aircraft design developments [AIAA PAPER 85-3060] p 15 A86-10930 PEER, F. Research and technology Fiscal Year 1985 report [NASA-TM-86532] p 62 N86-17225 PITZER, C. R. Retrofitting avionics - Closing the performance 'Generation gap [SAE PAPER 851813] p 79 A86-38324 QUIBB, G. F. p 72 A86-19524 Science operations management TADD C Space commercialization - An American case study in denationalization p 86 A86-27888 TAR .LL Support for global science: Remote sensing's challenge p 14 N86-32864 TEBBINS, F. J. Shuttle-launch triangular space station p 93 N86-24729 [NASA-CASE-MSC-20676-1] TEFIK. M. J. Perspectives on artificial intelligence programming p 29 A86-27167 TEPHENS, D. G. Sonic-boom research: Selected bibliography with annotation [NASA-TM-87685] p 65 N86-30470 TERN, R. C. Knowledge engineering for a flight management expert p 30 A86-28498 system TEUERWALT. M. Expert systems for design and simulation [DE85-017565] p 32 N86-18053 Expert assistants for design [DE86-003679] p 35 N86-29557 TIRTZ. D. R. Using automated tools to reduce software costs and insure system integrity [AIAA PAPER 85-6013] p 36 A86-11445 TOCKWELL, B. Insurance for space ventures [IAE PAPER 85-435] p 83 A86-15905 The broker's role in space insurance p 90 A86-44540 TOKER, C. R. Scientific program for a Mars base [AAS 84-166] p 53 A86-28792 TOLZ. S. D.

Marine-related research at MIT (Massachusetts Institute of Technology): A directory of research projects, 1985-1986 (PB86-158102) p 63 N86-26249

PERSONAL AUTHOR INDEX

2 ENCONVERSION NOT NO EX
STOWE, R. F.
Contractual and related agreements required for a
satellite launch p 89 A86-43342
STRACK, W. C.
Aeropropulsion opportunities for the 21st century [NASA-TM-88817] p 26 N86-31585
STREUFERT, S.
Aspects of cognitive complexity theory and research as
applied to a managerial decision making simulation
[AD-A161376] p 13 N86-22437
Data collection via a quasi-experimental simulation
technology. Part 1: Multiple measurement of performance excellence in complex and uncertain managerial tasks
[AD-A167949] p 9 N86-32969
STROUD, W. J.
Computational structural mechanics: A new activity at
the NASA Langley Research Center
[NASA-TM-87612] ρ 23 N86-11540 SUAREZ, L. M.
Trades and Analyses Management System (TRAMS)
p 21 A86-40514
SULLIVAN, L. J.
R and D Productivity: New Challenges for the US Space
Program [NASA-TM-87520] p 61 N86-15157
[NASA-TM-87520] p 61 N86-15157 SULZMAN, F. M.
Evaluation of the need for a large primate research
facility in space
[NASA-CR-179661] p 14 N86-32111
SUSMAN, G. I.
New technology implementation: Technical, economic and political factors p 24 N86-15172
SUTHERLAND, J. W.
Assessing the artificial intelligence contribution to
decision technology p 29 A86-25033
SUTTER, J. F.
Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 1
[AD-A171402] p 93 N86-24726
SWARTOUT, W. R.
Enhanced maintenance and explanation of expert
systems through explicit models of their development
p 28 A86-14847
SWEZEY, R. W. An annotated bibliography of literature integrating
organizational and systems theory
[AD-A160912] p 12 N86-19249
Aspects of cognitive complexity theory and research as
applied to a managerial decision making simulation [AD-A161376] p 13 N86-22437
SWIHART, J. M.
Which transport technologies will fly?
p 69 A86-41037
SYLVESTER, R. J.
The discipline of software acquisition [AIAA PAPER 85-5056] p 36 A86-11412
[AIAA PAPER 85-5056] p 36 A86-11412
T
Т
TALBOT, J. M.
A review of the psychological aspects of space flight
p 2 A86-29090
TASH, W.
Comparison of scientific and technical personnel trends
in the United States, France, West Germany and the United Kingdom since 1970
[PB86-133030] 0.7 N86 24554

in the United States, France, West Gern	iany an	d the United
Kingdom since 1970	•	
[PB86-133030]	p7	N86-24554
TEICHMAN, L. A.	P .	
Tough composite materials: Recent	dovolo	omonto
rough composite materials. Hecent		
	p 22	A86-45300
TERLECKYJ, N. E.		
Trends in industrial R and D activi	ities in	the United
States, Europe and Japan, 1963-83		
[PB86-141371]	p 63	N86-25290
	P 03	1100-20290
THACHER, P. S.		
Space technology and resource mai	nageme	ent
	p 58	A86-41981
THIEMAN, J.	•	
Central On-Line Data Directory	- 46	N86-29294
	µ 40	1100-29294
THOMASEN, C. T.		
The key to successful management	of STS	operations:
An integrated production planning syst	em	•
5		N86-15161
THOMPSON, D. R.	P 12	100-10101
	~ *	
Space station	p 65	N86-30602
THOMPSON, D. S.		
Insurance in space risk managemen	t	
•	p 68	A86-26453
TUONDOON		

THOMPSON, J. Next generation aircraft structures - The need for co-ordinated Canadian R & D programs p 21 A86-39567

THORLEY, G.		
ENVIROSAT-2000 report: Feder	al age	ncy satellite
requirements		
[NASA-TM-88752] TIBSHIRANI. R.	p 63	N86-26355
The bootstrap method for as		
accuracy	sessinį	g statistical
[AD-A161257]	p 81	N86-20047
TILANUS, C. B.	por	1100-20047
Failures and successes of quantit	ativo	methods in
management	ante	incinous in
[ARW-03-THE-BDK/ORS/83-06]	D 12	N86-11076
TILLINGHAST, C., JR.	P .=	
Finance of international carriers	p 67	A86-18539
TIMMER, J. P. J.		
Production and inventory control w	ith the	base stock
system		
[EUT/BDK/12]	p 77	N86-32328
TINLEY, R.		
Planning for Telesat Canada's	next	generation
satellites		
[IAF PAPER 85-354]	p 10	A86-15849
TODD, D.		
The world aircraft industry	p 17	A86-26114
TOELLE, R.		
Heavy lift launch vehicles for 1995 a		
[NASA-TM-86520]	p 23	N86-11216
TOL, K.		
Structuring the production control p	robien	n in a repair
Shop	- 07	NRC 00004
[THE/BDK/KBS/84-16]	p 27	N86-32334
[THE/BDK/KBS/84-16] TORRERO, E. A.		
[THE/BDK/KBS/84-16] TORRERO, E. A. Next-generation computers		N86-32334 A86-21317
[THE/BDK/KBS/84-16] TORRERO, E. A. Next-generation computers TORTORICH, R.	р 37	A86-21317
[THE/BDK/KBS/84-16] TORRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio	p 37 nal	A86-21317 adaptations,
[THE/BDK/KBS/84-16] TORRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results	p 37 nal	A86-21317
[THE/BDK/KBS/84-16] TORRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G.	p37 nal p5	A86-21317 adaptations, N86-15201
[THE/BDK/KBS/84-16] TORRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results	p 37 nal p 5 ctionee	A86-21317 adaptations, N86-15201 m ²
[THE/BDK/KBS/84-16] TORRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line additional of the field	p 37 nal p 5 ctionee	A86-21317 adaptations, N86-15201
[THE/BDK/KBS/84-16] TORTRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line ar TRIPPENSEE, G. A.	p 37 nal p 5 ctionee p 20	A86-21317 adaptations, N86-15201 yr A86-35645
[THE/BDK/KBS/84-16] TORTRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line ad TRIPPENSEE, G. A. Summary of results of NASA F-	p 37 nal p 5 ctionee p 20	A86-21317 adaptations, N86-15201 yr A86-35645
[THE/BDK/KBS/84-16] TORTARC, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line ar TRIPPENSEE, G. A. Surmary of results of NASA F- program	p37 nal p5 ctionee p20 15 flig	A86-21317 adaptations, N86-15201 or' A86-35645 ht research
[THE/BDK/KBS/84-16] TORTARCH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line ar TRIPPENSEE, G. A. Summary of results of NASA F- program [NASA-TM-86811]	p37 nal p5 ctionee p20 15 flig	A86-21317 adaptations, N86-15201 yr A86-35645
[THE/BDK/KBS/84-16] TORTRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line and TRIPPENSEE, G. A. Summary of results of NASA F- program [NASA-TM-66811] TRUELOVE, J. A.	p 37 nal p 5 ctionee p 20 15 flig p 25	A86-21317 adaptations, N86-15201 yr A86-35645 ht research N86-26277
[THE/BDK/KBS/84-16] TORTRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line au TRIPPENSEE, G. A. Summary of results of NASA F- program [NASA-TM-66811] TRUELOVE, J. A. Schema-based theory of informatio	p 37 nal p 5 ctionee p 20 15 flig p 25	A86-21317 adaptations, N86-15201 yr A86-35645 ht research N86-26277
[THE/BDK/KBS/84-16] TORTARC, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line ar TRIPPENSEE, G. A. Summary of results of NASA F- program [NASA-TM-66811] TRUELOVE, J. A. Schema-based theory of informatio distributed decision making	p 37 nal p 5 tionee p 20 15 flig p 25 n pres	A86-21317 adaptations, N86-15201 or' A86-35645 ht research N86-26277 entation for
[THE/BDK/KBS/84-16] TORTRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line and TRIPPENSEE, G. A. Summary of results of NASA F- program [NASA-TM-86811] TRUELOVE, J. A. Schema-based theory of informatio distributed decision making [AD-A163150]	p 37 nal p 5 ctionee p 20 15 flig p 25	A86-21317 adaptations, N86-15201 or' A86-35645 ht research N86-26277 entation for
[THE/BDK/KBS/84-16] TORTRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line ad TRIPPENSEE, G. A. Summary of results of NASA F- program [NASA-TM-86811] TRUELOVE, J. A. Schema-based theory of informatio distributed decision making [AD-A163150] TSAI, J.	p 37 nal p 5 tionee p 20 15 flig p 25 n pres p 13	A86-21317 adaptations, N86-15201 or' A86-35645 ht research N86-26277 entation for
[THE/BDK/KBS/84-16] TORTRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line and TRIPPENSEE, G. A. Summary of results of NASA F- program [NASA-TM-86811] TRUELOVE, J. A. Schema-based theory of informatio distributed decision making [AD-A163150]	p 37 nal p 5 ctionee p 20 15 flig p 25 n pres p 13 ctivity	A86-21317 adaptations, N86-15201 or' A86-35645 ht research N86-26277 entation for
[THE/BDK/KBS/84-16] TORTRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line and TRIPPENSEE, G. A. Summary of results of NASA F- program [NASA-TM-86811] TRUELOVE, J. A. Schema-based theory of informatio distributed decision making [AD-A163150] TSAI, J. Software quality and software produ	p 37 nal p 5 ctionee p 20 15 flig p 25 n pres p 13 ctivity	A86-21317 adaptations, N86-15201 rr' A86-35645 ht research N86-26277 entation for N86-25992
[THE/BDK/KBS/84-16] TORTRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line and TRIPPENSEE, G. A. Summary of results of NASA F- program [NASA-TM-66811] TRUELOVE, J. A. Schema-based theory of informatio distributed decision making [AD-A163150] TSAI, J. Software quality and software produ TUTTLE, M. H.	p 37 nal p 5 ctionee p 20 15 flig p 25 n pres p 13 ctivity p 38	A86-21317 adaptations, N86-15201 m ^r A86-35645 ht research N86-26277 entation for N86-25992 A86-28415
[THE/BDK/KBS/84-16] TORTRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line ad TRIPPENSEE, G. A. Summary of results of NASA F- program [NASA-TM-86811] TRUELOVE, J. A. Schema-based theory of informatio distributed decision making [AD-A163150] TSAI, J. Software quality and software produ TUTTLE, M. H. Adaptive wall wind tunnels: A selection	p 37 nal p 5 ctionee p 20 15 flig p 25 n pres p 13 ctivity p 38	A86-21317 adaptations, N86-15201 m ^r A86-35645 ht research N86-26277 entation for N86-25992 A86-28415
[THE/BDK/KBS/84-16] TORTRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line and TRIPPENSEE, G. A. Summary of results of NASA F- program [NASA-TM-66811] TRUELOVE, J. A. Schema-based theory of informatio distributed decision making [AD-A163150] TSAI, J. Software quality and software produ TUTTLE, M. H.	p 37 nal p 5 ctionee p 20 15 flig p 25 n pres p 13 ctivity p 38 ected,	A86-21317 adaptations, N86-15201 m ^r A86-35645 ht research N86-26277 entation for N86-25992 A86-28415
[THE/BDK/KBS/84-16] TORTRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line and TRIPPENSEE, G. A. Summary of results of NASA F- program [NASA-TM-86811] TRUELOVE, J. A. Schema-based theory of informatio distributed decision making [AD-A163150] TSAI, J. Software quality and software produ TUTTLE, M. H. Adaptive wall wind tunnels: A select bibliography [NASA-TM-87639]	p 37 nal p 5 ctionee p 20 15 flig p 25 n pres p 13 ctivity p 38 ected,	A86-21317 adaptations, N86-15201 or A86-35645 ht research N86-26277 entation for N86-25992 A86-28415 annotated
[THE/BDK/KBS/84-16] TORTRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line and TRIPPENSEE, G. A. Summary of results of NASA F- program [NASA-TM-86811] TRUELOVE, J. A. Schema-based theory of informatio distributed decision making [AD-A153150] TSAI, J. Software quality and software produced TUTTLE, M. H. Adaptive wall wind tunnels: A select bibliography [NASA-TM-87639] TUYAHOV, A.	p 37 nal p 5 ctionee p 20 15 flig p 25 n pres p 13 ctivity p 38 ected,	A86-21317 adaptations, N86-15201 or A86-35645 ht research N86-26277 entation for N86-25992 A86-28415 annotated
[THE/BDK/KBS/84-16] TORTRERO, E. A. Next-generation computers TORTORICH, R. Quality circles: Organizatio improvements and results TRIPP, W. G. The field representative 'front line and TRIPPENSEE, G. A. Summary of results of NASA F- program [NASA-TM-86811] TRUELOVE, J. A. Schema-based theory of informatio distributed decision making [AD-A163150] TSAI, J. Software quality and software produ TUTTLE, M. H. Adaptive wall wind tunnels: A select bibliography [NASA-TM-87639]	p 37 nal p 5 ctionee p 20 15 flig p 25 n pres p 13 ctivity p 38 acted, p 26	A86-21317 adaptations, N86-15201 or A86-35645 ht research N86-26277 entation for N86-25992 A86-28415 annotated

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VALETT, J.				
Software management tools: L	essons l	earned from		
use	p 47	N86-30360		
VALETT, J. D.				
DEASEL: An expert system for se	oftware e	ngineering		
		N86-30361		
VANDERBIJ, J. D.	•			
On the structure of manpower pl	anning, a	contribution		
of simulation experiments with de	composit	ion methods		
[MANPOWER-PLANNING-28]		N86-11073		
On the structure of manpower pl	annina, a	contribution		
of simulation experiments with aggr	egation n	nethods		
[MANPOWER-PLANNING-30]	p 4			
VANDERIET, R. P.	•			
Report on the AI trip				
[IR-82]	p 35	N86-30397		
VANDERSCHAAF, T. W.				
Risk propensity, action readine	ss and t	he roles of		
societal and individual decision make				
[IZF-1984-27]	p 12	N86-11077		
VANFELDT, W. J.				
Maintenance planning for the 19	990's (inif	tial planning)		
[PB86-106010]		N86-22065		
VANNATTER, R. L.	•			
New maintainability prediction tec	hnique			
<i>,</i>		A86-22379		
VANNORMAN, M.	•			
Development experience with a	simple ex	oert system		
demonstrator for pilot emergency procedures				
[NASA-TM-85919]		N86-23603		
VANSLYKE, G. R.	•			

VANSLYKE, G. R. Helicopter maintenance in the real world p 73 A86-30549

		·
VARN, G. L.		
Will the USAF need ground-based air	r traffic	control radar
in the year 2000?		
[AD-A166504]	p 8	N86-29805
VARY, A.		
Nondestructive techniques for	or c	haracterizing
mechanical properties of structura	il mat	erials: An

overview			
[NASA-TM-87203] p 80 N86-19636			
VAUGHAN, O. H.			
Spacelab 3 mission - Broadening horizons in space			
research p 56 A86-34967			
VENKAYYA, V. B.			
ASTROS - An advanced software environment for			
automated design			
[AIAA PAPER 86-0856] p 39 A86-38807			
VILLARREAL, H., JR.			
A software management tool p 38 A86-28423			
VIRIGLIO, G.			
Economic aspects of space industrialization			
p 70 A86-45636			
VLADUTZ, G.			
The world brain today: Scientographic databases. What			
are they, how are they created and what are they used			
for? p 44 N86-26007			
VOGT, S. T.			
Productivity improvement in engineering at			
Rocketdyne p 5 N86-15178			
VON KRIES, W.			
State supervision and registration p 89 A86-43345			
VON PUTTKAMER, J.			
Space - The long range future p 50 A86-14272			
Beyond the Space Station			
[AAS 84-161] p 53 A86-28787			
VOSTEEN, L. F.			
Tough composite materials: Recent developments			
p 22 A86-45300			
VOUTE, C.			
Human development and the conquest of space			
p 83 A86-18381			
The needs of developing countries in the application			

The needs of developing countries in the application of satellite technology for disaster management p 84 A86-21123

W

WAGENFAR, W. A.			
Risk propensity, action readines	s and	the roles of	
societal and individual decision maker	s		
[IZF-1984-27]	p 12	N86-11077	
WAKAYAMA, G.			
A rapid evaluation approach	for	configuration	
development of new aircraft [AIAA PAPER 85-3068]			
WALDRON, R.	p 15	A86-10932	
Space materials resources and pr	ocoeei	a ontione .	
Their influence on future space opera		ig options -	
		A86-27897	
WALKLET, D. C.	•		
Private funds will bolster tax dollars in	n the jo	b of financing	
the station	p 69	A86-29494	
WALLACE, R. S.			
Robotics and the space station WALLENIUS, K. T.	p 29	A86-20507	
Cost uncertainty assessment meth	odolog		
overview	ouolog	y: A chucai	
[AD-A161920]	p 71	N86-24575	
WÄLLTER, P. W.	P		
NASA supercomputer system to	beco	me available	
nationally			
[NASA-NEWS-RELEASE-86-92]	p 44	N86-28628	
WARE, R. H. The civilian space program			
The civilian space program perspective	- A	Washington	
[AAS 84-153]	n 86	A86-28779	
WARRIOR. J.	p 00	A00-20773	
Optical processing for future computer networks			
		A86-21973	
WASSERMAN, A. I.			
A relational database environm	ent f	or software	
development			
[IR-86] WATTS, R. L.	p 47	N86-30398	
Technology transfer is opportunity t	ransfor		
[DE85-016622]		N86-17230	
WEBSTER, F.	P		
The overall plan: A scientific strateg	IY		
	p 64	N86-29463	
WEHRLY, D. S.			
Information systems in space WEINSTEIN, L. M.	p 39	A86-34981	
Ice detector			
[NASA-CASE-LAR-13403-1]	n 93	N86-24673	
[P 90	1100-24070	

WEISBIN, C. R.

WEISBIN, C. R.
Real-time production system for intelligent robot control
[DE86-008501] p 36 N86-31271
WELCH, S. Mission strategy and spacecraft design for a Mars base
program
[AAS 84-169] p 53 A86-28795 WENKSTERN, F. B.
Environmental management of payload processing
facilities [AIAA PAPER 85-6067] p 78 A86-17602
WENNESON, G.
Software management tools: Lessons learned from use p 47 N86-30360
WESSELS, J.
On the structure of manpower planning, a contribution of simulation experiments with decomposition methods
[MANPOWER-PLANNING-28] p 3 N86-11073
On the structure of manpower planning, a contribution of simulation experiments with aggregation methods
[MANPOWER-PLANNING-30] p 4 N86-11075
WESSELSKI, C. J. Shuttle-launch triangular space station
[NASA-CASE-MSC-20676-1] p 93 N86-24729
WETHERALL, P. R. Applications of expert systems p 33 N86-19634
Applications of expert systems p 33 N86-19634 WHITE, H. M., JR.
International space law and direct broadcast satellites p 85 A86-24675
p 85 A86-24675 WHITE, M. E.
Productivity enhancement planning using participative
management concepts p 6 N86-15202 WHITING, M. A.
Managing the data analysis progress
р 44 N86-26005 WHITUS, T.
In-house CAD training: A realistic approach
[DE86-008926] p 8 N86-31251 WICKENS, C. D.
The functional age profile - An objective decision criterion
for the assessment of pilot performance capacities and capabilities p 3 A86-31823
WIGAND, R. T.
Information flow and work productivity through integrated information technology p. 42 N86-15183
information technology p 42 N86-15183 WIJNGAARD, J.
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/B0K/ORS/84/10] p 26 N86-32332 WILCOX, W. R.
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/B0K/ORS/84/10] p 26 N86-32332 WILCOX, W. R.
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems (THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W.
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in other hostile environments
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems (THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry: remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 WILLIAMS, J. G. Computer simulation and modeling - A tool for inventory
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 WILLIAMS, J. G.
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 WILLIAMS, J. G. Computer simulation and modeling - A tool for inventory management p 74 A86-35646 WILLIAMS, J. R. Commerce Lab - A program of commercial flight
information technology p 42 N86-15183 WIJNGARD J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 WILLIAMS, J. G. Computer simulation and modeling - A tool for inventory management p 74 A86-35646 WILLIAMS, J. R. Commerce Lab - A program of commercial flight opportunities p 56 A86-34965
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry: remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 WILLIAMS, J. G. Computer simulation and modeling - A tool for inventory management p 74 A86-35646 WILLIAMS, J. R. Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 WILLIAMSON, A. N., JR. Computer techniques for producing color maps
information technology p 42 N86-15183 WIJNGARD J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 WILLIAMS, J. G. Computer simulation and modeling - A tool for inventory management p 74 A86-35646 WILLIAMS, J. R. Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 WILLIAMSON, A. N., JR. Computer techniques for producing color maps [AD-A161159] p 42 N86-19955
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference. Remote operations and robotics in the nuclear industry; remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 WILLIAMS, J. G. Computer simulation and modeling - A tool for inventory management p 74 A86-35646 WILLIAMS, J. R. Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 WILLIAMSON, A. N., JR. Computer techniques for producing color maps [AD-A161159] p 42 N86-19955 WILLIAMSON, R. A. International cooperation and competition in civilian
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2366] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 WILLIAMS, J. R. Computer simulation and modeling - A tool for inventory management p 74 A86-35646 WILLIAMS, J. R. Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 WILLIAMSON, A. N., JR. Computer techniques for producing color maps [AD-A161159] p 42 N86-19955 WILLIAMSON, R. A.
information technology p 42 N86-15183 WIJNGARD J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry: remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 WILLIAMS, J. G. Computer simulation and modeling - A tool for inventory management p 74 A86-35646 WILLIAMS, J. R. Commerce Lab - A program of commercial flight opportunities p 56 A86-17435 WILLIAMSON, A. N., JR. Computer techniques for producing color maps [AD-A161159] p 42 N86-19955 WILLIAMSON, R. A. International cooperation and competition in civilian space activities p 83 A86-17743 Commercialization of space - The investment opportunities p 67 A86-18385
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2366] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 WILLIAMS, J. G. Computer simulation and modeling - A tool for inventory management p 74 A86-35646 WILLIAMS, J. R. Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 WILLIAMSON, A. N., JR. Computer techniques for producing color maps [AD-A161159] p 42 N86-19955 WILLIAMSON, R. A. International cooperation and competition in civilian space activities p 83 A86-17743 Commercialization of space - The investment
information technology p 42 N86-15183 WIJNGARD J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILLIA, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry: remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 WILLIAMS, J. G. Computer simulation and modeling - A tool for inventory management p 74 A86-35646 WILLIAMS, J. R. Computer techniques for producing color maps [AD-A161159] p 42 N86-19555 WILLIAMSON, A. N., JR. Computer techniques for producing color maps [AD-A161159] p 43 A86-17743 Commercialization of space - The investment opportunities p 83 A86-17743 Commercialization of space - The investment opportunities p 67 A86-18385 WILLSHIRE, K. F. Automation and robotics for Space Station in the twenty-first century
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 WILLIAMS, J. G. Computer simulation and modeling - A tool for inventory management p 74 A86-35646 WILLIAMS, J. R. Commerce Lab - A program of commercial flight opportunities p 42 N86-19955 WILLIAMSON, R. A. International cooperation and competition in civilian space activities p 83 A86-17743 Commercialization of space - The investment opportunities p 67 A86-18385 WILLIAMSH, K. F. Automation and robotics for Space Station in the
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry: remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 WILLIAMS, J. G. Computer simulation and modeling - A tool for inventory management p 74 A86-35646 WILLIAMS, J. R. Computer simulation and modeling - A tool for inventory management p 56 A86-34965 WILLIAMS, J. R. Computer techniques p p 33 A86-17743 Computer techniques p 83 A86-17743 Computer techniques p 83 A86-17743 Commercialization of space - The investment opportunities p 83 A86-17743 Commercialization of space Station in the twerty-first century [AIAA PAPER 86-2300] p 40 A86-48502 WILSON, A. Missions to Mars p 60 A86-48100
information technology p 42 N86-15183 WIJNGAARD, J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 WILLIAMS, J. G. Computer simulation and modeling - A tool for inventory management p 74 A86-35646 WILLIAMS, J. R. Commerce Lab - A program of commercial flight opportunities p 56 A86-13955 WILLIAMSON, R. A. International cooperation and competition in civilian space activities p 83 A86-17743 Commercialization of space - The investment opportunities p 67 A86-18385 WILLIAMSON, R. A. Internation and robotics for Space Station in the twenty-first century [AIAA PAPER 86-2300] p 40 A86-49552 WILSON, A.
information technology p 42 N86-15183 WIJNGARD J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 WILLIAMS, J. G. Computer simulation and modeling - A tool for inventory management p 74 A86-35646 WILLIAMS, J. R. Computer simulation and modeling - A tool for inventory management p 56 A86-34965 WILLIAMSON, A. N., JR. Computer techniques p 50 A86-17743 Computer techniques p 83 A86-17743 Computer techniques p 67 A86-18385 WILLIAMSON, R. A. Internation and robotics for Space Station in the twenty-first century [AIAA PAPER 86-2300] p 40 A86-49552 WILSON, A. Missions to Mars p 60 A86-48100 WISE, J. A. The quantitative modeling of human spatial habitability
information technology p 42 N86-15183 WIJNGARD J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 WILLIAMS, J. G. Computer simulation and modeling - A tool for inventory management p 74 A86-35646 WILLIAMS, J. R. Commerce Lab - A program of commercial flight opportunities p 56 A86-34965 WILLIAMSON, R. A. International cooperation and competition in civilian space activities p 83 A86-17743 Commercialization of space - The investment opportunities p 67 A86-18385 WILLSHIRE, K. F. Automation and robotics for Space Station in the twenty-first century [AIAA PAPER 86-2300] p 40 A86-48100 WISE, J. A. The quantitative modelling of human spatial habitability [NASA-CR-179716] p 9 N86-33210
information technology p 42 N86-15183 WIJNGARD J. On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11075 The structuring of production control systems [THE/BDK/ORS/84/10] p 26 N86-32332 WILCOX, W. R. Growth of electronic materials in microgravity [AIAA PAPER 86-2356] p 75 A86-46963 WILL, R. W. Space teleoperation research. American Nuclear Society Executive conference: Remote operations and robotics in the nuclear industry; remote maintenance in other hostile environments [NASA-TM-89234] p 35 N86-29513 WILLIAMS, J. G. Computer simulation and modeling - A tool for inventory management p 74 A86-35646 WILLIAMS, J. R. Computer simulation and modeling - A tool for inventory management p 56 A86-34965 WILLIAMSON, A. N., JR. Computer techniques p 50 A86-17743 Computer techniques p 83 A86-17743 Computer techniques p 67 A86-18385 WILLIAMSON, R. A. Internation and robotics for Space Station in the twenty-first century [AIAA PAPER 86-2300] p 40 A86-49552 WILSON, A. Missions to Mars p 60 A86-48100 WISE, J. A. The quantitative modeling of human spatial habitability

[AAS PAPER 84-117]	р1	A86-17320
Space crew productivity: A driving fa	ictor in s	pace station
design	p 5	N86-15187

WOLFF, E.

- Contracts of and with private enterprises concerning the development, the construction, and the assembly of space vehicles p 58 A86-43341
- WOLL, R. N. Keys to engineering management reducing the risks of R&D start-ups planning p 21 A86-41155 WOLZER, I.
- ENVIROSAT-2000 report: Federal agency satellite requirements {NASA-TM-88752} p 63 N86-26355
- WONG, D. G.

 Integrated structural analysis for rapid design support

 [AIAA PAPER 86-1010]
 p 39

 WOO, A. K.

 Productivity improvement in engineering at

 Rocketdyne
 p 5

 WOOD, L. L.

 Toward a permanent lunar settlement in the coming

 decade: the Columbus Project

 [DE86-066709]
 p 14
- WOOLLEY, D. Airports build for future traffic amid new security concern p 80 A86-48371 WORTHERLY, C. R. The design and analysis of a network interface for the multi-lingual database system
- multi-lingual database system [AD-A164756] p 44 N86-27121 WORTMANN, J. C. Due-date reliability in a repair shop: Implications for
- organizational and work design [THE/BDK/KBS/84-14] p 27 N86-32333 Structuring the production control problem in a repair
- shop [THE/BDK/KBS/84-16] p 27 N86-32334
- WOS, L. Automated reasoning: Basic research problems [DE86-009214] p 36 N86-31270
- WRIGHT, M. A. Expert systems for satellite stationkeeping
- р 30 А86-28497 WRIGHT, Р. К.
- Sharpening the senses of industrial robots p 31 A86-40831 WYLE, H.
- Trades and Analyses Management System (TRAMS) p 21 A86-40514 WYLIE, C. D.
- Technology transfer and artificial intelligence [AD-A166035] p 36 N86-30581

Y

- YARED, R.
- The flowering of Japan's space program p 60 A86-49453
- YATES, V. Organization as information processing systems: Toward a model of the research factors associated with significant research outcomes
- [AD-A168018] p 48 N86-33200 YODIS, E.
- Experience with a software engineering environment framework p 47 N86-30365 YOSHIDA, T.
- Future world meteorological satellite systems [IAF PAPER 85-87] p 82 A86-15663
- YOUNG, K. D. Variable structure model following control design for robotics applications
- [DE86-008136] p 35 N86-29234 YOUNG, R. S. Space Station - Life sciences
- [AIAA PAPER 86-2346] p 60 A86-46960 YUTA, S.
 - Computer architecture for intelligent robots p 28 A86-13529

Ζ

- ZAYTSEVA, Z. I. Influence of complexity of control task on level of activation of operators physiological functions when working with waiting p 7 N86-23260 ZELDENRUST, S.
- ZELDENRUST, S. Evaluation of research: Experiences and perspectives in the Netherlands
- [ESA-86-96709]
 p 65
 N86-31461

 ZEMANN, G.
 Implementation of computer-aided production systems detailed
 p 32
 N86-14611

 ZIMMERMAN, J. S.
 N86-14611
 N86-14611
 - The right stuff p 41 A86-49872

ZIRK. D.

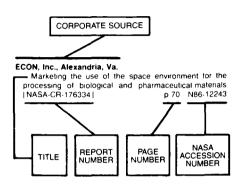
Human factors in rule-based systems [AD-A165309] p 8 N86-26840

CORPORATE SOURCE INDEX

MANAGEMENT / A Bibliography for NASA Managers

APRIL 1987

Typical Corporate Source Index Listing



Listings in this index are arranged alphabetically by corporate source. The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document.

Δ

- Administrative Sciences Corp., Alexandria, Va. Risk assessment preprocessor (RAPP)
- D 43 N86-24278 [AD-A161914] Advisory Group for Aerospace Research and Development, Neulily-Sur-Seine (France). The Value of Information as an Integral Part of
- Aerospace and Defence R and D Programmes [AGARD-CP-385] p 45 M
- [AGARD-CP-385] p 45 N86-28793 Air Command and Staff Coll., Maxwell AFB, Ala. Will the USAF need ground-based air traffic control radar in the year 2000?
- [AD-A166504] p 8 N86-29805 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. A cost analyst's guide to satellite autonomy and
- fault-tolerant computing
- [AD-A161853] p 71 N86-23630 Air Force Space Div., Los Angeles, Calif. National space transportation and support study/mission requirements and architecture studies [AIAA PAPER 86-1211] p 11 A86-40602
- Air Force Systems Command, Boiling AFB, Washington, D.C.

Guide to Canadian aerospace	related mou	stries
[AD-A167794]	p 26	N86-32327
Alabama Univ., Huntsville.		
Commerical use of space - St	atus and pro	spects
	n 58	A86-41154

	p 58	A86-41154
Allied Bendix Corp., Kansas City,		
Knowledge-based systems:	How will	they affect
manufacturing in the 80's		
[DE85-010601]	p 32	N86-13027
Intelligent N/C controllers		
[DE86-003132]	p 35	N86-30387
Robotic simulation		
[DE86-006517]	p 35	N86-30390
American Productivity Center, Ho	uston. Tex	e.
White collar productivity imp action research 1983 - 1985		
[NASA-CR-176366]	р 6	N86-21419

Amsterdam Univ. (Netherlands).

Evaluation of research: Expl	eriences and i	perspectives
in the Netherlands		
[ESA-86-96709]	p 65	N86-31461
Argonne National Lab., III.		
Automated reasoning: Basic	research prob	lems
[DE86-009214]	p 36	N86-31270
Computing Contings Softwar		

- Services Software Library [DE86-009491] p 48 N86-32340 Arizona State Univ., Tempe.
- Subjective workload and individual differences in information processing abilities [SAE PAPER 841491] p 2 A86-26011
- Information flow and work productivity through integrated information technology p 42 N86-15183
- Army Engineer Waterways Experiment Station,
- Vicksburg, Miss. Computer techniques for producing color maps [AD-A161159] p 42 N86-19955
- Army War Coll., Carlisle Barracks, Pa. Transfer of high-technology to the Soviet Union. A
- predicament for the US p 96 N86-30582 [AD-A166469]

В

- Bendix Corp., Southfield, Mich. through Improved productivity interactive p 12 N86-15181 communication Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
- An analysis of the application of AI to the development of intelligent aids for flight crew tasks [NASA-CR-3944] p.4 N86-12212
- Communication and miscommunication p 7 N86-24257 [AD-A162843]
- British Aerospace Public Ltd. Co., Weybridge (England).
 - The policy maker looks at information

p 45 N86-28794

С

California Univ., Berkeley.		
The group consensus problem		
[AD-A164064]	p 7	N86-26078
California Univ., La Jolla.	•	
Robotics for the United States Spa	aco Stati	00
riceones for the ormed otates opt		A86-28073
	h 59	A00-20073
California Univ., Los Angeles.		
Knowledge-based load leveling an		
human-machine systems	p 9	N86-32985
California Univ., San Diego.		
Extragalactic astronomy	p 65	N86-31489
California Univ., Santa Barbara.		
Support for global science:	Remote	sensing's
challenge	p 14	N86-32864
Carnegie-Mellon Univ., Pittsburgh, Pa	a. '	
Derivational analogy: A theory of re-		tive problem
solving and expertise acquisition	001101100	are p. 66.61.
[AD-A156817]	n 12	N86-10899
. ,		
A comparison of a manual and o		
production process in terms o	r proce	ess control
decision-making		100 00750
[AD-A168037]	p 14	N86-32750
Clemson Univ., S.C.		
Cost uncertainty assessment met	hodology	: A critical
overview		
[AD-A161920]	p 71	N86-24575
Colorado Univ., Boulder.		
A theoretically based review of the	eory and	research in
judgment and decision making		
[AD-A164914]	p 13	N86-27113
A study of factors related to comm	ercial spa	ace platform
services		
[NASA-CR-176881]	p 96	N86-30744
Columbia Univ., New York.		

Management behavior, group climate and performance appraisal at NASA p 4 N86-15163

Commerce Dept., W			
	d D and new prod		
	ew of assessment m	nethods	\$12.00/MF
A01 [PB86-110806]		p 13	N86-25289
Robot end effec	tor	p 13	1400-20209
[PB86-166042]		p 34	N86-27663
Committee on Appr	opriations (U. S. H		1100 27 000
	utics and Space Ad		ation
	• • • •	p 96	N86-31450
Committee on Appr			
National Aerona	utics and Space Ad		
			N86-13234
Committee on Scie			
	nical information in L	JS com	petitiveness
with Japan		- 04	NOC 10150
[GPO-51-564] High speed aero	naution	p 91	N86-16152
[GPO-51-341]	nautics	p 91	N86-19284
	appropriations	for	LANDSAT
commercialization	appropriations		earborn
[H-REPT-99-177]		p 91	N86-20174
Technology tran	sfer	F	
[GPO-49-539]		p 92	N86-20177
	Past, present and f	uture	
[GPO-55-239]		p 92	N86-20436
	to space during the		
[GPO-53-617]		p 92	N86-21453
Technology tran	ster		
[GPO-49-539]	cosmonauts biograp	p 92	N86-21458
data, revised June		nical ar	io statistical
[GPO-52-498]	20, 1905	p 7	N86-21499
NASA's long rar	ide plans	μ.	1100 21400
(GPO-55-035)	3- p.a	p 93	N86-22435
	appropriations	for	Landsat
commercialization			
[HR-REPT-99-177			N86-22448
Comptroller Genera D.C.	I of the United Sta	ites, W	ashington,
Federal agenci	es' policies and	practic	es are in
accordance with p	atent and tradema		
1980			
[B-207939]		p 91	N86-20175
Computer Horizons			
Linking science,	technology and eco		
Congressional Bud	get Office. Washin		N86-26006

- Congressional Budget Office, Washington, D. C. Budget effects of the Challenger accident
- p 92 N86-20464 Congressional Research Service, Washington, D.C. Public laws of the 98th Congress relating to information policy
- Coopers and Lybrand, Washington, D.C. Evaluating Prover
- Evaluating R and D and new product development ventures: An overview of assessment methods \$12.00/MF A01
 - [PB86-110806] p 13 N86-25289

D

- Defense Advanced Research Projects Agency, Arlington, Va. Robotics for the United States Space Station p 29 A86-28073 Defense General Supply Center, Richmond, Va. LOGMARS (logistics applications of automated marking and reading symbols) clearinghouse, applications directory
- [AD-A162327] p 75 N86-24586 Defense Systems Management School, Fort Belvoir, Va.
- Artificial intelligence and its use in cost type analyses with and example in cost performance measurement [AD-A161817] p 43 N86-22168
- Aids in validating a contractor's cost estimate p 71 N86-24574 [AD-A161871]
- Delaware Univ., Lewes.

The overall plan: A scientific strategy p 64 N86-29463

C-1

Department of Energy, Washington, D. C.

Department of Energy, Washington, D. C.

- Program Management System manual [DE86-005396] p 76 N86-28012 Cost and schedule control systems criteria for contract performance measurement. Data analysis guide p 15 N86-33198 [DE86-010796] Information technology resources long-range plan, FY
- 1987-FY 1991 p 48 N86-33206 [DF86-010457]
- Department of the Air Force, Washington, D.C. Robotic refueling system for tactical and strategic

aircraft		
[AD-D011980]	p 92	N86-21540
Power sensing device		

- [AD-D012171] p 94 N86-26529 Department of Transportation, Washington, D. C.
- Regulatory aspects commercial. of p 91 N86-17409 transportation
- DMEA Ltd., Scottsdale, Ariz. Exploration for strategic materials
- p 75 N86-24005 [PB86-126463] Dynamic Systems, Inc., Urbana, III. Leader-follower strategies under modeling and
- information uncertainties [DE86-000203] p 13 N86-27950

E

ECON, Inc., Alexandria, Va.

- Marketing the use of the space environment for the processing of biological and pharmaceutical materials [NASA-CR-176334] p 70 N86-12243 p 70 N86-12243 Federal government provision of third-party liability
- insurance to space vehicle users [NASA-CR-176346] p 90 N86-13230 ECON, Inc., Princeton, N.J.
- R and D limited partnerships (possible applications in advanced communications satellite technology experiment program)
- [NASA-CR-176333] p 61 N86-13221 Commercialization of the land remote sensing system: An examination of mechanisms and issues
- p 24 N86-14710 [E86-10008] Ecosystems International, Inc., Crofton, Md. Assessment of US industry's technology trends and new
- technology requirements [NASA-CR-176479] p 24 N86-17227
- Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho. Basic human factors considerations
- [DE86-008181] p 8 N86-31223 Human factors management
- [DE86-008184] p 8 N86-31226 Database capacity planning and management
- [DE86-009076] p 48 N86-32338 Engineering Research Associates, Inc., Vienna, Va.
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- p 45 N86-28798 Essex Corp., Alexandria, Va.
- Automation and the allocation of functions between human and automatic control: General method p 6 N86-20013 [AD-A161072]
- Human Factors Review Plan [DE86-010561] p 9 N86-33023
- Essex Corp., Goleta, Calif. Technology transfer and artificial intelligence [AD-A166035] p 36 N
- p 36 N86-30581 Essex Corp., Huntsville, Ala.
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- European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
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- p 77 N86-32584 [ESA-PSS-01-701-ISSUE-1] The qualification and procurement of two-sided printed circuit boards (fused tin-lead or gold plated finish) [ESA-PSS-01-710-ISSUE-1] p 82 N86-32660
- ESA and its Earth observation programs p 66 N86-32849

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C-2

Shuttle environment database		
[AAS 85-103]	р 39	A86-28578

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- [PB86-135100] p 94 N86-25288 A profile of selected firms awarded small business
- Innovation (AD-A165664) [AD-A165664] [AD-A165664] innovation research funds p 64 N86-28805 Assessing federal fundina mechanisms for university research
- p 95 N86-28806 [AD-A165721] Air safety: Federal Aviation Administration's role in
- developing mid-air collision avoidance back-up systems [PB86-197506] p 82 N86-32418 Freedom of Information Act: Noncompliance with
- affirmative disclosure provisions [AD-A168589] p 96 N86-33204
- University funding: Federal funding mechanisms in support of university research [AD-A168023] p 66 N86-33212
- General Motors Corp., Warren, Mich. Time optimal robotic manipulator motions and work
- places for point to point tasks p 31 A86-42983 General Research Corp., McLean, Va.
- Enabling technologies for transition to utilization of space-based resources and operations p 56 A86-34992
- George Mason Univ., Fairfax, Va.
- Trends in industrial R and D activities in the United States, Europe and Japan, 1963-83 [PB86-141371] p 63 N86-25290
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A discrete control model of PLANT n 47 N86-31220

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- p 62 N86-15165 ventures Hershey (Milton S.) Medical Center, Hershey, Pa. Data collection via a quasi-experimental simulation technology. Part 1: Multiple measurement of performance
- excellence in complex and uncertain managerial tasks p 9 N86-32969 [AD-A167949] Honeywell, Inc., Bloomington, Minn.
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The world brain today: Scientographic databases. What are they, how are they created and what are they used for? p 44 N86-26007

J

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- negotiations p 57 A86-40999 Automation and robotics for Space Station in the
- twenty-first century [AIAA PAPER 86-2300] p 40 A86-49552 Joint Publications Research Service, Arlington, Va. USSR report: Machine tools and metalworking

equipmer	nt				
JPRS-U	MM-85-01	01		p 23	N86-11394
USSR	report:	Machine	tools	and r	netalworking
equipmer	nt				-
[JPRS-U	MM-85-01/	4]		p 24	N86-13742
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- equipment [JPRS-UMM-85-013] p 24 N86-13745
- Implementation of computer-aided production systems p 32 N86-14611
- Influence of complexity of control task on level of activation of operators physiological functions when
- working with waiting p 7 N86-23260 Role of robotics in solving production, social problems
- p 34 N86-26062 USSR report: Cybernetics, computers and automation
- technology [JPRS-UCC-86-004] p 45 N86-28694
- Worldwide report: Telecommunications policy, research and development
 - p 95 N86-30064

p 43 N86-24285

p 35 N86-29234

p 14 N86-29874

p 9 N86-33023

p 48 N86-33048

p 7 N86-21499

p 10 A86-23561

p 79 A86-37479

p 6 N86-15202

p 6 N86-15203

p 20 A86-35438

Κ

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aircraft

[SAE PAPER 851379]

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management concepts

[SAE PAPER 851808]

robotics applications

Measuring the value of information and information p 45 N86-28799 systems, services and products

PASSCAL Field Data Management Plan (PFDMP)

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- p 32 N86-18053 Creativity in Science - a symposium
- [DE86-003289] p 63 N86 Application of teleoperator expertise to robotics p 63 N86-27109
- p 35 N86-29229 [DE86-003659] Expert assistants for design [DE86-003679] p 35 N86-29557
- Institutional supporting research and development, 1985
- [DE86-008580] p 65 N86-30583 Los Alamos software development tools
- p 48 N86-31248 [DE86-006024] Los Alamos Scientific Lab., N. Mex.
- Framework for generating expert systems to perform computer security risk analysis
- [DE85-014134] p 41 N86-10841 Loyola Univ., Chicago, III.
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- p 23 N86-11228 The factory of the future

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- p 76 N86-28418 Martin Marietta Aerospace, New Orleans, La. Quality circles: Organizational a adaptations.
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- p 21 A86-37060 Time optimal robotic manipulator motions and work places for point to point tasks p 31 A86-42983
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- of Technology): A directory of research projects, 1985-1986 [PB86-158102] p 63 N86-26249
- Exploiting sequential phonetic constraints in recognizing spoken words [AD-A165913] p 34 N86-29120
- Sensing strategies for disambiguating among multiple objects in known poses
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- McDonnell-Douglas Astronautics Co., Houston, Tex. Implementing quality/productivity improvement initiatives in an engineering environment
- p 80 N86-15158
- McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
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- Procedures for cause oriented analysis and consequence oriented analysis [DOT/FAA/PM-86/21] p 44 N86-28067

- Mohawk Research Corp., Lake Forest, III.
- Financing applied R and D in smaller companies p 71 N86-28783 [PB86-196987]

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- NASA supercomputer system to become available nationally
- [NASA-NEWS-RELEASE-86-92] p 44 N86-28628 NASA patent abstracts bibliography: A continuing bibliography. Section 1: Abstracts
- [NASA-SP-7039(29)-SECT-1] p 94 N86-28788 NASA Patent Abstracts Bibliography. A continuing bibliography. Section 2: Indexes (Supplement 29)
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- [NASA-SP-7053(SUPP-1)] p 47 N86-29720 Life Sciences Space Station planning document: A reference payload for the Life Sciences Research
- Facility [NASA-TM-89188] p 64 N86-30302
- NASA and general aviation [NASA-SP-485] p 26 N86-30720
- Spinoff 1985 [NASA-TM-89240] p 65 N86-31451
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- optimization [AIAA PAPER 85-3095] p 28 A86-14434
- Pilots of the future Human or computer? p1 A86-18541
- Space Station life sciences guidelines for nonhuman experiment accommodation
- [SAE PAPER 851370] p 52 A86-23553 Predicted versus experienced workload and performance on a supervisory control task
- p 2 A86-29879 Advanced concepts transport aircraft of 1995
- p 20 A86-35438 [SAE PAPER 851808] Towards a science of expert systems
- p 40 A86-49488 Expert systems development and application
- [NASA-TM-86746] p 32 N86-11194 Description of an experimental expert system flight
- status monitor [NASA-TM-86791] p.32 N86-11195 Development of space technology for ecological
- p 63 N86-19943 habitats Development experience with a simple expert system
- demonstrator for pilot emergency procedures [NASA-TM-85919] p 33 N86-23603 Summary of results of NASA F-15 flight research
- rogram [NASA-TM-86811] p 25 N86-26277
- Parallel structures in human and computer memory [NASA-TM-89402] p 46 N86-29535 Access control and privacy in large distributed
- systems [NASA-TM-89397] p 46 N86-29568 White paper: A plan for cooperation between NASA and DARPA to establish a center for advanced architectures
- [NASA-TM-89388] p 46 N86-29569 NASA Workshop on Animal Gravity-Sensing Systems
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- [NASA-TM-88263] p 34 N86-24687 National Aeronautics and Space Administration.
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- [AAS 85-103] p 39 A86-28578 The earth observing system [AAS PAPER 85-397] p 58 A86-43229
- Report on active and planned spacecraft and experiments [NASA-TM-874991 p 61 N86-13343
- A comparison of software verification techniques [NASA-TM-88585] p 43 N86-19965 Software verification and testing
- [NASA-TM-88587] p 43 N86-19966 Central On-Line Data Directory p 46 N86-29294 DEASEL: An expert system for software engineering
 - p 47 N86-30361

N Beach, Fla.

NASA. John F. Kennedy Spa	ce Co	enter	, Cocoa I
National Aeronautics and Space Adm F. Kennedy Space Center, Cocoa B			ohn
Space Station operations			
[IAF PAPER 85-45]	p 72		
Earth based approaches to enhance safety of space operations	ing the	nealth	and
[IAF PAPER 85-330]	p 77	A86-1	5833
Space station program operations			
[AAS PAPER 84-112]	p 72	A86-1	7318
Logistics support economy and	efficie	ncy thr	ough
consolidation and automation	p 74	A86-3	
Artificial intelligence - New tools for			
managers	p 30	A86-3	
Cost containment and KSC Shuttle		ies or	cost
containment and aerospace construct		A06 0	4080
Official and the Theorem Instantion	p 19	A86-3	
Office automation: The administrati integrated DBMS	p 41	N86-1	
Research and technology	P 47	1100-1	5174
[NASA-TM-83099]	p 62	N86-1	7265
Method and apparatus for operating of	•		
voice data			
[NASA-CASE-KSC-11285-1]	p 94	N86-2	7513
Proceedings of the 2nd Annua	l Con	ference	on
NASA/University Advanced Space De	sign Pr	ogram	
[NASA-TM-89399]	•	N86-2	
Historical data and analysis for the	e first fi	ve yea	rs of
KSC STS payload processing		NOC 0	0.474
[NASA-TM-83105]	p 77	N86-3	24/1
Vational Aeronautics and Space Admi Lyndon B. Johnson Space Center, H			
Automation and robotics - Key to pr			
[IAF PAPER 85-32]	p 28	A86-1	5623
Future uses of machine intelligence			
Space Station and implications for the	U.S. e	conomy	Y
	p 29	A86-2	
Automated subsystems control deve	elopmei	nt	
[SAE PAPER 851379]	p 10	A86-2	3561
Robotics for the United States Space			
	p 29	A86-2	8073 N
Space Station - The first step			
[AAS 84-160]	p 87	A86-2	8786
Maintainability planning for the Space [AIAA PAPER 86-9754]	p 73	A86-3	2005
Artificial intelligence - NASA	p 30	A86-3	
Space technology today	p 60	A86-4	
R and D Productivity: New Challenge			
Program			
[NASA-TM-87520]	p 61	N86-1	
Government-to-government coop			
station development Software productivity improvement	p 91	N86-1	
engineering technology	p 42	N86-1	
Scientific and technical papers pres			
by JSC authors in 1985		•	
[NASA-TM-58273]	p 76	N86-3	0568
Space station	p 65	N86-3	
Evaluating space station applications			
robotics technologies from a human p view		N86-3	
National Aeronautics and Space Admi			1412
Langley Research Center, Hampton			
Some comparisons of US and US		craft de	esign
developments			
[AIAA PAPER 85-3060]	p 15	A86-10	0930
Optical processing for future comput		A86-2	1079
Space telerobotics - A few more hur	p 37 Idles	A00-2	1973
	p 31	A86-3	7047
Construction and control of large sp			
	p 21	A86-3	7060
NASA storm hazards research in li	ightning	g strike	es to
aircraft	p 79	A86-3	
Retrofitting avionics - Closing	the p	erform	ance
'Generation gap' [SAE PAPER 851813]	p 79	A86-38	8324
Tough composite materials: Recent			
	p 22	A86-4	
Composites in today's and tomorrow			
	p 22	A86-41	7603
Automation and robotics for Spa	ace Sta	ation in	the
twenty-first century		A96	2550
[AIAA PAPER 86-2300] Computational structural mechanics:	p 40	A86-49 A86-49	
the NASA Langley Research Center		acuvi	nyat N
[NASA-TM-87612]	p 23	N86-1	
Ice detector	•	,	
[NASA-CASE-LAR-13403-1]	p 93	N86-24	
A computer modeling methodolo			
assessing design concepts for the S	pace S	tation	Data
Management System [NASA-TM-87647]	p 43	N86-24	4737
Langley aerospace test highlights, 1		100-24	
[NASA-TM-87703]	p 81	N86-26	5276

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Adaptive wall wind tunnels: A selected, annotated bibliography [NASA-TM-87639] p 26 N86-29871

Cryogenic wind tunnels for high Reynolds number [NASA-TM-87743]

p 26 N86-29872 Sonic-boom research: Selected bibliography with annotation

p 65 N86-30470 [NASA-TM-87685] Acoustics Division recent accomplishments and research plans

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Future directions in aeropropulsion technology

p 49 A86-11602 Space power systems - 'Spacecraft 2000' p 52 A86-24836 Spacecraft 2000

[AIAA PAPER 86-0616] p 18 A86-29586 Technology achievements and communication satellites of the future projections for

[NASA-TM-87201] p 62 N86-17595 techniques Nondestructive for characterizing mechanical properties of structural materials: verview

[NASA-TM-87203] p 80 N86-19636 Research and competition: Best partners p 76 N86-25321 [NASA-TM-87313]

NASA's Aircraft Icing Analysis Program [NASA-TM-88791] p 82 N86-31548

Aeropropulsion opportunities for the 21st century p 26 N86-31585 [NASA-TM-88817] Advanced instrumentation for aeronautical propulsion

research [NASA-TM-88853] p 27 N86-32703 National Aeronautics and Space Administration.

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p 16 A86-19525 The role of scientists in developing Hubble Space Telescope p 51 A86-19526

Space Station life sciences guidelines for nonhuman experiment accommodation

[SAE PAPER 851370] p 52 A86-23553 National space transportation systems planning p 54 A86-32527

Motivational contracting in space programs Government and industry prospectives p 55 A86-34963

Commerce Lab - A program of commercial flight p 56 A86-34965 opportunities

Spacelab 3 mission - Broadening horizons in space p 56 A86-34967 research

The human role in space: Technology, economics and optimization p 3 A86-37037

National transportation and space support study/mission requirements and architecture studies [AIAA PAPER 86-1211] p 11 A86-40602

Commerical use of space - Status and prospects p 58 A86-41154

Heavy lift launch vehicles for 1995 and beyond [NASA-TM-86520] N86-11216 p 23 Research and technology Fiscal Year 1985 report

[NASA-TM-86532] p 62 N86-17225 Reconfigurable work station for a video display unit and

keyboard [NASA-CASE-MFS-26009-1SB] p 92 N86-22114

Shuttle-launch triangular space station [NASA-CASE-MSC-20676-1] p 93 N86-24729 Space Processing Applications Rocket (SPAR) project: SPAR 10

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[PB86-140043] p 81 N86-26239 selecting ADP Guide on (Automatic Data Processing)backup processing alternatives

p 44 N86-26241 [PB86-154820] Standard reference data publications, 1964-1984 [PB86-155587] p 81 N86-26409

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p 14 N86-28007

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transfer to developing countries p 92 N86-21434 [PB85-2432691 National Weather Service, Silver Spring, Md.

Maintenance planning for the 1990's (initial planning) [PB86-106010] p 75 N86-22065 NATO Integrated Communications System

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p 45 N86-28795

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p 25 N86-28326 [AD-A165697] Naval Postgraduate School, Monterey, Calif.

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p 7 N86-25123 [AD-A163865] An application of cost risk in incentive contracts

[AD-A165177] p 71 N86-27115 The design and analysis of a network interface for the

multi-lingual database system [AD-A164756] p 44 N86-27121

New Mexico Univ., Albuquerque.

Task planning for control of a sensor-based robot [DE86-004225] p 33 N86-23954

New York Univ., New York. Numerical analysis and the scientific method

[DE86-005404] p 47 N86-29591

Northwestern Univ., Evanston, III. Computer-aided engineering

[AD-A162811]

p 81 N86-24256

Ο

Oak Ridge Gaseous Diffusion Plant, Tenn.

In-house CAD training: A realistic approach

[DE86-008926] p 8 N86-31251 Oak Ridge National Lab., Tenn. Future directions in mobile teleoperation [DE85-014308] p 61 N86-12976 Information Systems development aids

p 42 N86-18246 (DE85-018161) Use of broker organizations in technology transfer and

research utilization for the buildings industry [DF86-004674] p 25 N86-26262

Real-time production system for intelligent robot control

IDE86-0085011 p 36 N86-31271 Standard generalized markup language: A technique for

document interchange

[DE86-011504]

p 48 N86-31777 Office National d'Etudes et de Recherches

Aerospatiales, Paris (France). Activities report in aerospace research

[ETN-86-97190]

p 64 N86-28907 Office of Management and Budget, Washington, D. C. Managing federal information resources: Report under the Paperwork Reduction Act of 1980

[PB86-247682] p 13 N86-25299

P

Pacific Northwest Labs., Richland, Wash.

Technology transfer is opportunity transfer [DE85-016622] p 62 p 62 N86-17230 Managing the data analysis progress

p 44 N86-26005 Pattern Analysis and Recognition Corp., McLean, Va.

Human factors in rule-based systems [AD-A165309] p 8 N86-26840 Mental models and problem solving with a

knowledge-based expert system [AD-A165398] p 8 N86-26843 Pennsylvania State Univ., University Park,

New technology implementation: Technical, economic and political factors p 24 N86-15172 Perkin-Elmer Corp., Danbury, Conn.

Future space telescope design concepts p 23 N86-11107

CORPORATE SOURCE

- Planning Research Corp., Washington, D. C. Experience with a software engineering environment framework p.47 N86-30365
- Presidential Commission on the Space Shuttle Challenger Accident, Washington, D.C.
- Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 1
- p 93 N86-24726 [AD-A171402] Report of the Presidential Commission on the Space
- Shuttle Challenger Accident, volume 2 p 95 N86-28974 [AD-A171403] Report of the Presidential Commission on the Space
- Shuttle Challenger Accident, volume 3 [AD-A171403] p 95 N86-28975
- Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 4 [AD-A171404] p 95 N86-28976
- Report of the Presidential Commission on the Space Shuttle Challenger Accident, volume 5 p 95 N86-28977
- [AD-A171404] Princeton Synergetics, Inc., N.J.
- Communications satellite business ventures Measuring the impact of technology programmes and related policies p 69 A86-29699
- Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 1 [NASA-CR-174978] p 70 N86-16451 Evaluation of spacecraft technology programs (effects on communication satellite business ventures), volume 2
- p 24 N86-16452 [NASA-CR-174979] Purdue Univ., West Lafayette, Ind.
- Alerted monitors: Human operators aided by automated detectors [PB85-222750] p 4 N86-13906
- Efficiency and innovation: Steps toward collaborative p 62 N86-15168 interactions

R

Raitt (D. I.), Den Haag (Netherlands).

- The information needs of scientists and engineers in prospace p 45 N86-28796 aerosnace RAND Corp., Santa Monica, Calif.
- Depot maintenance of aviation components: Contractor versus organic repair
- [AD-A162071] p 75 N86-23556 Telecommunications alternatives for federal users: Market trends and decisionmaking criteria
- [PB86-153764] p 13 N86-25687 RCA Astro-Electronics Div., Princeton, N. J. Space Station polar orbiting platform - Mission analysis
- and planning [AIAA PAPER 86-2178] p 60 A86-47960 Reifer Consultants, inc., Torrance, Calif. Software management tools: Lessons learned from p 47 NBS-00360
- p 47 N86-30360 use

Research Inst. of National Defence, Stockholm (Sweden).

- Management of organizational operations in dynamic environments. Towards a frame of reference. [FOA-C5-85-0003-H2] p 12 N86-11072
- Rockwell International Corp., Canoga Park, Calif. Development history of the Space Shuttle Main
- Engine [AIAA PAPER 86-1635] p 21 A86-42764 Productivity improvement in engineering
- p 5 N86-15178 Rocketdyne Rockwell International Corp., Golden, Colo.
- Options for operational risk assessments [DE85-014904] p 70 N86-12390
- Rockwell International Corp., Pittsburgh, Pa. The key to successful management of STS operations:
- An integrated production planning system p 12 N86-15161

Royal Signals and Radar Establishment, Malvern (England).

Applications of expert systems	p 33	N86-19634

S

San Jose State Univ., Calif.

- The development of a project plan for the Get Away Special Program p 64 N86-27306
- Sandia National Labs., Albuquerque, N. Mex. Establishing a successful management information system for project management [DE85-018543]
- p 42 N86-19251 Allocation of tasks to robots for improved safety
- p 33 N86-22955 [DE86-002366] Task planning for control of a sensor-based robot
- [DE86-004225] p 33 N86-23954 Sensor driven robot systems testbed
- [DE86-005892] p 35 N86-30412

State of the art of geoscience libraries and information services

- p 49 N86-33207 [DE86-011188] Science Applications International Corp., McLean, Va. An annotated bibliography of literature integrating
- organizational and systems theory p 12 N86-19249 [AD-A160912] Aspects of cognitive complexity theory and research as
- applied to a managerial decision making simulation [AD-A161376] p 13 N86-22437 Search Technology, Inc., Norcross, Ga.
- The effects of type of knowledge upon human problem solving in a process control task p 1 A86-17771
- Selenia Industrie Associate S.p.A., Rome (Italy). An example of integrated logistic support applied also to production testing p 77 N86-30898
- Societe Nationale Industrielle Aerospatiale,
- Saint-Medard-en-Jalles (France).
- Legislation for software rights protection at last [SNIAS-861-422-114] p 96 N86-32343 Softech, Inc., Waltham, Mass.
- Ada (trademark) training curriculum: engineering for managers M101 teacher's guide curriculum: Software
- [AD-A165123] p 8 N86-27941 SoHaR, Inc., Los Angeles, Calif.
- Reliability prediction for spacecraft [AD-A164747]
- p 81 N86-26359 Space Command, Peterson AFB, Colo. Primer on operating and support (O and S) costs for
- space systems [AD-A162381] p 71 N86-24588
- SRI International Corp., Menio Park, Calif. Expert systems for Space Station automation
- p 28 A86-14548 Modeling and planning robotic manufacturing [AD-A161014] p 24 Ni p 24 N86-19620
- Stanford Univ., Calif. Robotics for the United States Space Station
- p 29 A86-28073 The bootstrap method for assessing statistical
- accuracy [AD-A161257] p 81 N86-20047 Decision procedures
- [AD-A163049] p 34 N86-25173 Data Base Management: Proceedings of a conference p 44 N86-25999 [AD-A158285]
- Survey of Soviet work in reliability [AD-A167607] p 82 N86-32766 State Dept., Washington, D. C.
- US space programs: Cooperation and competition from Europe
- [BPA-CP-695] p 90 N86-12163 State Univ. of New York, Binghamton.
- Evaluation of the need for a large primate research facility in space [NASA-CR-179661] p 14 N86-32111

Т

- Technion Israel Inst. of Tech., Haifa.
- The psychophysics of workload A second look at the relationship between subjective measures and p 3 A86-33804 performance Technische Hogeschool, Deift (Netherlands).
- Developments in quality control
- [REPT-186] p 81 N86-19638 Technische Hogeschool, Eindhoven (Netherlands).
- On the structure of manpower planning, a contribution of simulation experiments with decomposition methods [MANPOWER-PLANNING-28] p 3 N86-11073 p 3 N86-11073
- On the structure of manpower planning, a contribution of simulation experiments with aggregation methods [MANPOWER-PLANNING-30] p 4 N86-11 p 4 N86-11075
- Failures and successes of quantitative methods in management [ARW-03-THE-BDK/ORS/83-06] p 12 N86-11076
- Semimanufactured products made of copper and copper alloys: An analysis of production and sale in a world perspective
- [EUT/BDK/15] p 71 N86-31758 Production and inventory control with the base stock system
- FÉUT/BDK/121 p 77 N86-32328 Balancing production level variations and inventory
- variations in complex production systems [THE/BDK/84] p 77 N86-32329
- Calculating workload norms for job shops [BDK/KBS/84-04] p 26 p 26 N86-32330
- [BLK/KBS/84-04]
 p.26
 N86-32330

 The structuring of production control systems
 [THE/BDK/ORS/84/10]
 p.26
 N86-32332

 Due-date reliability in a repair shop: Implications for organizational and work design
 p.26
 N86-32332
- [THE/BDK/KBS/84-14] p 27 N86-32333

Structuring the production control problem in a repair shop

- [THE/BDK/KBS/84-16] p 27 N86-32334 Texas A&M Univ., College Station. Organization as information processing systems: Toward
- a model of the research factors associated with significant research outcomes [AD-A168018]
- p 48 N86-33200 Organizations as information processing systems: Environmental characteristics, company performance and chief executive scanning, an empirical study p 15 N86-33201 [AD-A168035]
- Texas Univ., Arlington. A case study in R and D productivity: Helping the
- program manager cope with job stress and improve communication effectiveness p 4 N86-15170

U

Universities Space Research Association, Huntsville,

- Productivity issues at organizational interfaces
- p 4 N86-15167 University of Southern California, Marina del Rey. Design of a master lexicon
- [AD-A1659991 p 47 N86-29721

VAIR, Inc., Williamsburg, Va.

Washington Univ., Seattle.

[NASA-CR-179716]

Columbia, Md.

(Switzerland).

Research program

Wyle Labs., Inc., Huntsville, Ala.

[WMO-2]

[WCRP-5]

opportunities

- Implementation of artificial intelligence rules in a data base management system [NASA-CR-178048]
- p 33 N86-21220 Vrije Universiteit, Amsterdam (Netherlands).
- Report on the AI trip [IR-82] p 35 N86-30397 A relational database environment for software
- development [IR-86] p 47 N86-30398

[AU-A158921] p 6 N86-15957 The quantitative modelling of human spatial habitability

First implementation plan for the World Climate

Commerce Lab - A program of commercial flight

Westinghouse Mfg. Systems and Technology Center,

Socio-technical integration of the workplace

World Meteorological Organization, Geneva

Meteorological services of the world

p.9 N86-33210

p 5 N86-15182

p 63 N86-23184

p 64 N86-29477

p 56 A86-34965

C-5

w

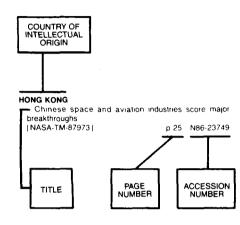
Problem solving under time-constraints [AD-A158921] p

FOREIGN TECHNOLOGY INDEX

MANAGEMENT / A Bibliography for NASA Managers

APRIL 1987

Typical Foreign Technology Index Listing



Listings in this index are arranged alphabetically by country of intellectual origin. The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the citation in the abstract section

В

BELGIUM

A programme manager's needs for information p 45 N86-28795

С

ÇA	NADA

CZECHOSI OVAKIA

Management of outer space

CANADA		
Planning for Telesat Canada's satellites	next	generation
[IAF PAPER 85-354]	p 10	A86-15849
The Canadian mobile satellite	servic	e and its
socio-economic assessment [IAF PAPER 85-364]	p 66	A86-15857
Quality control, reliability, and engine		design
adding control, rendoning, and origin		A86-17472
Assessing cost-effective weight	saving	in aircraft
operations	p 16	A86-20039
The world aircraft industry	p 17	A86-26114
Helicopter maintenance in the real v	vorld	
,		A86-30549
Next generation aircraft structur	es - T	he need for
co-ordinated Canadian R & D program		
	p 21	A86-39567
Possible models for specific space a	agreem	ents
		A86-43339
International information exchange necessary		ammes are N86-28800
,	p 00	1400-20000
CHINA, PEOPLE'S REPUBLIC OF Worldwide report: Telecommunication	ins poli	cy, research
and development		
[JPRS-TTP-86-011]	p 95	N86-30064

F

E

RANCE							
The economics	of	space	launchers	-	Outlook	for	the
future							

[IAF PAPER 85-420] p 66 A86-15893 Economic equity and international cooperation - The example of E.S.A.

[IAF PAPER 85-499] n 83 A86-15943 Tomorrow ... Concorde's successor?

p 17 A86-26299 Earth observation satellites - From technology push to

market pull p 68 A86-26465 Ariane 5 - A new launcher for Europe p 18 [AAS 84-226] A86-28596

Expert computer aided decision in supervisory control p 30 A86-33188

Aircraft ground support equipment standardization - The ros and cons of 'functional' vs 'technical' pros and cons of standardization [SAE PAPER 851794] p 79 A86-38317

ESA views on requirements for Space station: experimental and operational Earth observation missions p 62 N86-18379

The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes LAGARD-CP-3851 p 45 N86-28793

Activities report in aerospace research [ETN-86-97190] p 64 N86-28907

Legislation for software rights protection at last [SNIÅS-861-422-114] p 96 N86-32343

ESA and its Earth observation programs p 66 N86-32849

G

GERMANY, FEDERAL REPUBLIC OF

The ERS-1 program and its future applications

US-Soviet intergovernmental agreem space activities - Should it be re-established?

Space stations: Legal aspects of scientific and commercial use in a framework of transatlantic cooperation; Proceedings of the International Colloquium, Hamburg, West Germany, October 3, 4, 1984

Agreements between states and with international organizations Contracts of and with private enterprises concerning the development, the construction, and the assembly of sp

vehicles Applicable law and dispute settlement

situation State supervision and registration p 89 Information resources management in the R and D

environment GERMANY PEOPLES DEMOCRATIC REPUBLIC OF Implementation of computer-aided production systems p 32 N86-14611 detailed

Н

HONG KONG

Chinese space and aviation industries score major breakthroughs [NASA-TM-879731 p 25 N86-23749

INDIA

p 84 A86-19261

Artificial intelligence - The emerging technology p 29 A86-26070

INTERNATIONAL ORGANIZATION Plan for the implementation of the World Climate Research Programme p 49 A86-10403 p 49 A86-10403 ERS-1 - Mission objectives and system description p 49 A86-13823

Development and implementation of the Future Global Maritime Distress and Safety System (FGMDSS) p 77 A86-15839 [IAF PAPER 85-338] Inmarsat role in the future global maritime distress and afety system [IAF PAPER 85-339] p 78 A86-15840 Government in action - The role of political science in outer space activities [IAF PAPER 85-498] p 83 A86-15942 Intelsat and the challenge of competitive systems p 84 A86-18394 Decision making in product assurance D 78 A86-22394 The evolution of the agency's patent policy p 85 A86-24598 ESA Space Station planning [AAS 85-113] p 86 A86-28582 A chronicle of policy and procedure - The formulation of the Reagan administration policy on international satellite telecommunications p 87 A86-30290 Present and future prospects of microgravity A86-37870 p 57 Status of ESA's planning for the Space Station p 59 A86-44530 Horizon 2000 and its relation to the Columbus Programme p 59 A86-45643 ISRAEL Robotics for engineers p 27 A86-10560 The psychophysics of workload - A second look at the relationship between subjective measures and performance p 3 A86-33804 ITALY The space industry for communications and remote sensing [AAS 85-1361 p 52 A86-28593 Economic aspects of space industrialization p 70 A86-45636

An example of integrated logistic support applied also p 77 N86-30898 to production testing J

JAPAN Computer architecture for intelligent robots

p 28 A86-13529 Japanese policy on participation in the Space Station

program [AAS 85-1141 p 86 A86-28583 On a microcomputer integrated system for structural

engineering practices p 21 A86-39794 A study on robot path planning from a solid model p 32 A86-43061

MEXICO Satellite communications planning and equipment manufacturing in Latin America p 19 A86-30187

М

Ν

NETHERLANDS

Human development and the conquest of space p 83 A86-18381

The needs of developing countries in the application of satellite technology for disaster management

p 84 A86-21123 p 85 A86-26546 Space law in the United Nations

On the structure of manpower planning, a contribution simulation experiments with decomposition methods p 3 N86-11073 [MANPOWER-PLANNING-28]

On the structure of manpower planning, a contribution of simulation experiments with aggregation methods

[MANPOWER-PLANNING-30] p4 N86-11075 Failures and successes of quantitative methods in management

[ARW-03-THE-BDK/ORS/83-06] p 12 N86-11076 Risk propensity, action readiness and the roles of ocietal and individual decision makers

p 12 N86-11077 [IZF-1984-27]

FORM-GZ

p 50 A86-14095 ent on cooperative p 87 A86-29698

p 88 A86-43335 p 88 A86-43340

p 58 A86-43341

p 89 A86-43343 Insurance - Forms of coverage and current market p 89 A86-43344 A86-43345

p 46 N86-28803

SOUTH AFRICA, REPUBLIC OF

SOUTH AFRICA, REFUBLIC OF	
Developments in quality control [REPT-186] p 81 N86-19638	
The information needs of scientists and engineers in	
aerospace p 45 N86-28796	
Report on the AI trip	
[IR-82] p 35 N86-30397	
A relational database environment for software development	
[IR-86] p 47 N86-30398	
Evaluation of research: Experiences and perspectives in the Netherlands	
(ESA-86-96709) p 65 N86-31461	
Semimanufactured products made of copper and copper	
alloys: An analysis of production and sale in a world	
perspective	
[EUT/BDK/15] p 71 N86-31758	
Production and inventory control with the base stock	
system	
[EUT/BDK/12] p 77 N86-32328	
Balancing production level variations and inventory	
variations in complex production systems	
[THE/BDK/84] p 77 N86-32329	
Calculating workload norms for job shops	
[BDK/KBS/84-04] p 26 N86-32330	
The structuring of production control systems	
[THE/BDK/ORS/84/10] p 26 N86-32332	
Due-date reliability in a repair shop: Implications for	
organizational and work design [THE/BDK/KBS/84-14] p 27 N86-32333	
Structuring the production control problem in a repair	
shop [THE/BDK/KBS/84_16] p 27 N86-32334	

[THE/BDK/KBS/84-16] p 27 N86-32334 Data for selection of space materials

p 77 N86-32584 [ESA-PSS-01-701-ISSUE-1] The qualification and procurement of two-sided printed circuit boards (fused tin-lead or gold plated finish)

[FSA-PSS-01-710-ISSUE-1] p 82 N86-32660

S

SOUTH AFRICA, REPUBLIC OF

The selection and acquisition of commercial aircraft p 74 A86-44935 fleets SWEDEN

Management of organizational operations in dynamic environments. Towards a frame of reference [FOA-C5-85-0003-H2] p 12 N86-11072

SWITZERLAND Turboprop airliners get bigger - Will they have a p 66 Á86-10568 market?

One man and 3,000 million operations a second -Preparing for the LHX cockpit p 17 A86-24988 p 17 A86-24988 What technologies await the future airliner?

p 19 A86-31038 Planning for minimum overhaul time

p 75 A86-47616 Airports build for future traffic amid new security p 80 A86-48371 concern Space Station evolution - The uncertainty principle

Meteorological services of the world VMO-2] prevails

[WMO-2] p 63 N86-23184 First implementation plan for the World Climate Research program (WCRP-5)

U

p 64 N86-29477

U.S.S.R.

In-process inspection of the parameters of the electron beam in electron beam welding p 19 A86-34124 USSR report: Machine tools and metalworking USSR report: equipment [JPRS-UMM-85-010] p 23 N86-11394 USSR report: Machine tools and metalworking equipment [JPRS-UMM-85-014] p 24 N86-13742 USSR report: Machine tools and metalworking equipment [JPRS-UMM-85-013] p 24 N86-13745 Influence of complexity of control task on level of activation of operators physiological functions when working with waiting N86-23260 p 7 Role of robotics in solving production, social problems p 34 N86-26062

USSR report: Cybernetics, computers and automation technology A 45 NR6 29604

[][10000004]	μ 45	1100-20034
UNITED KINGDOM		
Europe goes independent	n 52	A86.21524

Europe - Towards a new long-term programme p 85 A86-22242

Space: The commercial opportunities; Proceedings of the International Business Strategy Conference, London, England, October 31, November 1, 1984 p 68 A86-26451 Insurance in space risk management p 68 A86-26453 Spacecab II - A low-cost small shuttle for Britain p 53 A86-28725 Hotol spaceplane is designed to slash launch costs by 80 percent p 54 A86-29496 History of British space science p 87 A86-33604 p 56 A86-35526 Prescription for profits Soviet spaceflight comes of age p 88 A86-36449 ERS-1 - Our new window on the oceans for the 1990s p 57 A86-38718 Advanced project management (2nd edition) p 57 A86-38959 Space - Technology and opportunity; Proceedings of the Conference, Geneva, Switzerland, May 28-30, 1985 p 58 A86-44526 Countertrade - A necessary part of marketing, or an p 69 A86-44537 expensive diversion? Financial structure for participation in industrial space p 69 A86-44538 projects A fully reusable launch vehicle for Europe? p 59 A86-44543 p 21 A86-44919 World aerospace profile 1986 p 90 A86-46375 Something has to change Missions to Mars p 60 A86-48100 The airline engineering role in the management of safetv p 80 A86-49084 Fifth generation computers: Concepts, implementations p 41 A86-50280 and uses Applications of expert systems p 33 N86-19634 The policy maker looks at information p 45 N86-28794 The costs of not having refined information

p 45 N86-28798 The application of composites to space structures:

Guidelines on important aspects for the designer p 76 N86-30759

D-2

CONTRACT NUMBER INDEX

N86-33210

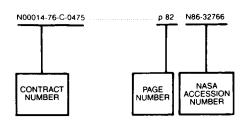
р9

MANAGEMENT / A Bibliography for NASA Managers

NAG2-346 ...

APRIL 1987

Typical Contract Number Index Listing



Listings in this index are arranged alphanumerically by contract number. Under each contract number, the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order with the AIAA accession numbers appearing first. The accession number denotes the number by which the citation is identified in the abstract section. Preceding the accession number is the page number on which the citation may be found.

AF-AFOSR-0122-81	p 7	N86-26078
DA PROJ. 201-61102-B-74-F	p 9	N86-32969
DA PROJ. 201-62722-A-791	p 12	N86-19249
BATTAGO. EGT-OE/EE-A-731	· ·	
	p 13	N86-22437
DA PROJ. 4A1-62719-AT-40	p 42	N86-19955
DAAB07-83-C-K506	р8	N86-27941
DE-AC01-81RA-50658	p 13	N86-27950
DE-AC02-76ER03077	p 47	N86-29591
DE-AC04-76DP-00613	p 32	N86-13027
	p 35	N86-30387
		N86-30390
DE-AC04-76DP-00789	p 35	
DE-AC04-76DP-00789	p 42	N86-19251
	p 33	N86-22955
	p 33	N86-23954
	p 35	N86-30412
	p 49	N86-33207
DE-AC04-76DP-03533	p 70	N86-12390
DE-AC05-84OR-21400	p 61	N86-12976
	p 42	N86-18246
	p 25	N86-26262
	р 36	N86-31271
	p 48	N86-31777
DE-AC05-84OT-21400	р 8	N86-31251
DE-AC06-76RL-01830	p 62	N86-17230
DE-AC07-76ID-01570	p 8	N86-31223
	p 8	N86-31226
	p 48	N86-32338
DLA900-84-C-1508	p 33	N86-20014
	p 33	N86-28067
	p 4	N86-13906
F30602-83-C-0018	p 81	N86-26359
F30602-84-C-0112	p 37	A86-17769
F33615-81-K-1539	p 28	A86-14850
F33615-82-C-0513	p 6	N86-20013
F33615-82-K-0522	p 3	A86-33787
F33615-83-C-1083	p 30	A86-28515
F33615-83-C-3232	p 39	A86-38807
F49620-80-C-0001	p 42	N86-19022
MDA903-79-C-0699	p 12	N86-19249
MD4000 04 0 0005	p 13	N86-22437
MDA903-81-C-0335	p 28	A86-14847
	p 47	N86-29721
MDA903-83-C-0106	p 9	N86-32969
MDA903-85-C-0139	p 25	N86-24589
NA-83-SAC-00658	p 24	N86-14710
NAGW-494	p 3	A86-33804
	p 96	N86-30744
NAG1-489	p 31	A86-42983
NAG2-123	p 1	A86-17771
	p2	A86-25038
NAG2-232	p 14	N86-32111
	P 14	1100-32111

	рy	N86-33210
NASA ORDER H-78175-B	p 63	N86-24712
NASW-3339	p 70	N86-12243
114011-0003		
	p 61	N86-13221
	p 90	N86-13230
	p 24	N86-14710
NASW-3455	p 23	N86-13235
NASW-3674	p 24	N86-17227
	· .	
	р6	N86-21419
NASW-4005	p 25	N86-23749
NAS1-17335	p 4	N86-12212
NAS1-17657	p 37	A86-21973
NAS1-18002	p 33	N86-21220
NAS2-11530	p 40	A86-49488
NAS2-11864	p 28	A86-14548
NAS3-23886	p 70	N86-16451
1466-25000		
11.05 00 100	p 24	N86-16452
NAS5-29400	p 60	A86-47960
NAS8-27980	p 21	A86-42764
NAS8-36607	p 22	A86-46964
NAVY ORDER 0002	p 79	A86-22402
NCC2-202	p 2	A86-26011
NCC2-387	p 46	N86-29568
	p 46	N86-29569
NGT21-002-080	p 64	N86-29888
NR PROJ. 042-267	p 44	N86-25999
NSF MEA-81-11917	p 34	N86-25808
NSF PRA-84-00689	p 13	N86-25687
NSF SRS-82-15756	p 7	
		N86-24554
	p 63	N86-25290
NSG-5123	p 42	N86-19022
N00014-76-C-0475	p 82	N86-32766
N00014-76-C-0476	p 44	N86-25999
N00014-77-C-0378	p 7	N86-24257
N00014-79-C-0610	p 55	A86-33544
N00044 70 0 0004		
	p 12	N86-10899
N00014-80-C-0505	p 33	N86-18736
	p 34	N86-29120
	p 34	N86-29220
N00014-81-C-0591	p 13	N86-27113
N00014-81-K-0004	р34	N86-25173
N00014-81-K-0143	p1	A86-25036
N00014 82 C 5076	p 2	A86-25037
N00014-82-C-5076	p 12	N86-10899
N00014-82-K-0334	p 33	N86-18736
	p 34	N86-29220
N00014-83-C-0025	p 48	N86-33200
	p 15	N86-33201
N00014-83-C-0100	p 75	N86-23556
N00014-83-C-0537	p 8	N86-26840
	p 8	
N00014 82 C 0640		N86-26843
N00014-83-C-0649	p 24	N86-19620
N00014-83-K-0472	p 81	N86-20047
N00014-84-C-0484	p 13	N86-25992
N00014-84-K-5553	p 6	N86-15957
N00014-85-C-0079	p7	N86-24257
N00014-85-K-0384	p7	N86-26078
100010 00 0 0000	p 79	A86-22402
	p 3	A86-31823
N62269-83-D-0115	p 36	N86-30581
W-31-109-ENG-38	p 36	N86-31270
	p 48	N86-32340
W-7405-ENG-36	p 41	N86-10841
	p 32	N86-18053
		N86-27109
	n 63	
	p 63	
	p 35	N86-29229
	р 35 р 35	N86-29229 N86-29557
	р 35 р 35 р 47	N86-29229 N86-29557 N86-29591
	р 35 р 35	N86-29229 N86-29557
	р 35 р 35 р 47	N86-29229 N86-29557 N86-29591 N86-30583 N86-31248
	p 35 p 35 p 47 p 65	N86-29229 N86-29557 N86-29591 N86-30583
	p 35 p 35 p 47 p 65 p 48	N86-29229 N86-29557 N86-29591 N86-30583 N86-31248
	p 35 p 35 p 47 p 65 p 48 p 43 p 35	N86-29229 N86-29557 N86-29591 N86-30583 N86-31248 N86-24285 N86-29234
	p 35 p 35 p 47 p 65 p 48 p 43 p 35 p 14	N86-29229 N86-29557 N86-29591 N86-30583 N86-31248 N86-24285 N86-29234 N86-29234
	p 35 p 35 p 47 p 65 p 48 p 43 p 35 p 14 p 9	N86-29229 N86-29557 N86-30583 N86-31248 N86-24285 N86-29234 N86-29874 N86-33023
W-7405-ENG-48	p 35 p 35 p 47 p 65 p 48 p 35 p 14 p 9 p 48	N86-29229 N86-29557 N86-30583 N86-31248 N86-24285 N86-29234 N86-29874 N86-33023 N86-33048
W-7405-ENG-48	p 35 p 35 p 47 p 65 p 48 p 43 p 35 p 14 p 9 p 48 p 66	N86-29229 N86-29557 N86-30583 N86-31248 N86-24285 N86-29234 N86-29874 N86-33023 N86-33048 N86-32950
W-7405-ENG-48	p 35 p 35 p 47 p 65 p 48 p 43 p 35 p 14 p 9 p 48 p 66	N86-29229 N86-29557 N86-30583 N86-31248 N86-24285 N86-29234 N86-29874 N86-33023 N86-33048
W-7405-ENG-48 199-40-12	p 35 p 35 p 47 p 65 p 48 p 43 p 35 p 14 p 9 p 48 p 66 p 43	N86-29229 N86-29557 N86-30583 N86-31248 N86-24285 N86-29234 N86-29874 N86-33023 N86-33048 N86-32950
W-7405-ENG-48 199-40-12 483-36-23-03 505-33-53-15	p 35 p 35 p 47 p 65 p 48 p 43 p 35 p 14 p 9 p 48 p 66 p 43 p 23	N86-29229 N86-29557 N86-29557 N86-30583 N86-31248 N86-24285 N86-29234 N86-29874 N86-33023 N86-33048 N86-32950 N86-32950 N86-24737 N86-11540
W-7405-ENG-48	p 35 p 35 p 47 p 65 p 48 p 35 p 14 p 35 p 14 p 9 p 48 p 66 p 43 p 23 p 33	N86-29229 N86-29557 N86-29591 N86-30583 N86-31248 N86-24285 N86-29234 N86-33028 N86-33048 N86-33048 N86-32950 N86-24737 N86-11540 N86-21220
W-7405-ENG-48 199-40-12 483-36-23-03 505-33-53-15	p 35 p 35 p 47 p 65 p 48 p 35 p 14 p 35 p 14 p 9 p 48 p 66 p 43 p 23 p 33 p 32	N86-29229 N86-29557 N86-29591 N86-30583 N86-31248 N86-24285 N86-29234 N86-32023 N86-33028 N86-33048 N86-32950 N86-24737 N86-11540 N86-21220 N86-11194
W-7405-ENG-48 199-40-12 483-36-23-03 505-33-53-15 505-33-53-16 505-34-11	p 35 p 35 p 47 p 65 p 48 p 43 p 35 p 14 p 9 p 48 p 43 p 9 p 48 p 43 p 23 p 23 p 32 p 32 p 32	N86-29229 N86-29557 N86-29591 N86-30583 N86-31248 N86-29234 N86-29234 N86-33023 N86-33048 N86-33048 N86-32950 N86-11540 N86-11195
W-7405-ENG-48	p 35 p 35 p 47 p 65 p 48 p 43 p 35 p 14 p 9 p 48 p 43 p 23 p 23 p 32 p 32 p 32 p 81	N86-29229 N86-29557 N86-29591 N86-30583 N86-31248 N86-324285 N86-29234 N86-33028 N86-33028 N86-33048 N86-33048 N86-33048 N86-32950 N86-21220 N86-11540 N86-11295 N86-1194 N86-26276
W-7405-ENG-48 199-40-12 483-36-23-03 505-33-53-15 505-33-53-16 505-34-11	p 35 p 35 p 47 p 65 p 48 p 43 p 35 p 14 p 9 p 48 p 43 p 9 p 48 p 43 p 23 p 23 p 32 p 32 p 32	N86-29229 N86-29557 N86-29591 N86-30583 N86-31248 N86-29234 N86-29234 N86-33023 N86-33048 N86-33048 N86-32950 N86-11540 N86-11195

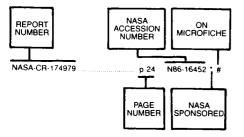
505-61-01-02	p 26	N86-29871
	p 26	N86-29872
505-61-11	p 65	N86-31340
505-66-11	p 34	N86-24687
505-68-11	p 82	N86-31548
505-90-01	p 27	N86-32703
506-53-1A	p 80	N86-19636
506-62-22	р70	N86-16451
	p 24	N86-16452
533-02-02	D 25	N86-26277
533-02-61	D 33	N86-23603
650-60-20	p 62	N86-17595
776-33-41-02	p 65	N86-30470

REPORT NUMBER INDEX

MANAGEMENT / A Bibliography for NASA Managers

APRIL 1987

Typical Report Number Index Listing



Listings in this index are arranged alphanumerically by report number. The page number indicates the page on which the citation is located. The accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A-86233	р66	N86-32950 * #
AAS PAPER 84-112	p 72	A86-17318 * #
AAS PAPER 84-117	p1	A86-17320 #
AAS PAPER 85-001A		A86-31777 #
AAS PAPER 85-397	p 58	
	p 56	A86-43229 * #
AAS 84-151	р53	A86-28777 #
AAS 84-153	р 86	A86-28779 #
AAS 84-154		A86-28780 #
AAS 84-160	p 87	A86-28786 * #
AAS 84-161	p 53	A86-28787 * #
AAS 84-166	р53	A86-28792 #
AAS 84-169	р53	A86-28795 #
AAS 84-170	р53	A86-28796 #
AAS 84-226	p.18	A86-28596 #
AAS 85-103	р39	A86-28578 * #
AAS 85-111	р73	A86-28581 * #
AAS 85-113	р86	A86-28582 #
AAS 85-114	р86	A86-28583 #
AAS 85-136	p 52	A86-28593 #
ACSC-86-2585	р 8	N86-29805 #
AD-A156817	р 12	N86-10899 #
AD-A158285		N86-25999 #
AD-A158921		N86-15957 #
AD-A160202		N86-19022 * #
AD-A160833		N86-18736 #
AD-A160912	p 12	N86-19249 #
AD-A161014		N86-19620 #
AD-A161072	p 6	N86-20013 #
AD-A161159	p 42	N86-19955 #
AD-A161161	p 33	N86-20014 #
AD-A161257	p.81	N86-20047 #
AD-A161376	p 13	N86-22437 #
AD-A161817	p. 43	N86-22168 #
AD-A161853	p 71	N86-23630 #
AD-A161871		
	p 71	N86-24574 #
AD-A161914	p71 p43	N86-24574 # N86-24278 #
AD 4404044	р 43	
AD-A161914	p43 p71	N86-24278 #
AD-A161914 AD-A161920	p 43 p 71 p 75	N86-24278 # N86-24575 # N86-23556 #
AD-A161914 AD-A161920 AD-A162071	p 43 p 71 p 75 p 75	N86-24278 # N86-24575 # N86-23556 # N86-24586 #
AD-A161914 AD-A161920 AD-A162071 AD-A162327	p 43 p 71 p 75 p 75	N86-24278 # N86-24575 # N86-23556 # N86-24586 # N86-24588 #
AD-A161914 AD-A161920 AD-A162071 AD-A162327 AD-A162381	p 43 p 71 p 75 p 75 p 71 p 81	N86-24278 # N86-24575 # N86-23556 # N86-24586 # N86-24588 # N86-24256 #
AD-A161914	p 43 p 71 p 75 p 75 p 75 p 71 p 81	N86-24278 # N86-24575 # N86-23556 # N86-24586 # N86-24588 # N86-24256 #
AD-A161914	p 43 p 71 p 75 p 75 p 71 p 81 p 7	N86-24278 # N86-24575 # N86-23556 # N86-24586 # N86-24588 # N86-24256 # N86-24257 #
AD-A161914 AD-A161920 AD-A162071 AD-A162071 AD-A162327 AD-A162381 AD-A162811 AD-A162813 AD-A162843 AD-A162968 AD-A163049 AD-A163150	p 43 p 71 p 75 p 75 p 75 p 71 p 81 p 7 p 25 p 34	N86-24278 # N86-24575 # N86-23556 # N86-24588 # N86-24586 # N86-24587 # N86-24588 # N86-24588 # N86-24588 # N86-24588 # N86-24589 #
AD-A161914	p 43 p 71 p 75 p 75 p 75 p 81 p 7 p 25 p 34 p 13	N86-24278 # N86-24575 # N86-23556 # N86-24588 # N86-24586 # N86-24526 # N86-24257 # N86-24258 # N86-24258 # N86-24258 # N86-24257 # N86-24589 # N86-25173 #
AD-A161914 AD-A161920 AD-A162071 AD-A162071 AD-A162327 AD-A162381 AD-A162811 AD-A162843 AD-A162968 AD-A163049 AD-A163049 AD-A163069	p 43 p 71 p 75 p 75 p 75 p 71 p 81 p 7 p 25 p 34 p 13 p 7	N86-24278 # N86-24575 # N86-24575 # N86-24586 # N86-24588 # N86-24588 # N86-24586 # N86-24587 # N86-24256 # N86-24257 # N86-24583 # N86-24583 # N86-24583 # N86-24583 # N86-24583 # N86-25173 # N86-25992 #
AD-A161914 AD-A161920 AD-A162071 AD-A162071 AD-A162327 AD-A162381 AD-A162811 AD-A162813 AD-A162843 AD-A162968 AD-A163049 AD-A163150 AD-A163150 AD-A163865	p 43 p 71 p 75 p 75 p 75 p 71 p 81 p 7 p 25 p 34 p 13 p 7 p 7	N86-24278 # N86-24575 # N86-24586 # N86-24588 # N86-24588 # N86-24586 # N86-24588 # N86-24589 # N86-24589 # N86-24589 # N86-25173 # N86-25123 # N86-25123 # N86-26078 #
AD-A161914 AD-A161920 AD-A162071 AD-A162327 AD-A162327 AD-A162381 AD-A162841 AD-A162843 AD-A162843 AD-A162968 AD-A163049 AD-A163150 AD-A163865 AD-A164064 AD-A163172	p 43 p 71 p 75 p 75 p 75 p 81 p 25 p 34 p 13 p 7 p 7 p 7 p 81	N86-24278 # N86-24575 # N86-24575 # N86-24586 # N86-24588 # N86-24586 # N86-24586 # N86-24587 # N86-24257 # N86-24257 # N86-24257 # N86-25173 # N86-25123 # N86-25123 # N86-26078 # N86-26359 #
AD-A161914 AD-A161920 AD-A162071 AD-A162071 AD-A162327 AD-A162381 AD-A162811 AD-A162813 AD-A162868 AD-A163049 AD-A163049 AD-A163150 AD-A163150 AD-A16365 AD-A164765 AD-A164756	p 43 p 71 p 75 p 75 p 71 p 71 p 71 p 71 p 25 p 34 p 13 p 7 p 81 p 44	N86-24278 # N86-24575 # N86-24556 # N86-24586 # N86-24588 # N86-24564 # N86-24557 # N86-24565 # N86-24567 # N86-2457 # N86-2457 # N86-24573 # N86-25123 # N86-25078 # N86-26078 # N86-26359 # N86-26359 # N86-27121 #
AD-A161914 AD-A161920 AD-A162071 AD-A162071 AD-A162327 AD-A162381 AD-A162811 AD-A162813 AD-A162843 AD-A163049 AD-A163049 AD-A163049 AD-A163150 AD-A163150 AD-A164064 AD-A164747 AD-A164756	p 43 p 71 p 75 p 75 p 75 p 81 p 81 p 25 p 313 p 7 p 7 p 7 p 7 p 81 p 7 p 81 p 7	N86-24278 # N86-24575 # N86-24575 # N86-24586 # N86-24588 # N86-24586 # N86-24586 # N86-24587 # N86-24257 # N86-24257 # N86-24257 # N86-25173 # N86-25123 # N86-25123 # N86-26078 # N86-26359 #

AD-A165143		D 14	N86-28007	#
		•		
	••••••	p 71	N86-27115	#
AD-A165309		p 8	N86-26840	#
AD-A165398	••••••	p 8	N86-26843	#
			N86-28805	#
AD-A165697	••••••	p 25	N86-28326	#
	••••••		N86-28806	#
		· · · ·	N86-29220	#
			N86-29120	
	••••••			#
		p 47	N86-29721	#
AD-A166035		p 36	N86-30581	#
AD-A166469		p 96	N86-30582	#
15 1/0000		· .	N86-29805	
	••••••			#
	••••••	•	N86-28793	#
		p 82	N86-32766	#
AD-A167794		p 26	N86-32327	#
			N86-32969	#
			N86-33200	#
			N86-33212	#
AD-A168035		p 15	N86-33201	#
AD-A168037		p 14	N86-32750	#
			N86-33204	#
10 1121100				
			N86-24726	#
	•••••	p 95	N86-28974	#
AD-A171403		p 95	N86-28975	#
AD-A171404		p 95	N86-28976	#
		p 95	N86-28977	#
AD-A171404	•••••••••	h a2	1100-20977	#
AD-D011980	•••••	p 92	N86-21540	#
AD-D012171		p 94	N86-26529	#
		P • •		"
		- 0	NOO 000 10	
	••••••	p8	N86-26840	#
AD-E750871	••••••	p 8	N86-29805	#
AD-F620003		p 24	N86-19620	#
AFAMRL-TR-85-017		n 6	N86-20013	#
		F *		"
AFOSR-85-0803TR		- 10	NOC 10000	
		p 42	N86-19022 *	
AFOSR-85-1108TR		p 81	N86-24256	#
AFSC-TR-86-001		p 26	N86-32327	#
AFSC-TR-86-001		p 26	N86-32327	#
AFSC-TR-86-001			N86-32327 N86-28793	# #
AGARD-CP-385		p 45	N86-28793	#
AGARD-CP-385		р 45 р 34	N86-28793 N86-29220	#
AGARD-CP-385		p 45	N86-28793	#
AGARD-CP-385		p 45 p 34 p 33	N86-28793 N86-29220 N86-18736	# ##
AGARD-CP-385		р 45 р 34	N86-28793 N86-29220	#
AGARD-CP-385 Al-M-855 Al-M-864 Al-M-867		p 45 p 34 p 33 p 34	N86-28793 N86-29220 N86-18736 N86-29120	# ###
AGARD-CP-385 Al-M-855 Al-M-864 Al-M-867 AlAA PAPER 85-3000		p 45 p 34 p 33 p 34 p 49	N86-28793 N86-29220 N86-18736 N86-29120 A86-12935	# ### #
AGARD-CP-385 AI-M-855 AI-M-864 AI-M-867 AIAA PAPER 85-3000 AIAA PAPER 85-3043	······	p 45 p 34 p 33 p 34 p 49 p 15	N86-28793 N86-29220 N86-18736 N86-29120 A86-12935 A86-10926	# ### ##
AGARD-CP-385 AI-M-855 AI-M-864 AI-M-867 AIAA PAPER 85-3000 AIAA PAPER 85-3043 AIAA PAPER 85-3043	· · · · · · · · · · · · · · · · · · ·	p 45 p 34 p 33 p 34 p 49 p 15	N86-28793 N86-29220 N86-18736 N86-29120 A86-12935 A86-10926 A86-10928	# ### ###
AGARD-CP-385 AI-M-855 AI-M-864 AI-M-867 AIAA PAPER 85-3000 AIAA PAPER 85-3043	· · · · · · · · · · · · · · · · · · ·	p 45 p 34 p 33 p 34 p 49 p 15 p 72	N86-28793 N86-29220 N86-18736 N86-29120 A86-12935 A86-10926 A86-10928	# ### ###
AGARD-CP-385 AI-M-855 AI-M-864 AI-M-867 AIAA PAPER 85-3043 AIAA PAPER 85-3043 AIAA PAPER 85-3062 AIAA PAPER 85-3062	· · · · · · · · · · · · · · · · · · ·	p 45 p 34 p 33 p 34 p 49 p 15 p 72 p 15	N86-28793 N86-29220 N86-18736 N86-29120 A86-12935 A86-10926 A86-10928 A86-10930	# ### ####
AGARD-CP-385 AI-M-855 AI-M-864 AI-M-867 AIAA PAPER 85-3043 AIAA PAPER 85-3043 AIAA PAPER 85-3068 AIAA PAPER 85-3068 AIAA PAPER 85-3068	· · · · · · · · · · · · · · · · · · ·	p 45 p 34 p 33 p 34 p 15 p 72 p 15 p 15 p 15	N86-28793 N86-29220 N86-18736 N86-29120 A86-12935 A86-10928 A86-10930 A86-10930	# ### #####
AGARD-CP-385 AI-M-855 AI-M-864 AI-M-867 AIAA PAPER 85-3003 AIAA PAPER 85-3063 AIAA PAPER 85-3068 AIAA PAPER 85-3068 AIAA PAPER 85-3068		p 45 p 34 p 33 p 34 p 15 p 72 p 15 p 15 p 15 p 16	N86-28793 N86-29220 N86-18736 N86-29120 A86-12935 A86-10926 A86-10928 A86-10932 A86-10932	# ### ######
AGARD-CP-385 AI-M-855 AI-M-864 AI-M-867 AIAA PAPER 85-3000 AIAA PAPER 85-3060 AIAA PAPER 85-3066 AIAA PAPER 85-3076 AIAA PAPER 85-3076 AIAA PAPER 85-3076		p 45 p 34 p 33 p 34 p 49 p 15 p 72 p 15 p 15 p 16 p 28	N86-28793 N86-29220 N86-18736 N86-29120 A86-12935 A86-10928 A86-10928 A86-10938 A86-10936 A86-1434	# ### #######
AGARD-CP-385 AI-M-855 AI-M-864 AI-M-867 AIAA PAPER 85-3002 AIAA PAPER 85-3052 AIAA PAPER 85-3060 AIAA PAPER 85-3078 AIAA PAPER 85-3078 AIAA PAPER 85-3095 AIAA PAPER 85-4001		p 45 p 34 p 33 p 34 p 49 p 15 p 72 p 15 p 15 p 16 p 28 p 36	N86-28793 N86-29220 N86-18736 N86-29120 A86-12935 A86-10926 A86-10928 A86-10932 A86-10932	# ### ######
AGARD-CP-385 AI-M-855 AI-M-864 AI-M-867 AIAA PAPER 85-3000 AIAA PAPER 85-3060 AIAA PAPER 85-3066 AIAA PAPER 85-3076 AIAA PAPER 85-3076 AIAA PAPER 85-3076		p 45 p 34 p 33 p 34 p 49 p 15 p 72 p 15 p 15 p 16 p 28 p 36	N86-28793 N86-29220 N86-18736 N86-29120 A86-10926 A86-10926 A86-10930 A86-10932 A86-10932 A86-10936	# ### #######
AGARD-CP-385 AI-M-855 AI-M-864 AI-M-867 AIAA PAPER 85-3003 AIAA PAPER 85-3063 AIAA PAPER 85-3066 AIAA PAPER 85-3095 AIAA PAPER 85-4001 AIAA PAPER 85-4001 AIAA PAPER 85-4001		p 45 p 34 p 33 p 34 p 49 p 15 p 72 p 15 p 15 p 16 p 28 p 36 p 16	N86-28793 N86-29220 N86-18736 N86-29120 A86-10926 A86-10926 A86-10926 A86-10932 A86-10932 A86-10936 A86-10940	# ### #########
AGARD-CP-385 AI-M-855 AI-M-864 AI-M-867 AIAA PAPER 85-3000 AIAA PAPER 85-3043 AIAA PAPER 85-3052 AIAA PAPER 85-3056 AIAA PAPER 85-3095 AIAA PAPER 85-4001 AIAA PAPER 85-4001 AIAA PAPER 85-50455		p 45 p 34 p 33 p 34 p 49 p 15 p 72 p 15 p 16 p 28 p 36 p 16 p 27	N86-28793 N86-29220 N86-18736 N86-29120 A86-10926 A86-10928 A86-10928 A86-10928 A86-10936 A86-10936 A86-10940 A86-10960 A86-11407	# ### ##########
AGARD-CP-385 AI-M-855 AI-M-864 AI-M-867 AIAA PAPER 85-3002 AIAA PAPER 85-3062 AIAA PAPER 85-3062 AIAA PAPER 85-3078 AIAA PAPER 85-3078 AIAA PAPER 85-4031 AIAA PAPER 85-4031 AIAA PAPER 85-5045 AIAA PAPER 85-5045 AIAA PAPER 85-5045		p 45 p 34 p 33 p 34 p 49 p 15 p 72 p 15 p 15 p 16 p 28 p 36 p 16 p 27 p 36	N86-28793 N86-29220 N86-18736 N86-29120 A86-10928 A86-10928 A86-10930 A86-10930 A86-10930 A86-10930 A86-1434 A86-10948 A86-10948 A86-10443 A86-10460 A86-11407 A86-11412	# ### ###########
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AGARD-CP-385 AI-M-855 AI-M-855 AI-M-864 AI-M-867 AIAA PAPER 85-3003 AIAA PAPER 85-3062 AIAA PAPER 85-3062 AIAA PAPER 85-3062 AIAA PAPER 85-3062 AIAA PAPER 85-3078 AIAA PAPER 85-5035 AIAA PAPER 85-5063 AIAA PAPER 85-6013 AIAA PAPER 85-6063 AIAA PAPER 86-6013 AIAA PAPER 86-0645 AIAA PAPER 86-0645 AIAA PAPER 86-0645 AIAA PAPER 86-0645 AIAA PAPER 86-0656 AIAA PAPER 86-06656 AIAA PAPER 86-0705 AIAA PAPER 86-0705 AIAA PAPER 86-1134 AIAA PAPER 86-1145 AIAA PAPER 86-1145 AIAA PAPER 86-1145 AIAA PAPER 86-1278 AIAA PAPER 86-1237 AIAA PAPER 86-22789 <td></td> <td>p 45 p 933 p p1572 p p1572 p p1572 p p23667 p p33234 p p1515168 p p2366772 p p181139 p p1210 p p203234 p p2044 p p203234 p p203234</td> <td>N86-28793 N86-29220 N86-18736 N86-29120 A86-10926 A86-10926 A86-10926 A86-10932 A86-10932 A86-10932 A86-10932 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10961 A86-29667 A86-29658 A86-29674 A86-29674 A86-29674 A86-29674 A86-29674 A86-29674 A86-29674 A86-29674 A86-29674 A86-29674 A86-29674 A86-43333 A86-40602 A86-4760</td> <td>* *** *********</td>		p 45 p 933 p p1572 p p1572 p p1572 p p23667 p p33234 p p1515168 p p2366772 p p181139 p p1210 p p203234 p p2044 p p203234	N86-28793 N86-29220 N86-18736 N86-29120 A86-10926 A86-10926 A86-10926 A86-10932 A86-10932 A86-10932 A86-10932 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10961 A86-29667 A86-29658 A86-29674 A86-29674 A86-29674 A86-29674 A86-29674 A86-29674 A86-29674 A86-29674 A86-29674 A86-29674 A86-29674 A86-43333 A86-40602 A86-4760	* *** *********
AGARD-CP-385 AI-M-855 AI-M-855 AI-M-864 AI-M-867 AIAA PAPER 85-3002 AIAA PAPER 85-3043 AIAA PAPER 85-3052 AIAA PAPER 85-3066 AIAA PAPER 85-3076 AIAA PAPER 85-5045 AIAA PAPER 85-5045 AIAA PAPER 85-5045 AIAA PAPER 85-5046 AIAA PAPER 85-5045 AIAA PAPER 85-6067 AIAA PAPER 86-6063 AIAA PAPER 86-606412 AIAA PAPER 86-60705 AIAA PAPER 86-60705 AIAA PAPER 86-61010 AIAA PAPER 86-61101 AIAA PAPER 86-1101 AIAA PAPER 86-1101 AIAA PAPER 86-1145 AIAA PAPER 86-1145 AIAA PAPER 86-12178		P 45 P 33 P 33 P 5 P 5 P 5 P 5 P 5 P 5 P 5 P 5 P 5 P 5	N86-28793 N86-29220 N86-18736 N86-29120 A86-10926 A86-10926 A86-10926 A86-10927 A86-10932 A86-10932 A86-10932 A86-10932 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-2054 A86-2054 A86-20554 A86-20552 A86-38807 A86-40552 A86-4764 A86-4764 A86-4764 A86-4764 A86-4764 A86-4764 A86-4764	# ### #################################
AGARD-CP-385 AI-M-855 AI-M-854 AI-M-864 AI-M-867 AIAA PAPER 85-3000 AIAA PAPER 85-3002 AIAA PAPER 85-3052 AIAA PAPER 85-3066 AIAA PAPER 85-3078 AIAA PAPER 85-4001 AIAA PAPER 85-4001 AIAA PAPER 85-5045 AIAA PAPER 85-5045 AIAA PAPER 85-6067 AIAA PAPER 86-0605 AIAA PAPER 86-0605 AIAA PAPER 86-0605 AIAA PAPER 86-0607 AIAA PAPER 86-0616 AIAA PAPER 86-0616 AIAA PAPER 86-0617 AIAA PAPER 86-0616 AIAA PAPER 86-0616 AIAA PAPER 86-0100 AIAA PAPER 86-0101 AIAA PAPER 86-1145 AIAA PAPER 86-1145 AIAA PAPER 86-1211 AIAA PAPER 86-1215 AIAA PAPER 86-2209 AIAA PAPER 86-2200 AIAA PAPER 86-2200 AIAA PAPER 86-22000		P 45 P 33 P 33 P 33 P 55 P 55 P 56 P 56 P 56 P 56 P 56 P 56	N86-28793 N86-29220 N86-18736 N86-29120 A86-10926 A86-10928 A86-10928 A86-10928 A86-10928 A86-10928 A86-10928 A86-10928 A86-10928 A86-10928 A86-10980 A86-10980 A86-11412 A86-11412 A86-11412 A86-11412 A86-11412 A86-19861 A86-29581 A86-29582 A86-29652 A86-38807 A86-29652 A86-43333 A86-40521 A86-4764 A86-4764 A86-47602 A86-4762 A86-4762 A86-4762 A86-4762 A86-4762	# ### #################################
AGARD-CP-385 AI-M-855 AI-M-855 AI-M-864 AI-M-867 AIAA PAPER 85-3002 AIAA PAPER 85-3052 AIAA PAPER 85-3062 AIAA PAPER 85-3062 AIAA PAPER 85-3078 AIAA PAPER 85-4031 AIAA PAPER 85-6013 AIAA PAPER 85-6013 AIAA PAPER 85-6013 AIAA PAPER 86-6013 AIAA PAPER 86-0412 AIAA PAPER 86-0645 AIAA PAPER 86-0656 AIAA PAPER 86-0645 AIAA PAPER 86-0705 AIAA PAPER 86-0705 AIAA PAPER 86-0705 AIAA PAPER 86-0705 AIAA PAPER 86-1134 AIAA PAPER 86-1145 AIAA PAPER 86-1145 AIAA PAPER 86-1278 AIAA PAPER 86-2300 AIAA PAPER 86-2300 AIAA PAPER 86-2300		45 943 9734 9572 97515 1568 9797	N86-28793 N86-29220 N86-18736 N86-29120 A86-10926 A86-10926 A86-10926 A86-10932 A86-10932 A86-10932 A86-10932 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-29667 A86-29668 A86-29674 A86-29658 A86-29674 A86-42764 A86-42764 A86-42764 A86-42764 A86-42764 A86-42764 A86-42764 A86-49558	# ### #################################
AGARD-CP-385 AI-M-855 AI-M-854 AI-M-864 AI-M-867 AIAA PAPER 85-3000 AIAA PAPER 85-3002 AIAA PAPER 85-3052 AIAA PAPER 85-3066 AIAA PAPER 85-3078 AIAA PAPER 85-4001 AIAA PAPER 85-4001 AIAA PAPER 85-5045 AIAA PAPER 85-5045 AIAA PAPER 85-6067 AIAA PAPER 86-0605 AIAA PAPER 86-0605 AIAA PAPER 86-0605 AIAA PAPER 86-0607 AIAA PAPER 86-0616 AIAA PAPER 86-0616 AIAA PAPER 86-0617 AIAA PAPER 86-0616 AIAA PAPER 86-0616 AIAA PAPER 86-0100 AIAA PAPER 86-0101 AIAA PAPER 86-1145 AIAA PAPER 86-1145 AIAA PAPER 86-1211 AIAA PAPER 86-1215 AIAA PAPER 86-2209 AIAA PAPER 86-2200 AIAA PAPER 86-2200 AIAA PAPER 86-22000		p 45 p 33 p 933 p 915 p p p p <td>N86-28793 N86-29220 N86-18736 N86-29120 A86-10926 A86-10928 A86-10928 A86-10928 A86-10928 A86-10928 A86-10928 A86-10928 A86-10928 A86-10928 A86-10980 A86-10980 A86-11412 A86-11412 A86-11412 A86-11412 A86-11412 A86-19861 A86-29581 A86-29582 A86-29652 A86-38807 A86-29652 A86-43333 A86-40521 A86-4764 A86-4764 A86-47602 A86-4762 A86-4762 A86-4762 A86-4762 A86-4762</td> <td># ### #################################</td>	N86-28793 N86-29220 N86-18736 N86-29120 A86-10926 A86-10928 A86-10928 A86-10928 A86-10928 A86-10928 A86-10928 A86-10928 A86-10928 A86-10928 A86-10980 A86-10980 A86-11412 A86-11412 A86-11412 A86-11412 A86-11412 A86-19861 A86-29581 A86-29582 A86-29652 A86-38807 A86-29652 A86-43333 A86-40521 A86-4764 A86-4764 A86-47602 A86-4762 A86-4762 A86-4762 A86-4762 A86-4762	# ### #################################
AGARD-CP-385 AI-M-855 AI-M-855 AI-M-864 AI-M-867 AIAA PAPER 85-3002 AIAA PAPER 85-3052 AIAA PAPER 85-3062 AIAA PAPER 85-3062 AIAA PAPER 85-3078 AIAA PAPER 85-4031 AIAA PAPER 85-6013 AIAA PAPER 85-6013 AIAA PAPER 85-6013 AIAA PAPER 86-6013 AIAA PAPER 86-0412 AIAA PAPER 86-0645 AIAA PAPER 86-0656 AIAA PAPER 86-0645 AIAA PAPER 86-0705 AIAA PAPER 86-0705 AIAA PAPER 86-0705 AIAA PAPER 86-0705 AIAA PAPER 86-1134 AIAA PAPER 86-1145 AIAA PAPER 86-1145 AIAA PAPER 86-1278 AIAA PAPER 86-2300 AIAA PAPER 86-2300 AIAA PAPER 86-2300		p 45 p 33 p 933 p 915 p p p p <td>N86-28793 N86-29220 N86-18736 N86-29120 A86-10926 A86-10926 A86-10926 A86-10932 A86-10932 A86-10932 A86-10932 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-29667 A86-29668 A86-29674 A86-29658 A86-29674 A86-42764 A86-42764 A86-42764 A86-42764 A86-42764 A86-42764 A86-42764 A86-49558</td> <td># ### #################################</td>	N86-28793 N86-29220 N86-18736 N86-29120 A86-10926 A86-10926 A86-10926 A86-10932 A86-10932 A86-10932 A86-10932 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-10948 A86-29667 A86-29668 A86-29674 A86-29658 A86-29674 A86-42764 A86-42764 A86-42764 A86-42764 A86-42764 A86-42764 A86-42764 A86-49558	# ### #################################

AIAA PAPER 86-2331	р 74	A86-46954 #
AIAA PAPER 86-2346		A86-46960 #
AIAA PAPER 86-2348		A86-46961 #
AIAA PAPER 86-2349		A86-50265 * #
AIAA PAPER 86-2356		A86-46963 # A86-46964 * #
AIAA PAPER 86-9754	·	A86-32095 * #
AIAA-85-6042-CP	- 22	N86-11195 * #
AIAA-86-9761		N86-11195 * # N86-26277 * #
	- 00	NOC 04070 #
ANL/MCS-TM-67	p 36	N86-31270 #
ANL/TM-436	p 48	N86-32340 #
AR-4	p 13	N86-25299 #
ARI-RN-85-95	p 12	N86-19249 #
ARI-RN-85-96	p 13	N86-22437 #
ARI-RN-86-41	p 9	N86-32969 #
ARW-03-THE-BDK/ORS/83-06	p 12	N86-11076 #
B-207939	p 91	N86-20175 #
B-216946	p 94	N86-25288 #
B-222851	p 82	N86-32418 #
BBN-5681	p 7	N86-24257 #
BDK/KBS/84-04	p 26	N86-32330 #
BDX-613-3185	p 32	N86-13027 #
BDX-613-3398	·	N86-30387 #
BDX-613-3410	p 35	N86-30390 #
BPA-CP-695	p 90	N86-12163 #
CMU-CS-85-115	p 12	N86-10899 #
CMU-RI-TR-86-6	p 14	N86-32750 #
CONF-8408177	p 63	N86-27109 #
CONF-850425-5		N86-29513 * #
CONF-8506148-3		N86-12976 #
CONF-8506175-1	·	N86-17230 # N86-12390 #
CONF-850862-1	p 32	N86-13027 #
CONF-850885-2	p 41	N86-10841 #
CONF-8509149-1		N86-18053 #
CONF-8510154-2		N86-19251 # N86-22955 #
CONF-8510211-1		N86-30387 #
CONF-8511155-1		N86-29874 #
CONF-851264-4	p 48	N86-31248 #
CONF-860366-1		N86-30412 # N86-31251 #
	p 35	N86-29234 #
CONF-860472-1	·	N86-29557 #
CONF-860487-3		N86-29229 #
CONF-860593-1	p 48	N86-32338 #
CONF-8606122-1	р49 р36	N86-33207 # N86-31271 #
CRJP-260		N86-27113 #
CRS-TK-7885-F		N86-27130 #
CS-TR-1519		N86-19022 * #
DE85-010601		N86-13027 #
DE85-014134		N86-10841 #
DE85-014308		N86-12976 #
DE85-014904 DE85-016622		N86-12390 #
DE85-010622		N86-17230 # N86-18053 #
DE85-018161		N86-18246 #
DE85-018543	p 42	N86-19251 #
DE85-902186		N86-29513 * #
DE86-000203		N86-27950 #
	р 33 р 35	NB6-22955 # N86-30387 #
DE86-003192	р 35 р 43	N86-24285 #
DE86-003289	· .	N86-27109 #

DE86-003659

REPORT NUMBER INDEX

DE86-003659	p 35	N86-29229 #
DE86-003679		N86-29557 #
DE86-004225	p 33	N86-23954 #
DE86-004674	p 25	N86-26262 #
DE86-005396	p 76	N86-28012 #
DE86-005404	p 47	N86-29591 #
DE86-005892		N86-30412 # N86-31248 #
DE86-006024 DE86-006517	p 46	N86-30390 #
DE86-006709	p 14	N86-29874 #
DE86-008136		N86-29234 #
DE86-008181		N86-31223 #
DE86-008184		N86-31226 #
DE86-008501 DE86-008580		N86-31271 # N86-30583 #
DE86-008926		N86-31251 #
DE86-009076		N86-32338 #
DE86-009214		N86-31270 #
DE86-009491		N86-32340 #
DE86-010457 DE86-010490	p 48	N86-33206 # N86-33048 #
DE86-010490 DE86-010561	p 40	N86-33023 #
DE86-010796	p 15	N86-33198 #
DE86-011188	p 49	N86-33207 #
DE86-011504	p 48	N86-31777 #
DOE/ER-03077/270	n 47	N86-29591 #
DOE/ER-03077/270	p 47	1000-29591 #
DOE/MA-0048-4	p 48	N86-33206 #
DOE/MA-0221	p 15	N86-33198 #
DOE/OR-21400/T265	p 48	N86-31777 #
DOE/RA-50658/T1	n 13	N86-27950 #
	619	1100-21330 #
DOE/RW-0043	p 76	N86-28012 #
DOT/FAA/PM-86/21	p 44	N86-28067 #
DOT/OST/P34-85/021	n 4	N86-13906 #
D01/001/104-03/021	ΡŦ	1000-10000 #
E-2856	p 62	N86-17595 * #
E-2858	p 80	N86-19636 * #
E-3044		N86-25321 * #
E-3121		N86-31548 * # N86-31585 * #
E-3177 E-3244		N86-31585 * # N86-32703 * #
		100-02/00 #
ECON-80-111	p 61	N86-13221 * #
ECON-81-110	p 70	N86-13221 * # N86-12243 * #
ECON-81-110 ECON-82-175	р 70 р 24	N86-13221 * # N86-12243 * # N86-14710 * #
ECON-81-110	р 70 р 24	N86-13221 * # N86-12243 * #
ECON-81-110 ECON-82-175	р70 р24 р90	N86-13221 * # N86-12243 * # N86-14710 * #
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286	р70 р24 р90 р48	N86-13221 * # N86-12243 * # N86-14710 * # N86-13230 * # N86-32338 #
ECON-81-110	р 70 р 24 р 90 р 48 р 77	N86-13221 * # N86-12243 * # N86-14710 * # N86-13230 * # N86-32338 # N86-32584 #
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286	р 70 р 24 р 90 р 48 р 77	N86-13221 * # N86-12243 * # N86-14710 * # N86-13230 * # N86-32338 #
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1	p 70 p 24 p 90 p 48 p 77 p 82	N86-13221 * # N86-12243 * # N86-14710 * # N86-32338 # N86-32584 # N86-32660 #
ECON-81-110	p 70 p 24 p 90 p 48 p 77 p 82	N86-13221 * # N86-12243 * # N86-14710 * # N86-13230 * # N86-32338 # N86-32584 #
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-97076	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64	N86-13221 * # N86-12243 * # N86-14710 * # N86-32338 # N86-32584 # N86-32660 # N86-31461 # N86-29477
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-96-97076 ETN-96-97076 ETN-86-97190	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 64	N86-13221 * # N86-12243 * # N86-12330 * # N86-32338 # N86-32388 # N86-32660 # N86-31461 # N86-29477 N86-28907 #
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-97076 ETN-86-97190 ETN-86-97190	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 64 p 35	N86-13221 * # N86-12243 * # N86-14710 * # N86-32338 # N86-32584 # N86-32660 # N86-31461 # N86-29477 N86-29077 # N86-30397 #
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-97076 ETN-86-97190 ETN-86-97190 ETN-86-97322	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 64 p 35 p 47	N86-13221 * # N86-12243 * # N86-1270 * # N86-13230 * # N86-32584 # N86-32660 # N86-31461 # N86-29477 N86-29477 N86-299477 # N86-30398 #
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-97076 ETN-86-97120 ETN-86-97322 ETN-86-97322 ETN-86-97322 ETN-86-97601	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 64 p 35 p 47 p 96	N86-13221 * # N86-12243 * # N86-14710 * # N86-32338 # N86-32584 # N86-32660 # N86-31461 # N86-29477 N86-29077 # N86-30397 #
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-97076 ETN-86-97120 ETN-86-97322 ETN-86-97322 ETN-86-97322 ETN-86-97601	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 64 p 35 p 47 p 96 p 77	N86-13221 * # N86-12243 * # N86-1270 * # N86-32338 # N86-32584 # N86-32660 # N86-31461 # N86-29477 N86-28907 # N86-30397 # N86-30398 #
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-97076 ETN-86-97120 ETN-86-97222 ETN-86-97687 ETN-86-97687 ETN-86-97688	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 64 p 35 p 47 p 977 p 971 p 77	N86-13221 * # N86-12243 * # N86-12233 * # N86-32338 # # N86-32584 # # N86-32660 # # N86-32807 # # N86-30397 # # N86-32328 # # N86-32328 # # N86-32329 # #
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-97076 ETN-86-97190 ETN-86-97122 ETN-86-9722 ETN-86-97601 ETN-86-97686 ETN-86-97688 ETN-86-97689 ETN-86-97689	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 64 p 35 p 47 p 96 p 77 p 71 p 77 p 77 p 77	N86-13221 * N86-12243 * N86-1223 * N86-1223 * N86-32338 * N86-32338 * N86-32584 * N86-32660 * N86-31461 * N86-30397 * N86-30397 * N86-32343 * N86-32328 * N86-32330 *
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-97076 ETN-86-97190 ETN-86-97322 ETN-86-97680 ETN-86-97686 ETN-86-97688 ETN-86-97688 ETN-86-97688 ETN-86-97689 ETN-86-97689	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 64 p 35 p 47 p 96 p 77 p 71 p 77 p 26 p 26	N86-13221 * N86-12243 * N86-12243 * N86-12230 * N86-32338 # N86-32338 # N86-32680 # N86-31461 # N86-30397 # N86-30398 # N86-32328 # N86-32329 # N86-32322 # N86-32322 #
ECON-81-110 ECON-82-175 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-86-96709 ETN-86-97076 ETN-86-97076 ETN-86-97120 ETN-86-97320 ETN-86-97601 ETN-86-97686 ETN-86-97688 ETN-86-97689 ETN-86-97689 ETN-86-97691 ETN-86-97691 ETN-86-97691 ETN-86-97691 ETN-86-97691	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 36 p 96 p 47 p 96 p 77 p 71 p 97 p 26 p 27	N86-13221 * N86-12243 * N86-1223 * N86-1223 * N86-32338 * N86-32338 * N86-32584 * N86-32660 * N86-31461 * N86-30397 * N86-30397 * N86-32343 * N86-32328 * N86-32330 *
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-955-01-710-ISSUE-1 ESA-86-96709 ETN-86-97076 ETN-86-97320 ETN-86-97320 ETN-86-97320 ETN-86-97681 ETN-86-97688 ETN-86-97688 ETN-86-97688 ETN-86-97689 ETN-86-97689 ETN-86-97693 ETN-86-97693 ETN-86-97693 ETN-86-97693 ETN-86-97693 ETN-86-97693 ETN-86-97693 ETN-86-97693	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 35 p 47 p 977 p 77 p 77 p 26 p 27 p 27	N86-13221 * # N86-12243 * # N86-12230 * # N86-3238 # N86-3238 # N86-32660 # N86-32640 # N86-32641 # N86-32641 # N86-32641 # N86-32641 # N86-32643 # N86-32643 # N86-3228 # N86-32320 # N86-32332 # N86-32333 #
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-97076 ETN-86-9722 ETN-86-9722 ETN-86-9722 ETN-86-97681 ETN-86-97686 ETN-86-97689 ETN-86-97689 ETN-86-97689 ETN-86-97689 ETN-86-97692 ETN-86-97692 ETN-86-97692 ETN-86-97692	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 37 p 96 p 77 p 71 p 26 p 26 p 27 p 77	N86-13221 * # N86-12243 * # N86-12233 * # N86-32338 # # N86-32338 # # N86-32660 # # N86-31461 # # N86-30397 # * N86-30397 # * N86-32328 # * N86-32330 # * N86-32332 # * N86-32332 # * N86-32333 # * N86-32333 # * N86-32334 # *
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-97190 ETN-86-97190 ETN-86-9722 ETN-86-9722 ETN-86-97686 ETN-86-97686 ETN-86-97688 ETN-86-97689 ETN-86-97689 ETN-86-97689 ETN-86-97692 ETN-86-97692 ETN-86-97692 ETN-86-97692 ETN-86-97796 ETN-86-97796	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 77 p 82 p 65 p 64 p 77 p 96 p 77 p 97 p 77 p 77 p 26 p 77 p 77 p 27 p 27 p 27 p 27 p 27 p 77 p 82	N86-13221 # N86-12243 # N86-12233 # N86-13230 # N86-32338 # N86-32338 # N86-32338 # N86-32338 # N86-3238 # N86-32437 # N86-30397 # N86-32328 # N86-32328 # N86-32328 # N86-32330 # N86-32330 # N86-32332 # N86-32332 # N86-32333 # N86-32334 # N86-32660 #
ECON-81-110 ECON-82-175 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-97076 ETN-86-97190 ETN-86-97320 ETN-86-97320 ETN-86-97686 ETN-86-97686 ETN-86-97686 ETN-86-97689 ETN-86-97689 ETN-86-97689 ETN-86-97693 ETN-86-97693 ETN-86-97796 ETN-86-97797 EUT/BDK/12	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 955 p 47 p 977 p 977 p 771 p 771 p 772 p 777 p 777	N86-13221 * # N86-12243 * # N86-12243 * # N86-12230 * # N86-32338 # # N86-32660 # # N86-32660 # # N86-32461 # # N86-32461 # # N86-32477 N86-28907 # N86-30398 # N86-32328 # N86-3228 # N86-3228 # N86-32320 # N86-32320 # N86-32330 # N86-32333 # N86-32333 # N86-32334 # N86-32564 # N86-32660 # # N86-3288 # #
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-97796 ETN-86-97190 ETN-86-97322 ETN-86-97632 ETN-86-97686 ETN-86-97686 ETN-86-97688 ETN-86-97689 ETN-86-97689 ETN-86-97693 ETN-86-97693 ETN-86-97693 ETN-86-97796 ETN-86-97796 ETN-86-97796 ETN-86-97797 EUT/BDK/12 EUT/BDK/15	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 55 p 64 p 55 p 64 p 56 p 64 p 577 p 777 p 777 p 777 p 777 p 82 p 777 p 777	N86-13221 # N86-12243 # N86-12233 # N86-13230 # N86-32338 # N86-32338 # N86-32338 # N86-32338 # N86-3238 # N86-32437 # N86-30397 # N86-32328 # N86-32328 # N86-32328 # N86-32330 # N86-32330 # N86-32332 # N86-32332 # N86-32333 # N86-32334 # N86-32660 #
ECON-81-110 ECON-82-175 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-97076 ETN-86-97190 ETN-86-97320 ETN-86-97320 ETN-86-97686 ETN-86-97686 ETN-86-97686 ETN-86-97689 ETN-86-97689 ETN-86-97689 ETN-86-97693 ETN-86-97693 ETN-86-97796 ETN-86-97797 EUT/BDK/12	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 55 p 64 p 55 p 64 p 56 p 64 p 577 p 777 p 777 p 777 p 777 p 82 p 777 p 777	N86-13221 * # N86-12243 * # N86-12243 * # N86-12230 * # N86-32338 # # N86-32660 # # N86-32660 # # N86-32461 # # N86-32461 # # N86-32477 N86-28907 # N86-30398 # N86-32328 # N86-3228 # N86-3228 # N86-32320 # N86-32320 # N86-32330 # N86-32333 # N86-32333 # N86-32334 # N86-32564 # N86-32660 # # N86-3288 # #
ECON-81-110 ECON-82-175 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-97202 ETN-86-97220 ETN-86-97222 ETN-86-97687 ETN-86-97686 ETN-86-97687 ETN-86-97689 ETN-86-97689 ETN-86-97689 ETN-86-97693 ETN-86-97693 ETN-86-97796 ETN-86-97796 ETN-86-97797 EUT/BDK/12 EUT/BDK/15 E86-10008	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 55 p 64 p 65 p 64 p 77 p 77 p 77 p 77 p 77 p 77 p 77 p 7	N86-13221 * # N86-12243 * # N86-12243 * # N86-13230 * # N86-32338 # N86-32338 # N86-32660 # N86-32660 # N86-30397 # N86-30397 # N86-32343 # N86-32332 # N86-32332 # N86-32332 # N86-32333 # N86-3234 # N86-3234 # N86-32358 # N86-32758 #
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-97796 ETN-86-97190 ETN-86-97322 ETN-86-97632 ETN-86-97686 ETN-86-97686 ETN-86-97688 ETN-86-97689 ETN-86-97689 ETN-86-97693 ETN-86-97693 ETN-86-97693 ETN-86-97796 ETN-86-97796 ETN-86-97796 ETN-86-97797 EUT/BDK/12 EUT/BDK/15	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 55 p 64 p 65 p 64 p 77 p 77 p 77 p 77 p 77 p 77 p 77 p 7	N86-13221 # N86-12243 # N86-12233 # N86-13230 # N86-32338 # N86-32338 # N86-32338 # N86-32338 # N86-3238 # N86-32460 # N86-32477 N86-30397 N86-30397 # N86-32343 # N86-32328 # N86-32330 # N86-32332 # N86-32334 # N86-32334 # N86-32334 # N86-32328 # N86-32334 # N86-32328 # N86-32334 # N86-32288 # N86-32328 # N86-3234 # N86-32234 # N86-32234 # N86-32238 # N86-32288 # N86-32288 #
ECON-81-110 ECON-82-175 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-9720 ETN-86-97320 ETN-86-97320 ETN-86-97681 ETN-86-97687 ETN-86-97688 ETN-86-97688 ETN-86-97689 ETN-86-97689 ETN-86-97693 ETN-86-97693 ETN-86-97796 ETN-86-97796 ETN-86-97797 EUT/BDK/12 EUT/BDK/15 E86-10008 FOA-C5-85-0003-H2	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 77 p 82 p 65 p 64 p 77 p 96 p 77 p 97 p 77 p 26 p 77 p 27 p 27 p 27 p 27 p 27 p 27 p 27	N86-13221 * # N86-12243 * # N86-12243 * # N86-32338 # N86-32338 # N86-32660 # N86-31461 # N86-29477 N86-29477 N86-29477 N86-30398 # N86-30398 # N86-32328 # N86-32328 # N86-32332 # N86-32332 # N86-32332 # N86-32332 # N86-32332 # N86-32332 # N86-32332 # N86-32328 # N86-32758 # N86-31758 # N86-31758 #
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-9720 ETN-86-9722 ETN-86-9722 ETN-86-9722 ETN-86-97687 ETN-86-97687 ETN-86-97687 ETN-86-97687 ETN-86-97687 ETN-86-97689 ETN-86-97693 ETN-86-97693 ETN-86-97796 ETN-86-9782 ETN-86-97	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 56 p 64 p 56 p 64 p 35 p 64 p 57 p 77 p 77 p 777 p 777 p 777 p 777 p 277 p 777 p 282 p 99 6 9 99 p 48 p 99 p 48 p 90 p 49 p 90 p 90 p 90 p 90 p 90 p 90 p 90 p 9	N86-13221 * # N86-12243 * # N86-12243 * # N86-13230 * # N86-32338 # N86-32338 # N86-32660 # N86-32660 # N86-30397 # N86-30397 # N86-32343 # N86-32332 # N86-32332 # N86-32332 # N86-32333 # N86-3234 # N86-3234 # N86-32358 # N86-32758 #
ECON-81-110 ECON-82-175 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-9720 ETN-86-97320 ETN-86-97320 ETN-86-97681 ETN-86-97687 ETN-86-97688 ETN-86-97688 ETN-86-97689 ETN-86-97689 ETN-86-97693 ETN-86-97693 ETN-86-97796 ETN-86-97796 ETN-86-97797 EUT/BDK/12 EUT/BDK/15 E86-10008 FOA-C5-85-0003-H2	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 56 p 64 p 56 p 64 p 35 p 64 p 57 p 77 p 77 p 777 p 777 p 777 p 777 p 277 p 777 p 282 p 99 6 9 99 p 48 p 99 p 48 p 90 p 49 p 90 p 90 p 90 p 90 p 90 p 90 p 90 p 9	N86-13221 * # N86-12243 * # N86-12243 * # N86-32338 # N86-32338 # N86-32660 # N86-31461 # N86-29477 N86-29477 N86-29477 N86-30398 # N86-30398 # N86-32328 # N86-32328 # N86-32332 # N86-32332 # N86-32332 # N86-32332 # N86-32332 # N86-32332 # N86-32332 # N86-32328 # N86-32758 # N86-31758 # N86-31758 #
ECON-81-110 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-97076 ETN-86-97076 ETN-86-97322 ETN-86-97322 ETN-86-97687 ETN-86-97687 ETN-86-97688 ETN-86-97689 ETN-86-97689 ETN-86-97689 ETN-86-97693 ETN-86-97693 ETN-86-97796 ETN-86-9769 ETN-86-9786 ET	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 35 p 77 p 96 p 96 p 96 p 97 p 97 p 77 p 77 p 77 p 77 p 77 p 77	N86-13221 * # N86-12243 * # N86-12243 * # N86-13230 * # N86-32338 # N86-32584 # N86-32660 # N86-32660 # N86-32343 # N86-32343 # N86-32343 # N86-32343 # N86-32333 # N86-32334 # N86-3234 # N86-3234 # N86-32328 # N86-32328 # N86-31758 # N86-11072 # N86-33204 #
ECON-81-110 ECON-82-175 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-9720 ETN-86-97320 ETN-86-97322 ETN-86-97687 ETN-86-97687 ETN-86-97687 ETN-86-97687 ETN-86-97689 ETN-86-97689 ETN-86-97693 ETN-86-97693 ETN-86-97796 ETN-86-97796 ETN-86-97796 ETN-86-97797 EUT/BDK/12 EUT/BDK/15 E86-10008 FOA-C5-85-0003-H2 GAO/GGD-86-68 GAO/NSIAD-86-3 GAO/RCED-86-105FS	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 65 p 64 p 65 p 64 p 55 p 64 p 56 p 777 p 777 p 777 p 777 p 777 p 777 p 277 p 7771 p 24 p 90 p 49 p 99 p 49 p 99 p 49 p 99 p 49 p 40 p 50 p 40 p 50 p 40 p 50 p 50 p 50 p 50 p 50 p 50 p 50 p 5	N86-13221 # N86-12243 # N86-12233 # N86-32338 # N86-32338 # N86-32338 # N86-32338 # N86-32338 # N86-32364 # N86-32477 N86-30397 N86-30397 # N86-32328 # N86-32328 # N86-32328 # N86-32330 # N86-32232 # N86-322660 # N86-3228 # N86-3228 # N86-3228 # N86-3228 # N86-3228 # N86-31758 # N86-11072 # N86-
ECON-81-110 ECON-82-175 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-9709 ETN-86-97190 ETN-86-9720 ETN-86-9722 ETN-86-97686 ETN-86-97686 ETN-86-97687 ETN-86-97689 ETN-86-97689 ETN-86-97689 ETN-86-97693 ETN-86-97693 ETN-86-97796 ETN-86-97796 ETN-86-97797 EUT/BDK/12 EUT/BDK/15 E86-10008 FOA-C5-85-0003-H2 GAO/RGD-86-68 GAO/NSIAD-86-3 GAO/RCED-86-105FS GAO/RCED-86-105FS GAO/RCED-86-113FS	p 70 p 24 p 90 8 8 p 77 p 82 p 65 p 64 9 77 p 82 p 65 p 64 9 77 p 77 p 82 p 65 p 64 9 77 p 77 p 77 p 77 p 77 p 77 p 77 p 77	N86-13221 # N86-12243 # N86-12233 # N86-32338 # N86-32338 # N86-32338 # N86-32338 # N86-32338 # N86-32437 # N86-32437 # N86-30398 # N86-3228 # N86-32328 # N86-32333 # N86-32333 # N86-32232 # N86-32238 # N86-324175 # N86-1107
ECON-81-110 ECON-82-175 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-9720 ETN-86-97320 ETN-86-97322 ETN-86-97687 ETN-86-97687 ETN-86-97687 ETN-86-97687 ETN-86-97689 ETN-86-97689 ETN-86-97693 ETN-86-97693 ETN-86-97796 ETN-86-97796 ETN-86-97796 ETN-86-97797 EUT/BDK/12 EUT/BDK/15 E86-10008 FOA-C5-85-0003-H2 GAO/GGD-86-68 GAO/NSIAD-86-3 GAO/RCED-86-105FS	p 70 p 24 p 90 p 48 p 77 p 82 p 65 p 64 p 96 p 96 p 96 p 96 p 977 p 977 p 96 p 977 p 977 p 977 p 777 p 7777 p 777 p 777 p 777 p 777	N86-13221 # N86-12243 # N86-12233 # N86-32338 # N86-32338 # N86-32338 # N86-32338 # N86-32338 # N86-32364 # N86-32477 N86-30397 N86-30397 # N86-32328 # N86-32328 # N86-32328 # N86-32330 # N86-32232 # N86-322660 # N86-3228 # N86-3228 # N86-3228 # N86-3228 # N86-3228 # N86-31758 # N86-11072 # N86-
ECON-81-110 ECON-82-175 ECON-82-175 ECON-84-101 EGG-M-03286 ESA-PSS-01-701-ISSUE-1 ESA-PSS-01-710-ISSUE-1 ESA-86-96709 ETN-86-97076 ETN-86-97190 ETN-86-9720 ETN-86-97220 ETN-86-97681 ETN-86-97686 ETN-86-97687 ETN-86-97689 ETN-86-97689 ETN-86-97693 ETN-86-97693 ETN-86-97795 ETN-86-97795 ETN-86-97797 EUT/BDK/12 EUT/BDK/15 E86-10008 FOA-C5-85-0003-H2 GAO/RGD-86-68 GAO/NSIAD-86-3 GAO/RCED-86-105FS GAO/RCED-86-113FS GAO/RCED-86-75	р 70 р 24 р 9 8 8 8 9 9 8 8 9 9 8 8 9 9 8 8 9 9 8 7 7 7 7	N86-13221 # N86-12243 # N86-12243 # N86-12233 # N86-32338 # N86-32338 # N86-32338 # N86-32338 # N86-32338 # N86-32437 M N86-30397 # N86-30397 # N86-30398 # N86-30397 # N86-30398 # N86-30398 # N86-32343 # N86-32330 # N86-32333 # N86-32333 # N86-32333 # N86-32333 # N86-32333 # N86-32334 # N86-32418 # N86-32218 # N86-32218 # N86-32218 # N86-32218 # N86-32218 # N86-32218 # N86-3221
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000 50 400	- 7	NOC 01400 #
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GPO-53-617		N86-21453 #
GPO-55-035		N86-22435 #
GPO-55-239		N86-20436 #
GPO-61-006	p 91	N86-20174 #
U DEDT 00 177	- 01	NOC 00174 #
H-REPT-99-177	p 91	N86-20174 #
11 4070	- 22	N86-23603 * #
H-1272	p 33	
H-1310	p 32	N86-11194 * # N86-11195 * #
H-1317	p 32	
H-1341	p 25	N86-26277 * #
H-1364	p 34	N86-24687 * #
HR-REPT-99-177	- 00	N86-22448 #
HR-REPT-99-177	p 35	1100-22440 #
IAF PAPER ST-85-04	p 50	A86-15949 #
AF FAFER 31-03-04	p 00	A00 10040 #
IAF PAPER 84-96	p 49	A86-12361 #
IAF PAPER 85-18	·	A86-15611 * #
IAF PAPER 85-28	·	A86-15619 #
IAF PAPER 85-32		A86-15623 * #
IAF PAPER 85-330		A86-15833 * #
IAF PAPER 85-338		A86-15839 #
IAF PAPER 85-339		A86-15840 #
IAF PAPER 85-354		A86-15849 #
IAF PAPER 85-364	p 66	A86-15857 #
IAF PAPER 85-420		A86-15893 #
IAF PAPER 85-422		A86-15895 * #
IAF PAPER 85-431	р 50	A86-15902 #
IAF PAPER 85-433	p 82	A86-15903 * #
IAF PAPER 85-435	p 83	A86-15905 #
IAF PAPER 85-454	p 50	A86-15914 * #
IAF PAPER 85-45	p 72	A86-15632 * #
IAF PAPER 85-48	p 10	A86-15635 * #
IAF PAPER 85-497		A86-15941 #
IAF PAPER 85-498	p 83	A86-15942 #
IAF PAPER 85-499	p 83	A86-15943 #
IAF PAPER 85-50	p 50	A86-15636 * #
IAF PAPER 85-87	p 82	A86-15663 #
IR-82		N86-30397 #
IR-86	p 47	N86-30398 #
ISBN-0-8330-0692-4		N86-25687 #
ISBN-90-6757-012-5		N86-32328 #
ISBN-90-6757-015-X	p 71	N86-31758 #
ISBN-92-63-03002-2		N86-23184
ISBN-92-835-0389-9	p 45	N86-28793 #
ISI/RR-85-163	p 47	N86-29721 #
	P -1	1100-23/21 #
ISSN-0347-7665	p 12	N86-11072 #
ISSN-0347-7665 ISSN-0379-4059		N86-11072 # N86-32584 #
ISSN-0347-7665 ISSN-0379-4059 ISSN-0379-4059	p 77	N86-11072 # N86-32584 # N86-32660 #
ISSN-0379-4059	p 77	N86-32584 #
ISSN-0379-4059	p 77 p 82	N86-32584 #
ISSN-0379-4059 ISSN-0379-4059	p 77 p 82	N86-32584 # N86-32660 #
ISSN-0379-4059 ISSN-0379-4059	p 77 p 82 p 12	N86-32584 # N86-32660 #
ISSN-0379-4059 ISSN-0379-4059 IZF-1984-27 JPRS-TTP-86-011	p 77 p 82 p 12 p 95	N86-32584 # N86-32660 # N86-11077 # N86-30064 #
ISSN-0379-4059 ISSN-0379-4059 IZF-1984-27	p 77 p 82 p 12 p 95	N86-32584 # N86-32660 # N86-11077 #
ISSN-0379-4059 ISSN-0379-4059 IZF-1984-27 JPRS-TTP-86-011 JPRS-UCC-86-004	p 77 p 82 p 12 p 95 p 45	N86-32584 # N86-32660 # N86-11077 # N86-30064 # N86-28694 #
ISSN-0379-4059 ISSN-0379-4059 IZF-1984-27 JPRS-TTP-86-011 JPRS-UCC-86-004 JPRS-UMM-85-010	p 77 p 82 p 12 p 95 p 45 p 23	N86-32584 # N86-32660 # N86-11077 # N86-30064 # N86-28694 # N86-11394 #
ISSN-0379-4059 ISSN-0379-4059 IZF-1984-27 JPRS-TTP-86-011 JPRS-UCC-86-004 JPRS-UMM-85-010 JPRS-UMM-85-013	p 77 p 82 p 12 p 95 p 45 p 23 p 24	N86-32584 # N86-32660 # N86-11077 # N86-30064 # N86-28694 # N86-11394 # N86-13745 #
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ISSN-0379-4059 ISSN-0379-4059 IZF-1984-27 JPRS-TTP-86-011 JPRS-UCC-86-004 JPRS-UMM-85-010 JPRS-UMM-85-013 JPRS-UMM-85-014 K/D-5697 L-16084 L-16127 LA-UR-85-1933	p 77 p 82 p 12 p 95 p 45 p 23 p 24 p 24 p 24 p 24 p 24 p 26 p 65 p 41	N86-32584 # N86-32660 # N86-11077 # N86-30064 # N86-30064 # N86-13745 # N86-13745 # N86-13745 # N86-31251 # N86-30470 * N86-30470 #
ISSN-0379-4059 ISSN-0379-4059 IZF-1984-27 JPRS-TTP-86-011 JPRS-UCC-86-004 JPRS-UMM-85-010 JPRS-UMM-85-013 JPRS-UMM-85-014 K/D-5697 L-16084 L-16127 LA-UR-85-1933 LA-UR-85-2838	p 77 p 82 p 12 p 95 p 45 p 23 p 24 p 24 p 8 p 26 p 65 p 41 p 32	N86-32584 # N86-32660 # N86-11077 # N86-30064 # N86-30064 # N86-30064 # N86-304 # N86-13745 # N86-31251 # N86-30470 # N86-30470 # N86-18053 #
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NAS 1.15:83105 NAS 1.15:85919 NAS 1.15:86520	p 77	NOC 00474 # #	
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NAS 1.15:86791		N86-11195 * #	
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NAS 1.15:87560		N86-21420 * #	
NAS 1.15:87612		N86-11540 * #	
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NAS 1.15:88587		N86-19966 * #	
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NAS 1.15:89399		N86-29888 * #	
NAS 1.15:89402		N86-29535 * #	
NAS 1.21:485		N86-30720 * #	
NAS 1.21:7038(08)		N86-26243 * #	
NAS 1.21:7039(28)SECT-2		N86-22444 * #	
NAS 1.21:7039(29)-SECT-1	p 94	N86-28788 * #	
NAS 1.21:7039(29)-SECT-2	p 94	N86-28789 * #	
NAS 1.21:7053(SUPP-1)		N86-29720 * #	
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NAS 1.26:174979		N86-16452 * #	
NAS 1.26:176283		N86-11657 * #	
NAS 1.26:176307		N86-12158 * #	
NAS 1.26:176322	p 23	N86-13235 * #	
NAS 1.26:176333		N86-13221 * #	
NAS 1.26:176334	p 70	N86-12243 * #	
NAS 1.26:176337		N86-14710 * #	
NAS 1.26:176346	р 90	N86-13230 * #	
NAS 1.26:176366		N86-21419 * #	
NAS 1.26:176479		N86-17227 * #	
NAS 1 26-176522		N86-19022 * #	
NAS 1.26:176522			
NAS 1.26:176754	p 63	N86-24712 * #	
NAS 1.26:176754 NAS 1.26:176881	р 63 р 96	N86-30744 * #	
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NAS 1.26:176754 NAS 1.26:1760861 NAS 1.26:178048 NAS 1.26:179661 NAS 1.26:179716 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NAS 1.71:IAFS-26009-1SB NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-LAR-13403-1 NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB	p 63 p 96 p 33 p 14 p 9 p 4 p 93 p 92 p 94 p 93 p 92 p 92 p 92 p 93	N66-30744 * # N86-30744 * # N86-31210 * # N86-33210 * # N86-3212 * # N86-22114 * # N86-22513 * # N86-22673 * # N86-22114 * # N86-22114 * #	
NAS 1.26:176754	p 63 p 96 p 33 p 14 p 9 p 4 p 93 p 92 p 92 p 94 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 92	N66-30744 * # N86-30744 * # N86-32110 * # N86-33210 * # N86-32110 * # N86-24673 * # N86-22114 * # N86-22114 * # N86-22114 * # N86-22114 * # N86-22114 * #	
NAS 1.26:176754 NAS 1.26:176861 NAS 1.26:178048 NAS 1.26:178048 NAS 1.26:179761 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NAS 1.71:MFS-26009-1SB NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB	p 63 p 96 p 33 p 14 p 9 p 4 p 93 p 92 p 94 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 92 p 92 p 93 p 92	N66-30744 * # N86-30744 * # N86-32110 * # N86-33210 * # N86-12212 * N86-22114 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-16451 * # N86-16452 * #	
NAS 1.26:176754 NAS 1.26:176881 NAS 1.26:178048 NAS 1.26:1790661 NAS 1.26:179716 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-LAR-13403-1 NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CR-174978 NASA-CR-174978 NASA-CR-176283 NASA-CR-176283 NASA-CR-176207	p 63 p 96 p 33 p 14 p 9 p 4 p 93 p 92 p 94 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 50 p 96 p 96 p 96 p 96 p 96 p 96 p 96 p 96	N66-30744 * # N86-30744 * # N86-32120 * # N86-32111 * # N86-3211 * # N86-227513 * # N86-22673 * # N86-24673 * # N86-24673 * # N86-24729 * # N86-16451 * # N86-16452 * # N86-1657 * #	
NAS 1.26:176754 NAS 1.26:176881 NAS 1.26:178048 NAS 1.26:1790661 NAS 1.26:179716 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-LAR-13403-1 NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CR-174978 NASA-CR-174978 NASA-CR-176283 NASA-CR-176283 NASA-CR-176207	p 63 p 96 p 33 p 14 p 9 p 4 p 93 p 92 p 94 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 50 p 96 p 96 p 96 p 96 p 96 p 96 p 96 p 96	N66-30744 * # N86-30744 * # N86-32110 * # N86-32110 * # N86-22114 * # N86-22513 * # N86-22513 * # N86-22513 * # N86-22114 * # N86-22114 * # N86-22114 * # N86-24729 * # N86-16452 * #	
NAS 1.26:176754 NAS 1.26:176881 NAS 1.26:178048 NAS 1.26:1790661 NAS 1.26:179716 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-LAR-13403-1 NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CR-174978 NASA-CR-174978 NASA-CR-176283 NASA-CR-176283 NASA-CR-176207	p 63 p 96 p 33 p 14 p 9 p 4 p 93 p 92 p 94 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 50 p 96 p 96 p 96 p 96 p 96 p 96 p 96 p 96	N66-30744 * # N86-30744 * # N86-32110 * # N86-33210 * # N86-12212 * N86-22114 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-16451 * # N86-16451 * # N86-16452 * # N86-112158 * # N86-1235 * #	
NAS 1.26:176754 NAS 1.26:176881 NAS 1.26:178048 NAS 1.26:1790661 NAS 1.26:179716 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-LAR-13403-1 NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CR-174978 NASA-CR-174978 NASA-CR-176283 NASA-CR-176283 NASA-CR-176207	p 63 p 96 p 33 p 14 p 9 p 4 p 93 p 92 p 94 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 50 p 96 p 96 p 96 p 96 p 96 p 96 p 96 p 96	N66-30744 * # N86-30744 * # N86-32120 * # N86-32111 * # N86-3211 * # N86-24673 * # N86-22513 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-16451 * # N86-16452 * # N86-16452 * # N86-12158 * # N86-13221 * #	
NAS 1.26:176754 NAS 1.26:176881 NAS 1.26:178048 NAS 1.26:179661 NAS 1.26:179716 NAS 1.26:3944 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-LAR-13403-1 NASA-CASE-MSC-200676-1 NASA-CR-174978 NASA-CR-17633 NASA-CR-176333 NASA-CR-176334	p 63 p 96 p 93 p 14 p 9 p 4 p 93 p 92 p 94 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 70 p 93 p 70 p 93 p 70 p 93 p 97 p 97 p 97 p 97 p 97 p 97 p 97 p 97	N66-30744 * # N86-30744 * # N86-32110 * # N86-32110 * # N86-22114 * # N86-22513 * # N86-22513 * # N86-24673 * # N86-24673 * # N86-24729 * # N86-16452 * # N86-16452 * # N86-1258 * # N86-13221 * #	
NAS 1.26:176754 NAS 1.26:178048 NAS 1.26:178048 NAS 1.26:179661 NAS 1.26:179716 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NAS 1.71:MFS-26009-1SB NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CR-174978 NASA-CR-174978 NASA-CR-176283 NASA-CR-176333 NASA-CR-176334 NASA-CR-176337 NASA-CR-176337	p 63 p 963 p 93 p 14 p 9 p 4 p 99 p 9 p 9 p 99 p 99 p 99 p	N66-30744 * # N86-30744 * # N86-32110 * # N86-33210 * # N86-12212 * N86-227513 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24729 * # N86-16451 * # N86-16452 * # N86-16452 * # N86-112158 * # N86-13221 * # N86-13221 * # N86-13221 * #	
NAS 1.26:176754 NAS 1.26:178048 NAS 1.26:178048 NAS 1.26:178048 NAS 1.26:17976 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NAS 1.71:MFS-26009-1SB NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CR-174978 NASA-CR-176283 NASA-CR-176307 NASA-CR-176333 NASA-CR-176334 NASA-CR-176334 NASA-CR-176334 NASA-CR-176346	p 63 p 963 p 93 p 14 p 9 p 4 p 99 p 9 p 9 p 99 p 99 p 99 p	N66-30744 * # N86-30744 * # N86-32110 * # N86-32110 * # N86-12212 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-16452 * # N86-16452 * # N86-12158 * # N86-12158 * # N86-1223 * # N86-1223 * #	
NAS 1.26:176754 NAS 1.26:176881 NAS 1.26:179681 NAS 1.26:179661 NAS 1.26:179716 NAS 1.26:179716 NAS 1.26:3944 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-LAR-13403-1 NASA-CASE-MSC-20676-1 NASA-CASE-MSC-20676-1 NASA-CR-174978 NASA-CR-176283 NASA-CR-176283 NASA-CR-176337 NASA-CR-176337 NASA-CR-176346 NASA-CR-176346	p 63 p 963 p 93 p 914 p 9 p 4 p 99 p 99 p 99 p 992 p 993 p 92 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 92 p 94 p 97 p 97 p 99 p 99 p 992 p 97 p 992 p 97 p 992 p 993 p 974 p 974 p 975 p	N66-30744 * # N86-30744 * # N86-32110 * # N86-32111 * # N86-32111 * # N86-22673 * # N86-22513 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24729 * # N86-16452 * # N86-16452 * # N86-16452 * # N86-12258 * # N86-13225 * # N86-13223 * # N86-13230 * # N86-13243 * #	
NAS 1.26:176754 NAS 1.26:178048 NAS 1.26:178048 NAS 1.26:178048 NAS 1.26:178048 NAS 1.26:179661 NAS 1.26:3944 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CR-174978 NASA-CR-176307 NASA-CR-176333 NASA-CR-176334 NASA-CR-176334 NASA-CR-176346 NASA-CR-176366 NASA-CR-17637	p 63 p 96 p 14 p 9 14 p 9 9 14 p 9 9 19 19 19 19 19 19 19 19 19 19 19 19	N66-30744 * # N86-30744 * # N86-32110 * # N86-33210 * # N86-12212 * N86-22114 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24729 * # N86-16451 * # N86-16452 * # N86-13235 * # N86-13235 * # N86-13230 * # N86-13230 * # N86-13237 * #	
NAS 1.26:176754 NAS 1.26:178048 NAS 1.26:178048 NAS 1.26:178048 NAS 1.26:178048 NAS 1.26:179661 NAS 1.26:3944 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CR-174978 NASA-CR-176307 NASA-CR-176333 NASA-CR-176334 NASA-CR-176334 NASA-CR-176346 NASA-CR-176366 NASA-CR-17637	p 63 p 96 p 14 p 9 14 p 9 9 14 p 9 9 19 19 19 19 19 19 19 19 19 19 19 19	N66-30744 * # N86-30744 * # N86-32120 * # N86-32111 * # N86-3211 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-16452 * # N86-16452 * # N86-16452 * # N86-12158 * # N86-12158 * # N86-1223 * # N86	
NAS 1.26:176754 NAS 1.26:176881 NAS 1.26:179661 NAS 1.26:179661 NAS 1.26:179716 NAS 1.26:3944 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-LAR-13403-1 NASA-CASE-MSC-200676-1 NASA-CR-174978 NASA-CR-176283 NASA-CR-176337 NASA-CR-176336 NASA-CR-176337 NASA-CR-176366 NASA-CR-176376 NASA-CR-176522	p 63 p 96 p 93 p 14 p 9 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 92 p 94 p 92 p 94 p 92 p 94 p 95 p 95 p 92 p 94 p 95 p 95 p 95 p 95 p 95 p 95 p 95 p 95	N66-30744 * # N86-30744 * # N86-30210 * # N86-32110 * # N86-32111 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24729 * # N86-16452 * # N86-16452 * # N86-16452 * # N86-12158 * # N86-1221 * # N86-1223 * # N86-1227 * # N86-17227 * # N86-19022 * #	
NAS 1.26:176754 NAS 1.26:178048 NAS 1.26:178048 NAS 1.26:179661 NAS 1.26:179716 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NASA-CASE-KSC-11285-1 NASA-CASE-KSC-11285-1 NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CR-17637 NASA-CR-17637 NASA-CR-176333 NASA-CR-176334 NASA-CR-176334 NASA-CR-176346 NASA-CR-176346 NASA-CR-176366 NASA-CR-176366 NASA-CR-176362 NASA-CR-176522 NASA-CR-176522 NASA-CR-176522 NASA-CR-176546	p 63 p 96 p 93 p 14 p 9 p 94 p 93 p 92 p 93 p 93 p 93 p 93 p 93 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 92 p 94 p 93 p 92 p 94 p 95 p 94 p 95 p 94 p 95 p 94 p 95 p 94 p 95 p 95 p 95 p 95 p 95 p 95 p 95 p 95	N66-30744 * # N86-30744 * # N86-30210 * # N86-33210 * # N86-12212 * N86-12212 * N86-22513 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24729 * # N86-16451 * # N86-16452 * N86-13235 * N86-13235 * N86-13230 * N86-13230 * N86-13230 * N86-13230 * N86-13230 * N86-13230 * N86-13230 * N86-13230 * N86-13230 * N86-13227 * N86-13227 * N86-13022 * N86-13022 * N86-13022 * N86-30744 *	
NAS 1.26:176754 NAS 1.26:178048 NAS 1.26:178048 NAS 1.26:178048 NAS 1.26:17976 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CR-174978 NASA-CR-176283 NASA-CR-176307 NASA-CR-176333 NASA-CR-176334 NASA-CR-176346 NASA-CR-176346 NASA-CR-176366 NASA-CR-176522 NASA-CR-17654 NASA-CR-17654 NASA-CR-176881	p 63 p 96 p 93 p 91 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 92 p 93 p 97 0 p 93 p 97 0 p 93 p 97 0 p 93 p 97 0 p 93 p 92 p 93 p 94 p 95 p 95 p 95 p 95 p 95 p 95 p 95 p 95	N66-30744 * # N86-30744 * # N86-32110 * N86-32110 * N86-32110 * N86-12212 * N86-24673 * N86-22114 * N86-24673 * N86-24673 * N86-24673 * N86-24673 * N86-24673 * N86-16452 * N86-16452 * N86-16452 * N86-12158 * N86-12158 * N86-12221 * N86-1223 * N86-1223 * N86-1223 * N86-1222 *	
NAS 1.26:176754 NAS 1.26:176881 NAS 1.26:179661 NAS 1.26:179661 NAS 1.26:179716 NAS 1.26:179716 NAS 1.26:179716 NAS 1.26:179716 NAS 1.26:179661 NAS 1.26:179716 NAS 1.26:179716 NAS 1.26:179716 NAS 1.26:179716 NAS 1.26:179716 NAS 1.26:179716 NAS 1.71:LAR-13403-1 NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-LAR-13403-1 NASA-CASE-MSC-206076-1 NASA-CASE-MSC-20676-1 NASA-CR-174978 NASA-CR-176283 NASA-CR-176307 NASA-CR-176330 NASA-CR-176334 NASA-CR-176337 NASA-CR-176336 NASA-CR-176346 NASA-CR-176522 NASA-CR-176652 NASA-CR-176681 NASA-CR-178048 NASA-CR-178061	p 63 p 96 37 p 93 p 93 p 94 p 93 p 99 p 99 p 99 p 99 p 99 p 99 p 99	N66-30744 * # N86-30744 * # N86-32110 * # N86-32111 * # N86-32111 * # N86-2673 * # N86-22114 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24729 * # N86-24729 * # N86-16452 * # N86-16452 * # N86-16452 * # N86-12158 * # N86-1221 * # N86-1221 * # N86-1222 * # N86-1227 * # N86-1227 * # N86-1227 * # N86-1227 * # N86-30744 * # N86-21220 * # N86-2121 * #	
NAS 1.26:176754 NAS 1.26:178048 NAS 1.26:178048 NAS 1.26:178048 NAS 1.26:17976 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CASE-MFS-26009-1SB NASA-CR-174978 NASA-CR-176283 NASA-CR-176307 NASA-CR-176333 NASA-CR-176334 NASA-CR-176346 NASA-CR-176346 NASA-CR-176366 NASA-CR-176522 NASA-CR-17654 NASA-CR-17654 NASA-CR-176881	p 63 p 96 p 93 p 91 p 93 p 92 p 93 p 99 p 93 p 99 p 93 p 99 p 93 p 99 p 93 p 93	N66-30744 * # N86-30744 * # N86-32110 * N86-32110 * N86-32110 * N86-12212 * N86-24673 * N86-22114 * N86-24673 * N86-24673 * N86-24673 * N86-24673 * N86-24673 * N86-16452 * N86-16452 * N86-16452 * N86-12158 * N86-12158 * N86-12221 * N86-1223 * N86-1223 * N86-1223 * N86-1222 *	
NAS 1.26:176754 NAS 1.26:176861 NAS 1.26:179048 NAS 1.26:179661 NAS 1.26:3944 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-MSC-20676-1 NASA-CASE-MSC-20676-1 NASA-CR-174978 NASA-CR-176322 NASA-CR-176333 NASA-CR-176334 NASA-CR-176354 NASA-CR-176522 NASA-CR-17654 NASA-CR-176648 NASA-CR-176661 NASA-CR-178661 NASA-CR-178661	p 63 p 96 p 93 p 93 p 94 p 93 p 92 p 94 p 93 p 94 p 93 p 92 p 94 p 93 p 92 p 94 p 95 p 94 p 95 p 95 p 95 p 95 p 95 p 95 p 95 p 95	N66-30744 * # N86-30744 * # N86-32110 * # N86-32111 * # N86-32111 * # N86-227513 * # N86-22673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-16451 * # N86-16452 * # N86-16452 * # N86-16452 * # N86-16452 * # N86-12218 * # N86-1221 * # N86-1221 * # N86-17227 * # N86-17227 * # N86-17227 * # N86-17227 * # N86-17227 * # N86-30744 * # N86-32111 * # N86-32111 * # N86-32111 * # N86-32111 * # N86-32111 * # N86-32111 * #	
NAS 1.26:176754 NAS 1.26:176881 NAS 1.26:179661 NAS 1.26:179661 NAS 1.26:179716 NAS 1.26:179761 NAS 1.26:179716 NAS 1.26:3944 NAS 1.71:LAR-13403-1 NAS 1.71:LAR-13403-1 NASA-CASE-KSC-11285-1 NASA-CASE-LAR-13403-1 NASA-CASE-MSC-200676-1 NASA-CASE-MSC-200676-1 NASA-CR-174978 NASA-CR-176283 NASA-CR-176307 NASA-CR-176333 NASA-CR-176336 NASA-CR-176337 NASA-CR-176346 NASA-CR-176522 NASA-CR-176526 NASA-CR-176527 NASA-CR-1766521 NASA-CR-1766521 NASA-CR-1766521 NASA-CR-1766521 NASA-CR-1766521 NASA-CR-1766521 NASA-CR-176651 NASA-CR-176641 NASA-CR-176641	p 63 p 96 p 93 p 91 p 93 p 92 p 94 p 94 p 95 p 94 p 95 p 94 p 95 p 94 p 95 p 94 p 95 p 94 p 95 p 95 p 95 p 95 p 95 p 95 p 95 p 95	N66-30744 * # N86-30744 * # N86-32110 * # N86-33210 * # N86-12212 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24673 * # N86-24729 * # N86-16451 * # N86-16451 * # N86-16452 * # N86-12158 * # N86-12158 * # N86-13221 * # N86-13230 * # N86-13230 * # N86-13230 * # N86-13230 * # N86-13230 * # N86-13230 * # N86-13221 * # N86-13220 * # N86-33210 * # N86-33210 * # N86-32111 * #	

F-2

REPORT NUMBER INDEX

NASA-SP-7038(08)	p 94	N86-26243 * #
NASA-SP-7039(28)SECT-2 NASA-SP-7039(29)-SECT-1	р93 р94	N86-22444 * # N86-28788 * #
NASA-SP-7039(29)-SECT-2	p 94	N86-28789 * #
NASA-SP-7053(SUPP-1)	p 47	N86-29720 * #
NASA-TM-58273	р 76	N86-30568 * #
NASA-1M-58273 NASA-TM-83099	p 62	N86-17265 * #
NASA-TM-83105	p 77	N86-32471 * #
NASA-TM-85919	p 33	N86-23603 * #
NASA-TM-86520 NASA-TM-86532	р23 р62	N86-11216 * # N86-17225 * #
NASA-TM-86532 NASA-TM-86548	p 76	N86-28972 * #
NASA-TM-86746	p 32	N86-11194 * #
NASA-TM-86791	p 32	N86-11195 * # N86-26277 * #
NASA-TM-86811 NASA-TM-87201	р 25 р 62	N86-26277 * # N86-17595 * #
NASA-TM-87203	p 80	N86-19636 * #
NASA-TM-87313	p 76	N86-25321 * #
NASA-TM-87499	р61 р41	N86-13343 * # N86-13224 * #
NASA-TM-87514 NASA-TM-87520	p 61	N86-15157 * #
NASA-TM-87560	p 63	N86-21420 * #
NASA-TM-87612	p 23	N86-11540 * #
NASA-TM-87639 NASA-TM-87647	р 26 р 43	N86-29871 * # N86-24737 * #
NASA-TM-87685	p 65	N86-30470 * #
NASA-TM-87703	p 81	N86-26276 * #
NASA-TM-87743	p 26	N86-29872 * #
NASA-TM-87973 NASA-TM-88249	р 25 р 66	N86-23749 * # N86-32950 * #
NASA-TM-88263	p 34	N86-24687 * #
NASA-TM-88585	p 43	N86-19965 * #
NASA-TM-88587	p 43	N86-19966 * #
NASA-TM-88752 NASA-TM-88791	р63 р82	N86-26355 * # N86-31548 * #
NASA-TM-88817	p 26	N86-31585 * #
NASA-TM-88853	p 27	N86-32703 * #
NASA-TM-88986	p 64	N86-27409 * #
NASA-TM-89012 NASA-TM-89188	р65 р64	N86-31340 * # N86-30302 * #
NASA-TM-89234	p 35	N86-29513 * #
NASA-TM-89240	p 65	N86-31451 * #
NASA-TM-89388	p 46	N86-29569 * #
NASA-TM-89397 NASA-TM-89399	р46 р64	N86-29568 * # N86-29888 * #
NASA-TM-89402	p 46	N86-29535 * #
NDC OD 700	- 04	NO0 00400 #
NBS-SP-708	p 81	N86-26409 #
NBS/SP-500/134	p 44	N86-26241 #
	•	
NBSIR-85/3254	p 81	N86-26239 #
NF-150/1-86	р9	N86-32102 * #
	P •	1100 02102 //
NOAA-TM-NWS-ENG-11	p 75	N86-22065 #
NOSC/TD-250-REV-A	n 96	NOC 00006 #
NOSC/TD-250-REV-A	p 25	N86-28326 #
NPS74-85-002	р7	N86-25123 #
NSF-84-335		N86-24554 #
NSF-85-308 NSF-85-40		N86-23482 # N86-23484 #
NSF/ENG-85044	D 34	
		N86-25808 #
NSE/PR4-85023		
NSF/PRA-85023		
NSF/PRA-85023	p 13	N86-25687 #
NSSDC/WDC-A-R/S-85-01	р 13 р 61	N86-25687 # N86-13343 * #
	р 13 р 61	N86-25687 #
NSSDC/WDC-A-R/S-85-01	р 13 р 61 р 7	N86-25687 # N86-13343 * # N86-26078 #
NSSDC/WDC-A-R/S-85-01	р 13 р 61 р 7 р 25	N86-25687 # N86-13343 * # N86-26078 # N86-26262 #
NSSDC/WDC-A-R/S-85-01 ORC-85-13 ORNL/TM-9581 ORNL/TM-9647	p 13 p 61 p 7 p 25 p 42	N86-25687 # N86-13343 * # N86-26078 # N86-26262 # N86-18246 #
NSSDC/WDC-A-R/S-85-01 ORC-85-13 ORNL/TM-9581 ORNL/TM-9647 PAR-85-108	p 13 p 61 p 7 p 25 p 42 p 8	N86-25687 # N86-13343 * # N86-26078 # N86-26262 # N86-18246 # N86-26843 #
NSSDC/WDC-A-R/S-85-01 ORC-85-13 ORNL/TM-9581 ORNL/TM-9647	p 13 p 61 p 7 p 25 p 42 p 8	N86-25687 # N86-13343 * # N86-26078 # N86-26262 # N86-18246 #
NSSDC/WDC-A-R/S-85-01 ORC-85-13 ORNL/TM-9581 ORNL/TM-9647 PAR-85-108 PAR-85-109 P885-199578	p 13 p 61 p 7 p 25 p 42 p 8 p 8 p 8 p 61	N86-25687 # N86-13343 * # N86-26078 # N86-26262 # N86-18246 # N86-26843 # N86-26843 # N86-26840 # N86-11657 * #
NSSDC/WDC-A-R/S-85-01 ORC-85-13 ORNL/TM-9581 ORNL/TM-9647 PAR-85-108 PAR-85-109 PB85-199578 PB85-222750	p 13 p 61 p 7 p 25 p 42 p 8 p 8 p 8 p 61 p 4	N86-25687 # N86-13343 * N86-26078 # N86-26262 # N86-18246 # N86-26843 # N86-26843 # N86-26840 # N86-11657 * N86-13906 #
NSSDC/WDC-A-R/S-85-01 ORC-85-13 ORNL/TM-9581 ORNL/TM-9647 PAR-85-108 PAR-85-109 PB85-199578 PB85-222750 PB85-2243269	p 13 p 61 p 7 p 25 p 42 p 8 p 8 p 8 p 61 p 4 p 92	N86-25687 # N86-13343 * # N86-26078 # N86-26262 # N86-26843 # N86-26840 # N86-26840 # N86-13906 # N86-13906 #
NSSDC/WDC-A-R/S-85-01 ORC-85-13 ORNL/TM-9581 ORNL/TM-9647 PAR-85-108 PAR-85-109 PB85-199578 PB85-222750 PB85-243269 PB86-106010 PB86-110806	p 13 p 61 p 7 p 25 p 42 p 8 p 8 p 8 p 8 p 61 p 4 p 92 p 75 p 13	N86-25687 # N86-13343 * N86-26078 # N86-26262 # N86-18246 # N86-26843 # N86-26843 # N86-26840 # N86-11657 * N86-13906 #
NSSDC/WDC-A-R/S-85-01 ORC-85-13 ORNL/TM-9581 ORNL/TM-9647 PAR-85-108 PAR-85-109 PB85-199578 PB85-222750 PB85-222750 PB85-243269 PB86-10806 PB86-10006 PB86-120706	p 13 p 61 p 7 p 25 p 42 p 8 p 8 p 8 p 8 p 61 p 4 p 92 p 75 p 13 p 25	N86-25687 # N86-13343 * N86-26078 # N86-26262 # N86-26843 # N86-26840 # N86-26840 # N86-21434 # N86-21434 # N86-22434 # N86-2268 # N86-22482 #
NSSDC/WDC-A-R/S-85-01 ORC-85-13 ORNL/TM-9581 ORNL/TM-9647 PAR-85-108 PAR-85-109 PB85-199578 PB85-222750 PB85-243269 PB86-10806 PB86-10806 PB86-120706 PB86-125184	p 13 p 61 p 7 p 25 p 42 p 8 p 61 p 4 p 92 p 75 p 13 p 25 p 13	N86-25687 # N86-13343 * # N86-26078 # N86-26078 # N86-26262 # N86-18246 # N86-26843 # N86-26840 # N86-13906 # N86-1434 # N86-21434 # N86-22482 # N86-23484 #
NSSDC/WDC-A-R/S-85-01 ORC-85-13 ORNL/TM-9581 ORNL/TM-9647 PAR-85-108 PAR-85-109 PB85-199578 PB85-222750 PB85-243269 PB86-243269 PB86-106010 PB86-106010 PB86-125184 PB86-125184	p 13 p 61 p 7 p 25 p 42 p 8 p 8 p 8 p 8 p 92 p 75 p 13 p 25 p 13 p 25 p 75	N86-25687 # N86-13343 * # N86-26078 # N86-26078 # N86-26262 # N86-18246 # N86-26843 # N86-26840 # N86-13906 # N86-2684 # N86-23482 # N86-23484 # N86-24005 #
NSSDC/WDC-A-R/S-85-01 ORC-85-13 ORNL/TM-9581 ORNL/TM-9647 PAR-85-108 PAR-85-109 PB5-199578 PB5-222750 PB5-223269 PB65-123269 PB66-106010 PB66-120706 PB66-125184 PB66-125184 PB66-125184 PB66-130300 PB66-135100	p 13 p 61 p 7 p 25 p 42 p 8 p 8 p 8 p 8 p 8 p 92 p 75 p 13 p 25 p 13 p 25 p 93 p 75 p 7	N86-25687 # N86-13343 * # N86-26078 # N86-26078 # N86-26262 # N86-18246 # N86-26843 # N86-26840 # N86-13906 # N86-2684 # N86-23482 # N86-23484 # N86-24005 #
NSSDC/WDC-A-R/S-85-01 ORC-85-13 ORNL/TM-9581 ORNL/TM-9647 PAR-85-108 PAR-85-109 PB85-199578 PB85-222750 PB85-243269 PB86-243269 PB86-10806 PB86-110806 PB86-125184 PB86-125184 PB86-125184 PB86-125184 PB86-125184 PB86-13030 PB86-135100 PB86-140043	p 13 p 61 p 7 p 25 p 42 p 8 p 8 p 4 p 92 p 75 p 42 p 8 p 93 p 75 p 93 p 75 p 7 p 94	N86-25687 # N86-26078 # N86-26078 # N86-26262 # N86-18246 # N86-26843 # N86-26843 # N86-26840 # N86-26840 # N86-21434 # N86-22065 # N86-23482 # N86-23484 # N86-23484 # N86-2465 # N86-2454 # N86-2288 # N86-2628 #
NSSDC/WDC-A-R/S-85-01 ORC-85-13 ORNL/TM-9581 ORNL/TM-9647 PAR-85-108 PAR-85-109 PB85-199578 PB85-222750 PB85-243269 PB86-10806 PB86-10806 PB86-120706 PB86-125184 PB86-125184 PB86-13030 PB86-13010 PB86-140043 PB86-141371	p 13 p 61 p 7 p 25 p 42 p 8 p 8 p 92 p 42 p 8 p 92 p 13 p 92 p 13 p 92 p 13 p 61 p 42 p 8 p 92 p 13 p 13 p 13 p 14 p 14 p 15 p 14 p 15 p 14 p 15 p 15 p 16 p 16 p 17 p 16 p 16 p 17 p 16 p 17 p 16 p 16 p 17 p 16 p 16 p 17 p 16 p 16 p 16 p 16 p 16 p 16 p 16 p 16	N86-25687 # N86-13343 * N86-26078 # N86-26078 # N86-26843 # N86-26840 # N86-26840 # N86-26840 # N86-21434 # N86-21434 # N86-22689 # N86-23482 # N86-23482 # N86-2405 # N86-24554 # N86-26288 # N86-26289 # N86-25290 #
NSSDC/WDC-A-R/S-85-01 ORC-85-13 ORNL/TM-9581 ORNL/TM-9647 PAR-85-108 PAR-85-109 PB5-199578 PB5-222750 PB5-243269 PB65-222750 PB65-10006 PB66-120706 PB66-125184 PB66-125184 PB66-125184 PB66-130300 PB66-130300 PB66-141371 PB68-141371 PB86-153764	p 13 p 61 p 7 p 25 p 42 p 8 p 42 p 75 p 42 p 75 p 92 p 75 p 93 p 75 p 7 p 7 p 94 p 75 p 7 p 5 5 p 7 p 7 p 25 p 13 p 13 p 13 p 13 p 13 p 13 p 14 p 13 p 13 p 15 p 14 p 15 p 16 p 16 p 17 p 15 p 16 p 17 p 15 p 16 p 17 p 15 p 16 p 17 p 17 p 17 p 17 p 17 p 17 p 17 p 17	N86-25687 # N86-13343 * # N86-26078 # N86-26262 # N86-18246 # N86-26840 # N86-26840 # N86-21434 # N86-21434 # N86-21434 # N86-22482 # N86-23482 # N86-23482 # N86-23482 # N86-25288 # N86-26239 # N86-25288 #
NSSDC/WDC-A-R/S-85-01 ORC-85-13 ORNL/TM-9581 ORNL/TM-9647 PAR-85-108 PAR-85-109 PB5-199578 PB5-222750 PB5-243269 PB65-223750 PB66-10010 PB66-10010 PB66-125184 PB66-125184 PB66-125184 PB66-130300 PB66-130100 PB66-141371 PB66-141371 PB66-153764	p 13 p 61 p 7 p 25 p 42 p 8 p 42 p 7 p 25 p 42 p 7 p 44 p 92 p 75 p 93 p 95 p 95 p 95 p 95 p 95 p 95 p 95 p 95	N86-25687 # N86-26078 # N86-26078 # N86-26262 # N86-18246 # N86-26843 # N86-26843 # N86-26840 # N86-21434 # N86-21434 # N86-22484 # N86-22484 # N86-22484 # N86-2548 # N86-26239 # N86-26239 # N86-2588 #
NSSDC/WDC-A-R/S-85-01 ORC-85-13	p 13 p 61 p 7 p 25 p 42 p 8 p 42 p 75 p 74 p 75 p 75 p 75 p 75 p 941 p 63 p 13 p 934	N86-25687 # N86-26078 # N86-26078 # N86-26262 # N86-18246 # N86-26843 # N86-26843 # N86-26840 # N86-21434 # N86-21434 # N86-22484 # N86-22484 # N86-22484 # N86-2548 # N86-26239 # N86-26239 # N86-2588 #

PB86-158102 PB86-166042 PB86-196987 PB86-197506 PB86-247682	р 34 р 71 р 82	N86-26249 # N86-27663 # N86-28783 # N86-32418 # N86-25299 #
PNL-SA-12976	p 62	N86-17230 #
P86-10152 P86-10182		N86-28628 * # N86-31563 * #
R-028-85 R-3355-NSF		N86-25992 # N86-25687 #
RADC-TR-85-229	p 81	N86-26359 #
RAND/N-2225-NAVY	p 75	N86-23556 #
REPT-186 REPT-3 REPT-5	p 91	N86-19638 # N86-20175 # N86-25808 #
RFP-3855	p 70	N86-12390 #
RIACS-TR-86.10 RIACS-TR-86.2 RIACS-TR-86.6	p 46	N86-29569 * # N86-29535 * # N86-29568 * #
S-553	p 76	N86-30568 * #
SAE PAPER 841491 SAE PAPER 841534 SAE PAPER 851332 SAE PAPER 851368 SAE PAPER 851370 SAE PAPER 851379 SAE PAPER 851379 SAE PAPER 851874 SAE PAPER 851808 SAE PAPER 851813 SAE PAPER 851801 SAE PAPER 851901 SAE PAPER 851907	p 37 p 1 p 52 p 52 p 10 p 79 p 20 p 79 p 3 p 20	A86-26011 * # A86-26005 # A86-23521 # A86-23553 * A86-23553 * A86-23553 * A86-32553 * A86-38317 # A86-38438 * A86-38440 # A86-36941 # A86-36941 #
SAI-82-03-178 SAI-82-03-178		N86-19249 # N86-22437 #
SAND-84-2401C SAND-85-0958 SAND-85-2032C SAND-85-2386C SAND-86-1284C	р 33 р 35 р 33	N86-19251 # N86-23954 # N86-30412 # N86-22955 # N86-33207 #
SAWE PAPER 1673 SAWE PAPER 1682		A86-35216 # A86-35223 #
SEL-85-001 SEL-85-005		N86-19965 * # N86-19966 * #
SME PAPER MF85-506	p 17	A86-24667 #
SNIAS-861-422-114	p 96	N86-32343 #
SPIE-485	p 28	A86-15278 #
SSDC-30 SSDC-34		N86-31226 # N86-31223 #
SU-STAN-CS-85-1064		N86-25173 #
TDCK-79524	p 12	N86-11077 #
THE/BDK/KBS/84-14 THE/BDK/KBS/84-16	р 27 . р 27	N86-32333 # N86-32334 #
THE/BDK/ORS/84/10	р 26	N86-32332 #
THE/BDK/84	р77	N86-32329 #
TR-DG-19-ONR TR-DG-20-ONR		N86-33200 # N86-33201 #
TR-10 TR-373 TR-51231-1	p 82	N86-15957 # N86-32766 # N86-30581 #
UCID-20575 UCID-20643		N86-24285 # N86-33048 #
UCRL-15688 UCRL-93621 UCRL-94074	. p 14	N86-33023 # N86-29874 # N86-29234 #
US-PATENT-APPL-SN-587764 US-PATENT-APPL-SN-6-829052 US-PATENT-APPL-SN-655601 US-PATENT-APPL-SN-756549	.р34 .р94	N86-24729 * # N86-27663 # N86-27513 * # N86-26529 #

US-PATENT-APPL-SN-764820 p 92	N86-21540 #
US-PATENT-APPL-SN-805011 p 92	N86-22114 * #
US-PATENT-APPL-SN-846429 p 93	N86-24673 * #
US-PATENT-CLASS-179-188C p 94	N86-27513 * #
US-PATENT-CLASS-244-159 p 93	N86-24729 * #
US-PATENT-CLASS-340-347DD p 94	N86-27513 * #
US-PATENT-CLASS-365-768 p 94	N86-27513 * #
US-PATENT-4,579,302 p 93	N86-24729 * #
US-PATENT-4,588,986 p 94	N86-27513 * #
WCRP-5 p 64	N86-29477
WES/MP/GL-85-13 p 42	N86-19955 #
WMO-2 p 63	N86-23184

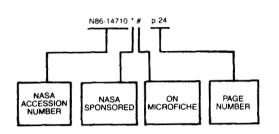
WMO-2

ACCESSION NUMBER INDEX

MANAGEMENT / A Bibliography for NASA Managers

APRIL 1987

Typical Accession Number Index Listing



Listings in this index are arranged alphanumerically by accession number. The page number listed to the right indicates the page on which the citation is located. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A86-10200 #	p 27	A86-17320 #	p 1
A86-10403 #	p 49	A86-17472 #	p 78
A86-10560 #	p 27	A86-17602 #	p 78
A86-10568 #	p 66	A86-17672 #	p 51
A86-10926 #	p 15	A86-17673 #	p 67
A86-10928 #	p 72	A86-17743 #	p 83
A86-10930 * #	p 15	A86-17769 #	p 37
A86-10932 #	p 15	A86-17771 *#	p 1
A86-10936 #	p 16	A86-18368 #	p 83
A86-10948 #	p 36	A86-18381 #	p 83
A86-10960 #	p 16	A86-18384 #	p 84
A86-11023 #	p 82	A86-18385 #	p 67
A86-11407 * #	p 27	A86-18389 #	p 84
A86-11412 #	p36 p36	A86-18392 #	p 84
A86-11445 #		A86-18394 #	p 84
A86-11602 * #	p 49	A86-18539 #	p 67
A86-11961 # A86-12361 #	р 16 р 49	A86-18541 * #	p 1
A86-12361 # A86-12935 #	p 49 p 49	A86-18848 #	p 84
	p 28	A86-19261 #	p 84
A86-13529 # A86-13823 #	р 20 р 49	A86-19487 #	p 10
A86-14095 #	p 50	A86-19489 #	p 16
A86-14095 #	p 16	A86-19524 * #	p 72
A86-14272 *#	p 50	A86-19525 * #	p 16
A86-14434 * #	p 28	A86-19526 * #	p 51
A86-14548 * #	p 28	A86-19685 * #	p 72
A86-14847 #	p 28	A86-19861 #	p 84
A86-14850 #	p 28	A86-20039 #	p 16
A86-15278 #	p 28	A86-20426 * #	p 29
A86-15611 * #	p 50	A86-20507 #	p 29
A86-15619 *#	p 10	A86-20591 #	p 16
A86-15623 * #	p 28	A86-20921 #	p 51
A86-15632 * #	p 72	A86-21055 #	p 72
A86-15635 * #	p 10	A86-21123 #	p 84
A86-15636 * #	p 50	A86-21126 #	p 85
A86-15663 #	p 82	A86-21317 #	p 37
A86-15833 * #	p 77	A86-21519 #	p 51
A86-15839 #	p 77	A86-21524 #	p 52
A86-15840 #	p 78	A86-21878 #	p 78
A86-15849 #	p 10	A86-21886 #	p 67
A86-15857 #	p 66	A86-21889 #	p 29
A86-15893 #	p 66	A86-21895 #	p 29
A86-15895 * #	p 67	A86-21896 #	p 17
A86-15902 #	p 50	A86-21973 * #	р37 р17
A86-15903 *#	p 82	A86-22141 # A86-22178 #	p 78
A86-15905 #	p 83	A86-22176 # A86-22185 #	p 78
A86-15914 *#	p 50		
A86-15941 #	p 83	A86-22242 # A86-22244 #	р 85 р 85
A86-15942 #	p 83	A86-22267 #	p 72
A86-15943 #	p 83	A86-22377 #	p 72
A86-15949 #	p 50	A86-22377 #	p 78
A86-17301 * #	p 51	A86-22379 #	p 73
A86-17307 * #	p 51	A86-22394 #	р 76 р 79
A86-17308 #	p 51	A86-23009 #	p 79
A86-17318 * #	p 72	A86-23521 #	p 1
A00-1/310 #	p / 2	A00-20021 #	μı

	p 52
	p 52 p 10
A86-24102 #	p 67
	p 67 p 17
A86-24110 #	p 67
	p 10 p 85
A86-24122 # A86-24123 #	p 68
A86-24127 #	p 85
	р73 р85
A86-24667 #	p 17
	p 52 p 85
A86-24828 #	p 17
A86-24836 *# A86-24988 #	р 52 р 17
A86-25033 #	p 29
A86-25036 # A86-25037 #	p 1 p 2
A86-25038 * #	p 2
A86-25866 # A86-25999 #	р 79 р 37
A86-26005 #	p 37
A86-26011 * # A86-26070 #	р 2 р 29
A86-26114 #	p 17
A86-26299 # A86-26451 #	р 17 р 68
A86-26453 #	p 68
A86-26464 # A86-26465 #	р 68 р 68
A86-26525 #	p 73
A86-26546 #	p 85 p 37
A86-27166 # A86-27167 #	р 37 р 29
A86-27877 #	p 86 p 86
A86-27881 # A86-27883 #	р86 р86
A86-27885 #	p 68
A86-27886 # A86-27887 #	р68 р10
A86-27888 #	p 86
A86-27896 # A86-27897 #	р 52 р 73
A86-28055 #	p 52
A86-28073 * # A86-28346 #	p 29 p 18
A86-28409 #	p 38
A86-28415 # A86-28416 #	p 38 p 38
A86-28418 #	p 68
A86-28422 # A86-28423 #	р 38 р 38
A86-28424 #	р 38
A86-28425 # A86-28427 #	р 38 р 39
A86-28455 #	p 18
A86-28482 # A86-28497 #	р39 р30
A86-28498 #	p 30
A86-28515 # A86-28578 * #	р30 р39
A86-28581 * #	p 73
A86-28582 # A86-28583 #	р86 р86
A86-28593 #	p 52
A86-28596 # A86-28725 #	p 18 p 53
A86-28777 #	p 53
A86-28779 # A86-28780 #	р86 р87
A86-28786 * #	p 87
A86-28787 * # A86-28792 #	р53 р53
A86-28795 #	p 53
A86-28796 #	p 53
A86-29090 # A86-29494 #	р2 р69
A86-29496 #	p 54
A86-29581 *#	p 54

486-38959 # # p 57 A86-39567 p 21 A86-39794 # # p 21 p 21 A86-40514 A86-40526 # p 11 A86-40602 D 11 # # # A86-40831 p 31 p 40 p 57 A86-40845 A86-40999 # # A86-41000 p 31 A86-41037 A86-41154 p 69 ######### p 58 A86-41155 p 21 p 11 A86-41385 A86-41648 p 31 A86-41681 A86-41981 р 69 р 58 p 88 A86-42236 р 88 р 21 р 31 A86-42764 ### A86-42983 A86-43061 A86-43229 p 32 р 32 р 58 р 74 #### A86-43333 p 88 A86-43335 A86-43339 p 88 p 88 p 58 A86-43340 ###### A86-43341 A86-43342 p 89 A86-43343 A86-43344 p 89 p 89 A86-43345 p 89 p 89 p 89 A86-43346 A86-43349 ##### A86-43881 A86-43884 p 74 p 74 p 32 p 80 A86-43901 A86-43905 р40 р58 ############## A86-44404 A86-44526 A86-44530 p 58 p 59 p 69 A86-44537 A86-44538 A86-44540 p 69 p 69 p 90 p 90 p 59 p 59 p 70 A86-44541 A86-44543 A86-44548 A86-44549 A86-44919 р 70 р 21 р 74 A86-44935 486-45300 • # p 22 p 40 A86-45470 .######## p 70 p 59 A86-45636 A86-45643 A86-45709 p 59 A86-46104 р40 р90 A86-46375 A86-46425 p 11 p 59 p 59 A86-46763 **** A86-46938 p 74 A86-46951 A86-46952 р74 р40 р74 A86-46954 p 60 p 70 p 75 p 22 p 60 p 75 p 22 p 22 p 22 A86-46960 A86-46961 A86-46963 A86-46964 A86-47052 A86-47139 A86-47402 A86-47603 A86-47616 p 75 **** A86-47648 p 60 р 60 р 60 р 80 A86-47960 A86-48100 A86-48371 A86-48373 A86-48451 p 60 р 60 р 22 A86-48995 p 80 A86-49084 p 22 A86-49448 # p 60 A86-49453 # p 90 A86-49454 # # A86-49478 p 80

4000000-02

G-1

A86-49488

I

ACCESSION NUMBER INDEX

A00-49400	
A86-49488 * # p 40	N86-20013 # p6
A86-49552 * # p 40	N86-20014 # p 33
	N86-20047 # p81
A86-49558 * # p 11	N86-20174 # p91
A86-49571 # p 23	N86-20175 # p 91
A86-49872 # p 41	N86-20177 # p 92
A86-50265 * # p 11	N86-20436 # p 92
A86-50280 # p 41	N86-20464 # p 92
	N86-21220 * # p 33
N86-10841 # p 41	N86-21419 * # p6
N86-10899 # p 12	N86-21420 * # p 63
N86-11072 # p 12	N86-21434 # p 92
N86-11073 # p 3	N86-21453 # p 92
N86-11075 # p4 N86-11076 # p12	N86-21458 # p 92
N86-11076 # p 12 N86-11077 # p 12	N86-21499 # p7
N86-11107 # p 23	N86-21540 # p 92
N86-11194 *# p 32	N86-22065 # p 75
N86-11195 * # p 32	N86-22114 * # p 92
N86-11216 # p 23	N86-22168 # p43 N86-22435 # p93
N86-11228 * # p 23	N86-22433 # p 33
N86-11394 # p 23	N86-22444 * # p 93
N86-11540 * # p 23	N86-22448 # p 93
N86-11657 # p 61	N86-22955 # p 33
N-86-12158 * # p 61	N86-23184 p 63
N86-12163 # p90	N86-23260 # p 7
N86-12212 * # p 4	N86-23315 # p 43
N86-12243 # p 70	N86-23482 # p 25
N86-12390 # p 70	N86-23484 # p 93 N86-23556 # p 75
N86-12976 # p 61	
N86-13027 # p32 N86-13221 * # p61	N86-23603 * # p 33
N86-13221 # p 61	N86-23630 # p 71
N86-13230 *# p 90	N86-23749 * # p 25
N86-13234 # p 91	N86-23954 # p33 N86-24005 # p75
N86-13235 # p 23	
N86-13235 * # p 23 N86-13343 * # p 61	N86-24256 # р81 N86-24257 # р7
N86-13742 # p 24	N86-24278 # p 43
N86-13745 # p 24	N86-24285 # p 43
N86-13906 # p 4	N86-24554 # P 7
N86-14611 # p 32	N86-24574 # p 71
N86-14710 * # p 24	N86-24575 # p 71
N86-15157 # p 61	N86-24586 # p 75
N86-15158 # p 80	N86-24588 # p71
N86-15160 # p 80	N86-24589 # p 25
N86-15161 # p 12	N86-24673 * # p 93
N86-15163 * # p 4 N86-15164 * # p 4	N86-24687 * # p 34
N86-15165 * # p 62	N86-24712 *# p63 N86-24726 # p93
N86-15166 * # p 91	N86-24726 # p93 N86-24729 *# p93
N86-15167 # p4	N86-24737 * # p 43
N86-15168 * # p 62	N86-25123 # P 7
N86-15170 * # p 4	N86-25173 # p 34
N86-15171 * # p 41	N86-25288 # p 94
N86-15172 * # p 24	N86-25289 # p 13
N86-15173 * # p 41	N86-25290 # p63
N86-15174 * # p 41	N86-25299 # p 13
N86-15178 # p5 N86-15180 # p42	N86-25321 * # p 76
N86-15180 # p 42	N86-25687 # p 13
N86-15182 # p5	N86-25808 # p34 N86-25992 # p13
N86-15183 *# p 42	N86-25992 # p13 N86-25999 # p44
N86-15184 # p5	N86-26005 # p 44
N86-15186 * # p 5	N86-26006 # p 44
N86-15187 *# p5	N86-26007 # p 44
N86-15194 # p5	N86-26062 # p 34
N86-15197 # p 24	N86-26078 # p7
N86-15201 *# p5 N86-15202 *# p6	N86-26239 # p81
N86-15202 # p 6	N86-26241 # p 44 N86-26243 * # p 94
N86-15957 # p6	N86-26243 # p 34 N86-26249 # p 63
N86-16152 # p 91	N86-26262 # p 25
N86-16451 * # p 70	N86-26276 * # p 81
N86-16452 * # p 24	N86-26277 * # p 25
N86-17225 * # p 62	N86-26355 * # p 63
N86-17227 * # p 24	N86-26359 # p81
N86-17230 # p 62	N86-26409 # p 81
N86-17265 * # p 62 N86-17409 # p 91	N86-26529 # p 94
N86-17595 * # p 62	N86-26840 # p 8
N86-18053 # p 32	N86-26843 # p8 N86-27109 # p63
N86-18246 # p 42	N86-27113 # p13
N86-18379 # p 62	N86-27115 # p 71
N86-18736 # p 33	N86-27121 # p 44
N86-19022 * # p 42	N86-27130 # p94
N86-19249 # p 12	N86-27306 * # p 64
N86-19251 # p 42	N86-27352 * # p 94
N86-19284 # p91 N86-19620 # p24	N86-27409 * # p 64
N86-19620 # p 24 N86-19630 # p 42	N86-27513 * # p 94 N86-27663 # p 34
N86-19634 # p 33	N86-27663 # р34 N86-27941 # р8
N86-19636 * # p 80	N86-27941 # 0.8 N86-27950 # 0.13
N86-19638 # p 81	N86-28007 # p14
N86-19943 * # p 63	N86-28012 # p 76
N86-19955 # p 42	N86-28067 # p 44
N86-19965 * # p 43	N86-28067 # p 44 N86-28326 # p 25
N86-19966 * # p 43	1100-20320 # P 23

N86-28418 # p 76 N86-28628 # p 44 N86-28793 # p 94 N86-28793 # p 94 N86-28793 # p 94 N86-28793 # p 45 N86-28793 # p 45 N86-28795 # p 45 N86-28796 # p 45 N86-28796 # p 45 N86-28799 # p 45 N86-28796 # p 45 N86-28000 # p 95 N86-28070 # p 46 N86-28972 # p 95 N86-28976 # p 95 N86-28977 # p 95 N86-28977 # p 95 N86-29207 # p 46 N86-29207 # p 46 N86-2931 # p 47
N86-31461 # p 65 N86-31548 # p 65 N86-31563 # p 82 N86-31563 # p 26 N86-31563 # p 26 N86-31758 # p 71 N86-31777 # p 48 N86-32102 # p 9 N86-32111 # p 14

N86-32703	•#	p 27
N86-32750	#	p 14
N86-32766	#	p 82
N86-32849	#	p 66
N86-32864	• #	p 14
N86-32950	• #	p 66
N86-32969	#	p 9
N86-32985	• #	p 9
N86-33023	#	p 9
N86-33048	#	p 48
N86-33198	#	p 15
N86-33200	#	p 48
N86-33201	#	p 15
N86-33204	#	p 96
N86-33206	#	p 48
N86-33207	#	p 49
N86-33210	• #	p 9
N86-33212	#	p 66

G-2

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