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RESEARCH REPORT

Battelle
Columbus Laboratories

FINAL REPORT

on

PHASE II STS NEW USER DEVELOPMENT PROGRAM:

VOLUME II, NARRATIVE REPORT

to

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER

CONTRACT NUMBER NAS8-31621

March 18, 1976

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PREFACE

This Battelle report, entitled "Phase II STS New User Development Program", is submitted under NASA Contract No. NAS8-31621 and consists of five volumes as specified below:

Volume I - Executive Summary
Volume II - Narrative Report
Volume III - The Implementation Plan
Volume IV - Guidance/Instructions for Representatives
Volume V - Informational Materials.

The five volumes make up the Phase II STS New User Development Program Final Report and summarize the results, conclusions and recommendations from the nine-month study performed by Battelle's Columbus Laboratories (BCL). This contract was administered by the NASA Marshall Space Flight Center, Huntsville, Alabama.

Battelle's Columbus Laboratories would like to acknowledge the efforts of W. Robert Mixon, Jr., of NASA/MSFC as the Contracting Officer Representative for the study program. The following BCL staff should be recognized for their technical contributions to this study:

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INTRODUCTION

The planned use of the Space Transportation System (STS) is reflected in NASA's 1973 Payload Model. Although the model was developed as a planning document it is of interest that only 18 percent of the total payloads included are non-NASA/non-DoD. In general, it is felt that the users of the STS other than NASA and DoD have not been delineated accurately and that the projections in the payload model for these users are probably conservative. This is believed to be especially true relative to the U. S. industry sector and other government agencies. While the non-NASA/non-DoD user community is potentially extensive it has yet to be developed. In recognition of this, the overall objective of NASA's STS New User Development (NUD) Program is to obtain new users other than NASA and DoD in order to maximize the use of the STS.

Phase I of the NASA STS NUD Program was completed in 1974; it involved four separate contractor studies(1)* which developed techniques and methodologies for identifying new uses and new users in the educational, industrial, and international sectors and U. S. Government agencies other than NASA and DoD. The four studies were to be used as a base for the follow-on Phase II study.

The objective of the Phase II STS NUD Program, which has been undertaken by Battelle (BCL), was to develop a NUD program implementation plan and attendant informational material which may be used by NASA or its contractors in subsequent phases of the STS NUD Program. The BCL study effort was conducted over a period of 9 months with a funding level of $130,000.

The problems associated with the development of new users for the STS will be very much like the problems faced by industry in marketing their services and new products. As a point of interest, it should be noted that the terms "marketing", "the market", and "market analysis" are used in this report in many places in conjunction with the terms "user development", "the user community", and "use analysis". This has been done as a recognition and, perhaps, an acceptance that the term "marketing" is very descriptive and can be readily associated with an identifiable, effective and extensively used operation. It is, however, recognized that the uniqueness and broadness of the "product" in the STS case dictates key differences in marketing the STS. Therefore, the intent throughout this study has been to identify new, innovative market approaches in conjunction with tried and proven techniques. Some of the unique product characteristics of the STS include the following:

- The product to be marketed is STS service. The service will provide routine, easy access to the space environment.
- The STS and its utility are unknown to many potential users. Relevant uses and benefits of the STS will not be readily apparent to these users.

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* Superscript numbers refer to references shown at the end of the text.

- The STS capability (including services and related space facilities) to a user is very broad:
  - A reimbursable space transport service (launch and return)
  - National science facilities (space telescope, infrared observatory)
  - Facilities for space research and development [Spacelab, Long Duration Exposure Facility (LDEF), etc.]
  - Remote sensing
  - Means leading toward commercial manufacturing in space
- The greatest potentials are probably yet to be developed or even considered.
- Full operational capability is long-term (1980's). The means for early involvement of a user is not clear.
- Broad mission support and on-orbit service can be provided.
- Capability, reliability, and availability are yet to be demonstrated.

The broad capabilities and services to be offered by the STS will potentially be of interest and benefit to a wide spectrum of users. These users will range from those already involved in space operations to those unaware of space benefits, let alone the applications of the STS. Thus, the introduction of a new era in space transportation must be marketed as a replacement and as an enhancement (lower cost, more frequent and easy access to space, flexibility in mission operations, etc.) to space users already in the space business (communications, Earth observations, weather, etc.) who are currently using other space launch vehicles. To the "new to space" users the marketing of a beneficial space technology (crystal growth, biological processing, etc.) is the primary product to be marketed with a correlation shown to using the STS as an economical mechanism for implementing an economically viable space operation. Also, the categories of users will include those who directly interface with the orbiter or upper stages as a payload carrier, those interfacing with a space processing furnace or LDEF experiment tray, and those who are interested in space derived data. User organizations will conceivably include government agencies, regional centers, industry companies, industrial associations, consortiums, educational institutions and space brokers. The study conducted by BCL had to consider and address all of the above as a universe of STS use and potential users.

The study approach followed was based upon the contract statement of work and was initially presented to NASA at MSFC on July 9, 1975. The study approach, shown in Figure 1, included three major tasks and related subtasks. This volume of the final report describes the objectives, procedures, and results of each task. Each task is discussed separately in following sections of this volume. The major conclusions are summarized at the end of the volume.

TASK I - ESTABLISH BASIS FOR THE IMPLEMENTATION PLAN

Objective

The objective of Task I was to establish the data base and background for the remaining tasks in the study, especially the development of the implementation plan and informational material in Task III.

Procedure and Results

All of the STS NUD Program Phase I reports were reviewed by the BCL study personnel to establish the background which these studies provided in terms of the marketing approaches recommended, the barriers to marketing identified and the organizational recommendations made. These reviews assured the awareness of all study personnel of the results of Phase I.

The STS data base, prepared by BCL during its Phase I study to provide a simplified description of the significant STS parameters, was expanded and updated. The expansion included the identification of several STS future planning and policy categories and a significant updating and additional cross-referencing to current documentation available in the Battelle BMI-NLVP (NASA Launch Vehicle Program) library. The resultant data base, which was used continuously by study personnel, is included in this report as Appendix A.

The final portion of Task I, and considered to be the most significant, was the identification, review and coordination of several other NASA and contractor programs, key individuals, and organizations which have valuable inputs to the development of an implementation plan and information material. As an example, the final performance review of the General Electric Beneficial Uses of Space (BUS) study was attended.[2] Several issues, barriers, and concerns

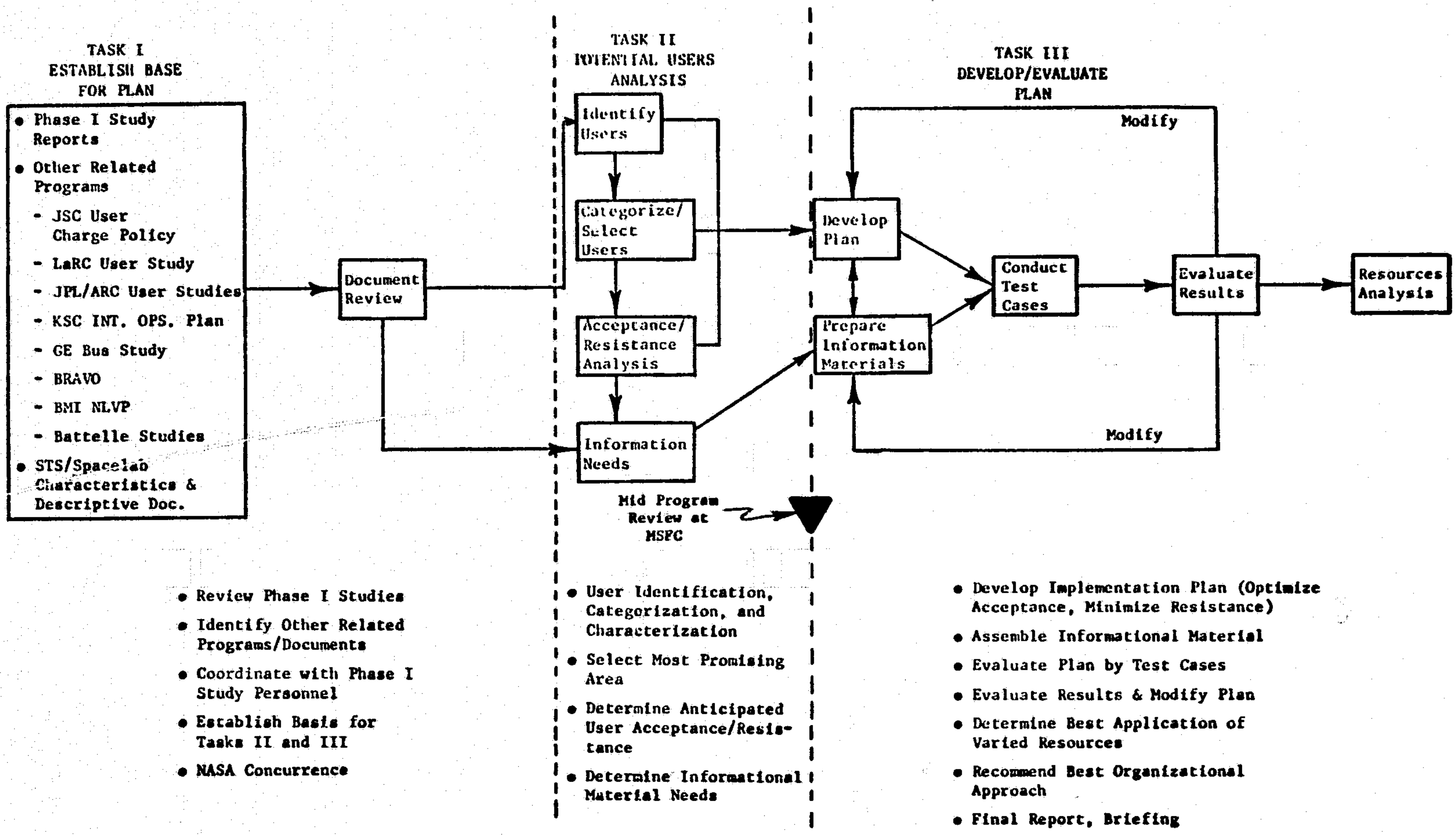

FIGURE 1. NEW USER DEVELOPMENT PROGRAM TECHNICAL APPROACH

expressed by potential space users and methods used in user contacts were discussed with GE personnel. The complete technical, operations and financial assessment of the candidate idea concerning high specificity separation of isoenzymes in space was of particular interest. This idea, involving electrophoretic separation, was shown to be an attractive business venture, once the technical feasibility of large pore gel electrophoresis in space has been demonstrated. Therefore, although the idea lacks technical credibility at this time, the concept and the market analysis/financial venture descriptions included in the BUS reports provided a valuable input to the strategy used and informational material provided in conducting the test cases in Task II.

Similarly, the McDonnell-Douglas (MDAC) study(3) on the feasibility of commercially manufacturing silicon ribbon in space was reviewed and found to be applicable to marketing in the semiconductor industry. Specifically, the free-flyer concept, the market analysis, the yield improvement projections, and the investment analysis were found to be very useful material to be presented and discussed during two test cases (Task III). The background for this idea, the role of Monsanto in the concept development and the response of several semiconductor companies contacted during the study were discussed with the MDAC study program manager. It should also be noted that a meeting was held with the program manager subsequent to the NUD semiconductor test cases to coordinate the results of those meetings.(4)

Additional coordination of the STS NUD study was accomplished with the NASA Office of Applications. Plans for conducting test cases in the space processing area of STS use were discussed with the Program Manager of Space Processing.(2) Additional discussions in NASA/OA were held to coordinate the NUD with present and future user development planning in the Office of User Affairs.(5,6) The planning related to LANDSAT marketing provided an input to assessing the resources within NASA for recommendations on the resources allocations subtask in Task III.

The user development approach and results of NASA/LaRC on the LDEF experiment program were discussed with the LDEF Experiment Manager. During these discussions, it was learned that a contract for developing experiment ideas within the research areas at The Ohio State University was being conducted at OSU as one of several universities. The approach and results of the OSU effort were subsequently discussed with OSU personnel, and the study is reported in the Task III section of this report.

During Task I, preliminary contacts were made and a meeting was held with the president of the Public Service Satellite Consortium (PSSC) to determine the role of the PSSC in the educational sector and to explore the feasibility of conducting a test case with them.(5) Subsequently, the PSSC supplied BCL with considerable material to provide a profile on their organization as part of the NUD study data base.

A better understanding of the objectives and proposed role (especially with NASA) of the National Space Institute (NSI) was obtained in a meeting with them.(7) This information was to be used in evaluation of the resources subtask in Task III. In addition, a valuable insight into the details of the approach and results of the NASA/NSI meeting with the Pharmaceutical Manufacturers Association (PMA), which occurred in October 1975, was obtained. This information was very significant as an input to the implementation plan and the strategy used in the pharmaceutical test cases (Task III).

It was recognized that the activities being conducted by the STS User Charge Intercenter Working Group provided pertinent information to the NUD study tasks. Close coordination between the two programs was maintained since BCL is a participating member of the NASA/JSC working group. Interactions and relationships between the two program activities existed in several areas. The general development of a user charge policy and sharing concept, although considered privileged information relative to outside discussions, provided the NUD study with a meaningful insight into the objectives, issues and options being considered. The intent and organization of the STS Tariff Book was included in discussions with the test case organizations (Task III). Of additional interest were several contacts made by User Charge personnel with potential user groups. NASA/JSC personnel had a series of meetings with various payload and discipline offices at JSC, ARC, and JPL.(8) BCL personnel also made several contacts with space users outside NASA.(9-13) These contacts provided a significant survey of views, concerns and problems expressed by potential users of the STS which need to be taken into account by the NUD Implementation Plan (Task III).

Three documents prepared for the User Charge Group were included in the NUD study data base. An Outside (non-NASA/non-DoD) Users Payload Model[14] identifies specific user organizations (payload sponsors), with accompanying references and scenarios justifying the payload projections and describing the conditions under which it would occur. This model provides a matching of STS uses to specific users and was a direct input to Task II. Of significance is the wide review and coordination of this model within NASA and several space user organizations (RCA, Hughes, INTELSAT, Aeroneutronic-Ford, Canada, etc.) which has led to a final version[15] generally accepted as a current, reasonable projection of uses and users of the STS. Another BCL document, "Terms and Conditions Policy for STS Use"[16], provides an assessment of the effect and sensitivity of various proposed terms and conditions of STS use on future non-NASA/non-DoD users. As such, the information provided background to the determination of anticipated acceptance/resistance to a NUD representative (Task II) and, also, a set of barriers which the implementation plan (Task III) should consider. Providing background data for the same task utilization was a third document, "External Competition for the STS".[17] This report projects significant, potential launch vehicle competition for the STS and documents the views of many space users regarding the competitiveness of the STS (cost, availability, risk, etc.)

As can be seen, Task I resulted in a broad review and correlation of information activitives from related programs, key individuals, organizations and many documents. The establishment of this background and data base permitted effective achievement of the remaining study tasks introducing broad, technical and programmatic credibility.

TASK II - STS POTENTIAL USERS ANALYSIS

Objective

The objective of Task II was to analyze the potential community of STS users, outside NASA and DoD, to identify the most promising uses/users in the commercial and domestic government areas. The analysis was to subsequently determine the projected response (acceptance or resistance) which a STS New User Development representative (either NASA or NASA sponsored) may encounter in developing the most promising uses with potential users. Additionally, informational needs, including guidance and instructions, which the representative requires to know about the user and must provide to a user were to be determined.

Procedure and Results

The accomplishment of Task II involved several subtasks, as follows:

- User Identification, Categorization and Characterization
- Selection of Most Promising Use Area
- Determination of Anticipated User Acceptance/Resistance
- Determination of Informational Needs.

The first two subtasks were done in sequence while the remaining two subtasks were accomplished as separate, but related efforts.

User Identification, Categorization and Characterization

The Outside (non-NASA/non-DoD) Users Payload Model[14,15] developed by Battelle to support the STS User Charge Intercenter Working Group (NASA/JSC) was identified and used as a primary matching of known STS uses to potential user organizations. A high level of confidence was given to acceptance of this model as a current, reasonable projection of uses and users as a result of the wide circulation and review of the document within NASA and several automated spacecraft manufacturers. It was felt that additional data should be summarized in the different use areas to supplement the payload model and to characterize a use area relative to background, objectives, status, potential user community and the projected application of STS. A primary document reviewed for this summary was the NASA/OA report[18] describing space applications programs as an input to the NASA/NAE 1974 summer study. The National Research Council final report[19] (including the 14 supporting papers) of the summer study was also used. The major categories of STS known uses were assumed to be

- Earth Observations
- Earth and Ocean Dynamics
- Communications/Navigation
- Space Processing
- Space Technology
- Space Science.

A result of this subtask was the preparation of a table (Table 1) providing an informational background by major categories, and subcategories, of STS use. This information, together with the outside user payload model and information from several documents in the study program data base, provided the informational baseline for the following subtask.

Selection of Most Promising Use Area

The approach to this subtask was to develop a methodology for analyzing the known STS uses and the potential community of STS users, outside NASA and DoD, and to identify the most promising uses and users in the commercial and domestic government areas. Implicit in this objective was that the methodology to be developed was to be applicable to an operational NUD function and not for the sole purpose of identifying potential users for test case candidates in Task III. A description of the methodology developed, results of applying it, and an evaluation of the results and comments regarding its use are included in the following discussion.

TABLE 1. STS POTENTIAL USE/USER SUMMARY

Major Use Area - Subcategories	Use Objective (or Product)	Use Status	Potential User Community	Application of STS	Remarks
Earth Observations					
- Weather [illegible]				Space Transportation - Delivery, Servicing, Retrieval; Spacelab - R&D Facility	High potential for use/application of data. Users considered to be secondary users of STS.
Weathe[illegible] (Lan[illegible]	Forecasts	Current-needs improvements	Weather Bureau/Commercial Weather Services Public/Commerce/Firms		
Seastate Prediction	Forecasts	Under development	Above + Offshore Oil/Shipping		
Weather Danger/Disaster Warning	Forecasts	Current/under development	Weather Bureau/"Local" Gov'ts		
Weather/Climate Prediction/Modification	Precipitation/Temperature Changes	Research	Weather Bureau/"Local" & Fed. Gov'ts		
Oceanographic Studies	Knowledge	Some current +use/development	Research Community/Navy		
Sea & Pack Ice	Forecasts	Under development	Shipping/Gov'ts/Polar Coast Dev. (Oil)		
- Earth Resources Survey				Same as above...	Considered by many as operational system. Efficient distribution of data is of concern. High potential in data use/application. Improved sensor resolution desired. Commercial sensor payloads issue with NASA.
Agriculture/Forestry	Inventory/Forecasts/Warnings/Proper Use of Land	Current-needs improvements	Gov't/Farmers/Buyers		
Fishing	Inventory/Forecasts/Enforcement	Research	Fisheries/Gov'ts		
Rescue/Recovery	Accident/Shipwreck Locations	Requires improvements in resolution & response times	Gov't (Coast Guard)/Salvage Co's		
Oil/Mineral Surveys	Oil/Gas/Mineral Locations and Reserve Estimates	Current-needs improvements	Extractive Industries/Gov'ts		
Geological/Hydrological Surveys	Surveys	Current-needs improvements	Gov'ts/Extractive Industries		
Monitoring of Extractive Industries	Surveys	Current-needs improvements	Gov'ts		
Land Use	Maps/Surveys	Current-needs improvements in resolution	Gov'ts/Commerce/Public		
Gravity Modeling/Altimetry	Surveys	Current improvements under development	Gov't/Oil/Gas Exploration/Research		
Geothermal Mapping	Surveys/Locations	Development	Gov'ts/Electric Power Co's		
Geology/Earthquake Prediction	Surveys/Forecasts	Development	Gov'ts/Public		

TABLE 1. (Continued)

Major Use Area - Subcategories	Use Objective (or Product)	Use Status	Potential User Community	Application of STS	Remarks
- Environmental Quality Monitoring				Space Transportation - Delivery, Servicing, Retrieval Spacelab - R&D Facility	
Air Pollution & Sources Water Pollution Sedimentation Oil Spills Eutrophication Land Sanitary Land Fills Strip Mines Pollution Effects Construction Practices	Surveys/Monitoring	Current & Developmental	Predominantly Government. Some use by large companies to keep ahead of government		
Earth & Ocean Dynamics Applications Programs				Same as above...	
- Oceanography	(Synoptic) Data on Waveheight/direction Wind strength/direction Air & Water Temperatures Currents Topography/Geoid/Gravity Effects Interfaces (Air/Water) (Water/Water) (Ice/Water) Atmospheric Measurements Sedementation/Rust Formation Plant/Fish Distribution	Developmental	Navy/Gov't/Industry Research leading to Weather & Climate Forecasting & Modification Ocean Monitoring for Oil Industry Operations Shipping Fishing Aquiculture Ocean Energy Applications Tsunami Prediction		
Communications/Navigation				Same as above...	Mature use area growing in domestic communications - R&D pullout by NASA of concern. High potential application for Data Use.
- Communications	Telephone Facsimile Data T.V.	Current & Development	Gov't/Industry/Public Telecommunications Shipping, Medicine, Education, Research Data Collection, Libraries, Mail		
- Navigation	Position & velocity data	Current & Developmental	Gov'ts/Military Shipping/Air Transport/Oil & Offshore Ops Fishing & Recreation		

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TABLE 1. (Continued)

Major Use Area – Subcategories	Use Objective (or product)	Use Status	Potential User Community	Application of STS	Remarks
Space Processing				NASA sponsored R&D, Spacelab payloads, eventual industry involvement up to space mfg.	
– Electronic Materials	Larger perfect crystals Ribbon crystals Magnetic bubble materials	Exploratory, Flight demonstrated, Economically beneficial	Semiconductor industry Power Industry	• Space transportation in sortie missions, Spacelab payload configurations • Deployment, retrieval, servicing of free-flyers	Great potential as product improvement mechanism
– Biological Processes	• Complete separation of solutions • Cell growth • Vaccines, serum	Exploratory in electrophoretic separation	Pharmaceuticals Federal Health agencies private medical research Health/sciences field	Same as above	Potential for high value added product Considered as highest potential of space processing for new products
– Metallurgical Products	Purer metal crystals Homogeneous, purer metals and alloys Superconductors Immiscibles Improved electrical/magnetic properties Highly ductile tungsten	Exploratory, some flight demo.	Materials industry – Product lines (X-rays) – Aircraft eng.mgf.	Same as above	Relative low value added products in general
– Glass/Ceramics	New types of glass Improved quality (purity and optical homogeneity) Optical fibres	Exploratory	Glass industry	Same as above	Low emphasis in NASA

TABLE 1. (Continued)

Major Use Area - Subcategories	Use Objective (or product)	Use Status	Potential User Community	Application of STS	Remarks
- Advanced Ideas	• Surface acoustic wave components • Fractional HP motor testing • High temp. turbine blades	Conceptual			
<u>Space Technology</u>	Develop space technology for NASA research centers, industry and academic (engineering) communities	Conceptual designs of facilities in progress. Development of users in progress	• NASA Res. Centers • Aerospace industry • Private research organizations • Institutions	Space transportation - delivery, servicing, retrieval Spacelab payload	NASA/LARC programs to extend their research into space and serve other centers
- Advanced Technology Lab (ATL)	Provide general purpose lab facility for space technology developments	Conceptual design Experiments under study	Same as above	Same as above	Being developed as a national research facility
- Long Duration Exposure Facility (LDEF)	Provide passive free-flyer for space exposure experiments (6 months)	• Preliminary design in progress • User development studies	Same as above	Space transportation on sortie missions - delivery, servicing and retrieval	Will be deployed on one of first STS flights. Being developed as a national research facility
- Space Technology Experiments	Specialized disciplines for experiment development • Physics & Chemistry • Atmospheric • Entry technology • Contamination • Engineering technology	All in study definition status and conceptual design	Primarily NASA/LARC principal investigators Other NASA centers can utilize experiments	To be conducted in ATL or orbiter	

TABLE 1. (Continued)

Major Use Area - Subcategories	Use Objective (or product)	Use Status	Potential User Community	Application of STS	Remarks
<u>Space Science</u>	Scientific knowledge National space science facilities	Continuation of current science programs	Individual scientists Institutions Non-Profit research Aerospace industry	IUS/TUG Spacelab payloads Space transportation Retrieval, servicing R&D (instrument) platform	Primarily NASA sponsored. Some non-NASA government sponsors. A lot of cooperative missions planned. Some reimbursables
- Atmospheric & Space Physics	AMPS payload for Spacelab, free-flyers	Payloads under design	Same as above		
- Optical Astronomy	Large space telescope	Under design	Same as above		
- IR Astronomy	SIRO (IR Observatory - free flyers	Under design	Same as above		
- High Energy Astrophysics	Automated spacecraft Spacelab research platform	HEAO experiments under design	Same as above		
- Solar Physics	Automated spacecraft Sortie solar observatory	Under design	Same as above		
- Planetary Exploration	Various programs	Pioneer, Mariner Viking configurations exist	Same as above		
- Life Sciences	Automated spacecraft (BESS) Spacelab biomed lab. free flyers	Design underway	Same as above		

Some of the problems that the NASA New User Development Program faces are ones which all industrial and other commercial organizations constantly have in developing marketing strategies for their products and services. The problems are how to identify potential customers for their products or services, and how to get the greatest economic return for their investment of manpower and financial resources in the marketing effort. Due to the wide diversity of potential uses of space which the STS brings within the physical and technological reach of potential users in both the commercial and government sectors of the world economy, it would be impractical for NASA, or any other organization, to attempt to contact, develop, and bring to fruition all such users and their uses. Thus, in order for the NUD program to be effective, it is necessary to develop and use a logical approach to selecting which potential uses and users to contact and develop. The screening and ranking methodology which is described in the following sections is a cost- and effort-effective approach to identifying specific uses and users with high potential for new user development. This approach provides a logical systematic methodology for the identification of potential uses and users, thus alleviating the need for uses and/or user selection being based entirely upon intuitive reasoning. It should help to structure the decision-making process and make it more cost-effective, thus improving the return to NASA on its NUD program. It should enable the application of the NUD program resources (manpower and financial) to be concentrated on those uses/users having the greatest potential for a significantly large return to NASA.

<u>General Methodology Approach</u>. A series of sequential screening steps is used to quickly home in on the most viable uses and users. In this methodology the uses and/or users of lowest potential are eliminated with a minimum of cost and effort early in the process. After the screening step, the uses and/or users remaining receive increasing attention in the identification process.

Through the proper selection of screening and ranking criteria, it is possible to quickly and economically identify those uses/users having specific desired characteristics. The types of characteristics to be used include the following:

<u>For Uses</u>

(1) Timing of projected use
(2) Magnitude of R&D necessary before commercial operations
(3) Magnitude of total investment for commercial operation
(4) Diversity of need/application
(5) Political/emotional support existing
(6) Technical feasibility
(7) Etc.

<u>For Users</u>

(1) Organizational resources available
  (a) Management capability
  (b) Financial capability
  (c) Manpower capability
  (d) Technical capability
(2) Organizational interest
(3) Ease of contact
  (a) Single user
  (b) Diversity of small users
(4) Organizational philosophy of operations
(5) Risk aversion of the organization
(6) Etc.

Within each of these and related types of categories, specific screening and ranking criteria are developed. Applying these criteria to the potential uses/user is carried out by a small team (3 or 4) of the most knowledgeable (by use area) individuals available. Each individual independently evaluates the uses/users against each criterion. In the application of the screening criteria a pass or fail decision is made. In the ranking procedure each evaluator determines a numerical score for fit. In this ranking procedure each criterion has three levels of fit, with each level having a different numerical value, and the best fit having the highest score. Weight factors for the criteria are used as a means of consideration for the relative importance of the various ranking criteria.

The total score generated for ranking each potential use/user is the sum of the products on the criterion weight factor and the value of the fit with the criterion. That is:

$$\text{Total Score} = \sum_{i=1}^{n} W_i \times F_i \ ,$$

where:

W_i is the numerical value of the weight factor for the i^{th} rating criterion

F_i is the numerical value of the fit of the use/user with the i^{th} rating criterion

n is the number of criteria.

After the total scores are calculated it is possible to place the uses/users in rank order. It is generally the case that, after rank ordering of the uses/users, they appear to fall into groups as opposed to a continuous distribution. The uses/users can then be identified in groups as the highest ranking, intermediate ranking and lowest ranking. It is these groupings which are of interest; especially the highest ranking group.

The ranking process, when carried out in this fachion, is not sufficiently discriminating to indicate a positive ranking of uses/users in a first, second, third, etc., order. If more discrimination is desired among the uses/users which are in each of the classes of ranking, it is possible to develop an additional set of ranking criteria and then, again, rank the uses/users among which it is desired to discriminate.

Specific NUD Adaptation and Application of the Screening and Ranking Methodology. In this section a screening and ranking methodology, as described in general in the foregoing section of this report, is made specific to the NUD program and applied in a trial application to the situation.

The following definitions and assumptions have been made in the development and trial application of this screening and ranking methodology:

(1) The greatest potential return is interpreted to mean the maximum in flow of non-NASA, non-DoD money to NASA for use of the STS system as a result of the NUD program.

(2) It is assumed that the NUD program will have a limited budget for its activities and thus will be forced to be selective in terms of which and how many potential new uses/users with which it will be able to work.

(3) The potential use areas which have already been identified and demonstrated as feasible use areas (e.g., space communications) are chosen for the trial application because they are considered to be of the greatest potential for providing the desired cash in-flow to NASA within:

   (a) A limited NUD program budget

   (b) A near-term time frame from 1980 to 1985 and possibly 1990.

   It is recognized that, in the long term, these identified demonstrated use areas may not be the ones which ultimately provide the greatest source of STS use, but in the shorter term they are expected to provide the most significant and readily obtained volumes of STS use and cash in flow. In part, this is due to the length of time necessary to perform R&D and then translate the results into use of the STS.

(4) The term "commercial users", as used in this context, includes all types and classes of non-government users.

Structure of the Methodology. The structure of the specific methodology developed for the identification of commercial and governmental users has the capability of being used to handle the identification problem from both the uses and the users approaches. An overview of the methodological approach is shown in Figure 2. Product related use refers to a STS use resulting in a physical product; as an example, resulting from space processing. Non-product related use refers to a use resulting in informational material (e.g., remote sensing, space communications).

Figure 3 shows all the steps involved in the application of the methodology for NUD identification for all of the approaches. This methodology provides the ability to handle the identification problem from either the users or uses approach.

The Uses Approach - The uses approach first screens in non-NASA/non-DoD potential use areas. These potential use areas are then separated into those which have been demonstrated, tried, or had R&D conducted on them and those which have not been demonstrated.

The major use areas which have been demonstrated (e.g., space communications) are first screened by a series of criteria, with each use area being scored as passing or failing each of the criteria. Those use areas passing all of the screening criteria are then ranked using the weighted ranking criteria.

The highest ranking use areas are then selected for further application of the methodology. The next step is to screen and rank the use subareas; again selecting, within each of the use areas, the highest ranking subareas. After identification of the highest ranking subareas a list of possible users interested in and/or experienced in the technology or technological application of each of the subareas is compiled.

This list of possible users is screened and then ranked using either the criteria for commercial or government entities. Thus, the result is the identification of those commercial and government entities having the greatest potential of purchasing STS services within the demonstrated use areas and their respective subareas which have been selected as having the greatest potential for user development.

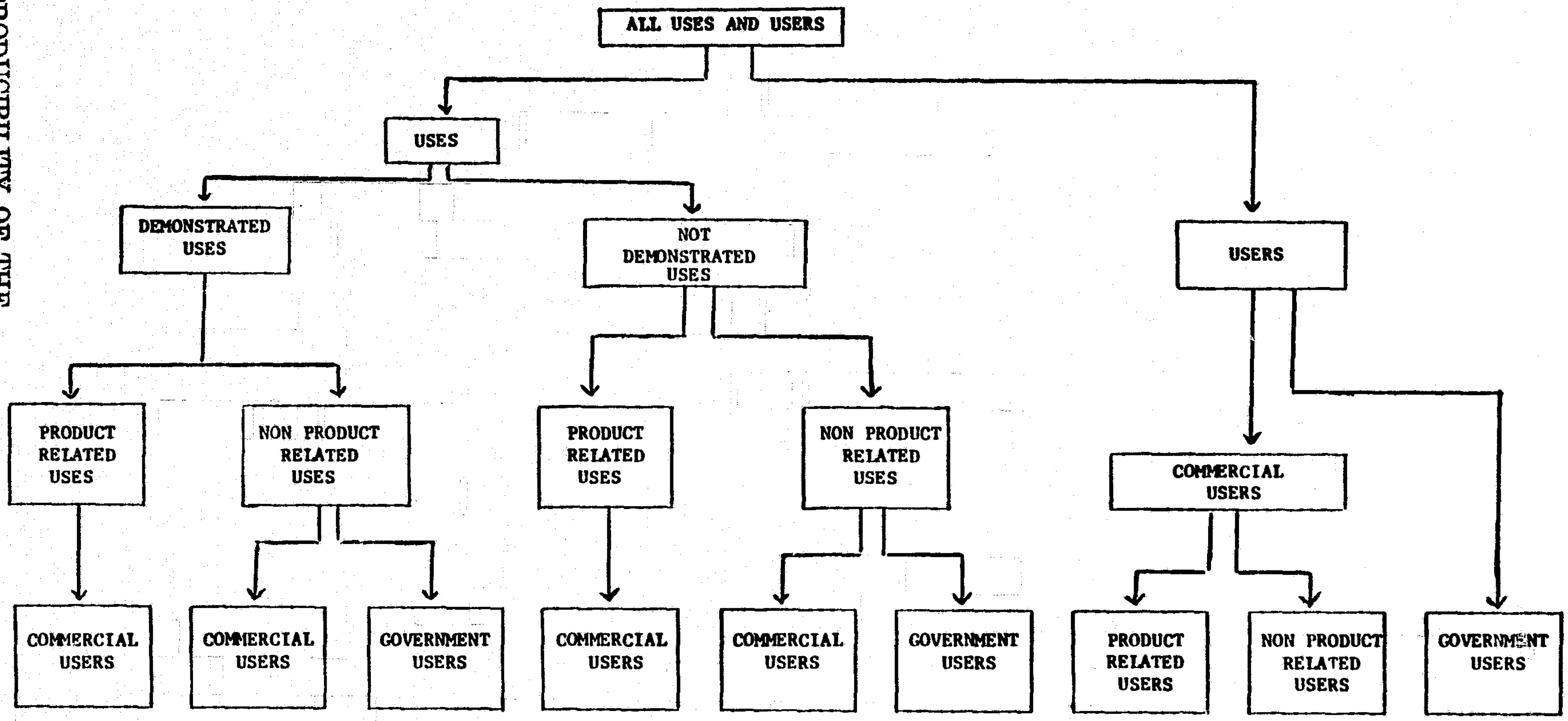
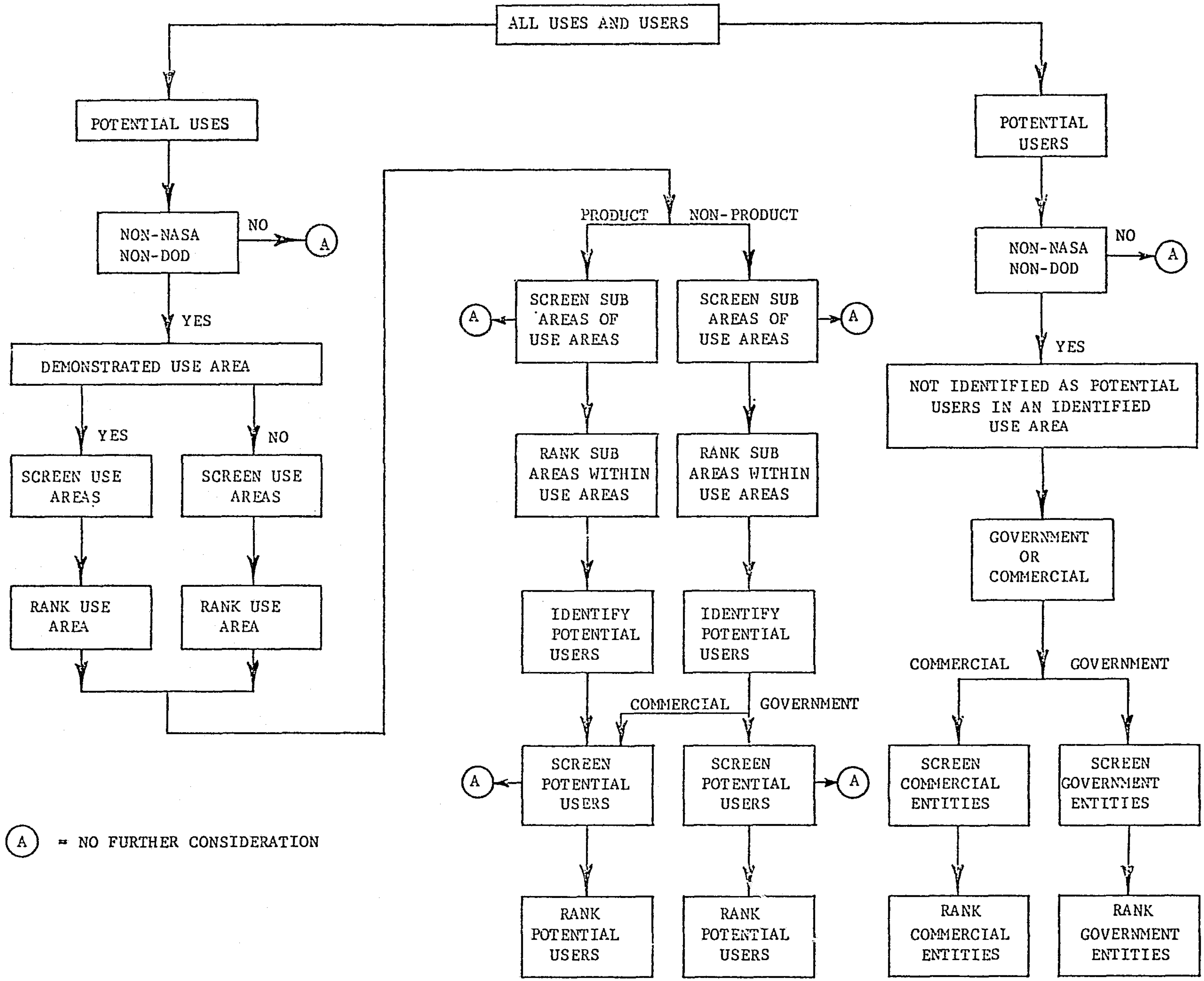


FIGURE 2. METHODOLOGICAL APPROACH TO USE AND USER IDENTIFICATION



ALL USES AND USERS
POTENTIAL USES
NON-NASA NON-DOD
NO
A
YES
DEMONSTRATED USE AREA
YES
NO
SCREEN USE AREAS
SCREEN USE AREAS
RANK USE AREA
RANK USE AREA
PRODUCT
NON-PRODUCT
SCREEN SUB AREAS OF USE AREAS
SCREEN SUB AREAS OF USE AREAS
RANK SUB AREAS WITHIN USE AREAS
RANK SUB AREAS WITHIN USE AREAS
IDENTIFY POTENTIAL USERS
IDENTIFY POTENTIAL USERS
COMMERCIAL
GOVERNMENT
SCREEN POTENTIAL USERS
SCREEN POTENTIAL USERS
RANK POTENTIAL USERS
RANK POTENTIAL USERS
POTENTIAL USERS
NON-NASA NON-DOD
NO
YES
NOT IDENTIFIED AS POTENTIAL USERS IN AN IDENTIFIED USE AREA
GOVERNMENT OR COMMERCIAL
COMMERCIAL
GOVERNMENT
SCREEN COMMERCIAL ENTITIES
SCREEN GOVERNMENT ENTITIES
RANK COMMERCIAL ENTITIES
RANK GOVERNMENT ENTITIES
A = NO FURTHER CONSIDERATION

Also within the uses approach is another portion of the methodology for handling use areas which have not yet been demonstrated (e.g., biological processing). This element of methodology directly parallels that for identification in the demonstrated uses area using the same screening and ranking steps but employing different sets of criteria at the several steps.

The Users Approach - The users approach to identification of potential STS users is considered less likely to be as cost- and effort-effective as the uses approach. However, it is via this approach, which will identify commercial and government entities having a high number of the characteristics of potential users, that as yet unidentified use areas and uses most likely will be identified.

The first step in the users identification process is to eliminate all NASA and DoD users and then to identify those potential users which have not been previously associated as potential users in an STS use area.

The next step is to divide the potential users into the commercial and government categories. The government entities are then screened and ranked in a manner analogous to that used for such purposes in the use areas methodology. The commercial entities are first divided into two categories, depending upon whether or not they have product related or non-product related interests. It is possible that some diversified companies might appear in both categories. These lists are then screened and ranked in a manner similar to that previously described, but using the specific criteria for these categories.

Trial Application of the Methodology. In this trial applications, the methodology is applied to the demonstrated use areas and no further treatment of the non-demonstrated use areas and the users approach is carried out.

The demonstrated potential use areas and their respective subareas are listed in Table 2. These use areas were first screened using the screening criteria for use areas (Table 3) and then ranked using the ranking criteria for use areas (Table 3). The three highest ranking potential use areas were then chosen for use in the subsequent parts of the trial application of this methodology.

The subareas of these three highest ranking use areas were then screened using either the product related subarea screening criteria (Table 4) or the non-product related subarea screening criteria (Table 5). Following the screening, the subareas remaining (those passing the screening criteria) were ranked using the ranking criteria in Tables 4 and 5 for the product related and non-product related subareas, respectively.

Table 6 contains the highest ranking subareas. For three of these subareas a list of government and business entities which are involved in or interested in each of the subareas was compiled. Sources for the list of entities include such references as the Dun & Bradstreet Million Dollar Directory, News Front Magazine's 30,000 Leading Corporations, etc. As an example, for the category "Electronic Components", SIC* Code 367, over 116 companies are listed. The complete lists are not detailed in this report. These lists of entities were screened and then ranked using the criteria in Tables 7 and 8 for industrial and government entities, respectively.

Table 9 contains the lists of the government and business entities having the greatest potential for new user development as identified in this trial application of the NUD screening and ranking methodology.

The two other parts of the methodology were not put through trial applications. The first of these is the element for screening and ranking of use areas which at the present time have not been demonstrated, tried in space or had R&D conducted on them. Table 10 contains the screening and ranking criteria for these non-demonstrated use areas. The second element not put through a trial application is that of the users approach where there are no identified use areas. Table 11 contains the screening and ranking criteria for identifying potential commercial users in non-identified use areas which may be either product related or non-product related. Table 12 contains the screening and ranking criteria for identifying potential government users in non-identified use areas.

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* SIC Code - OMB's designation of Standard Industrial Classification of a commercial operation.

TABLE 2. POTENTIAL USE AREAS AND SUBAREAS (ADAPTED FROM STS POTENTIAL USE/USER SUMMARY, TABLE 1)

Earth Observations

Weather and Climate

1 - Hazardous Weather Warning

2 - Long-Range Weather and Climate Prediction

3 - Weather and Climate Modification

Oceanography

1 - Forecasting of Wind, Waves, Ice and Storm Hazards

2 - Air and Water Temperatures

3 - Plant/Fish Distribution

4 - Management of Near Shore Zone

5 - Current Measurement

Earth Resources

1 - Land Use Planning

2 - Agriculture/Forestry Monitoring

3 - Fishery Monitoring

4 - Oil/Mineral Surveys

5 - Geological/Hydrological Surveys

6 - Gravity Monitoring

7 - Geothermal Mapping

8 - Earthquake Prediction

9 - Extractive Industry Monitoring

10 - Water Resource Management

Environmental Quality

1 - Air Pollution and Sources

2 - Water Pollution/Sedimentation

3 - Monitoring Land Fills

4 - Monitoring Strip Mines

TABLE 2. (Continued)

Communications/Navigation

Communication

1 - Telephone Communication

2 - Facsimile Communication

3 - Data Transmission

4 - TV Transmission

Navigation

1 - Position Location

Space Processing

Biological Materials

1 - Blood Components Separation

2 - Cell Growth

3 - Vaccines, Serums

Electronic Materials

1 - Crystals from Solution or Melt

2 - Magnetic Bubble Material

Metallurgical Products

1 - Purer Metal Crystals

2 - Homogeneous, Purer Metals and Alloys

3 - Superconductors

4 - Highly Ductile Tungsten

Glass/Ceramics

1 - New Types of Glass

2 - Improved Purity

3 - Optical Fibers

TABLE 2. (Continued)

<u>Space Technology</u>
1 - Advanced Technology Labs
2 - Long Duration Exposure Facility
3 - Space Technology Experiments
• Physics and Chemistry
• Atmospheric
• Entry Technology
• Contamination
• Engineering Technology
<u>Space Science</u>
1 - Atmospheric and Space Physics
2 - Optical Astronomy
3 - IR Astronomy
4 - High Energy Atmospherics
5 - Solar Physics
6 - Planetary Exploration
7 - Life Sciences

TABLE 3. SCREENING AND RANKING CRITERIA FOR USE AREAS

Screening Criteria	Pass	Fail
Identifiable Market	Yes	No
Timing for the Market Too Long or Short	1980 to 1990	< 1980, > 1990
Identifiable Need	Yes	No
Identifiable Technical Approach or R & D	Yes	No

Ranking Criteria

Weight Factor	Criteria	Value of the Fit 3	2	1
1	Level of Technological Readiness	High	Med	Low
2	Benefit/Cost Ratio	High	Med	Low
1	Level of Government and Public Support	High	Med	Low
2	Level of Demonstrated Use	High	Med	Low
2	Can be done on Earth	No	--	Yes
1	Magnitude of Investment Necessary	Low	Med	High
2	Number of Flights	High	Med	Low
3	Dependence on STS	Only Launch Vehicle	--	Other Vehicles Available

TABLE 4. SCREENING AND RANKING CRITERIA FOR PRODUCT RELATED SUBAREA

Screening Criteria	Pass	Fail
Identifiable Market	Yes	No
Market Timing Too Long or Short	1980 to 1990	< 1980, > 1990
Identifiable Need	Yes	No
Market Size Too Small (Flights/Yr.)	2 to 11	<1
Use of STS (Flights/Yr.) significantly exceeds planned capability	No	Yes

Ranking Criteria

Weight Factor	Criteria	Value of the Fit 3	2	1
2	Value Added	High	Med	Low
1	Process has Small Equipment	Yes	--	No
2	Process or R & D Identifiable	Process	R & D	Neither
1	Level of Process Automation	High	Med	Low
1	Industry Accustomed to High Quality Control	Yes	--	No
2	Product Critical to Development of New Technology	Yes	--	No
1	Magnitude of Effort Needed to Bring to Production	Small	Med	Large
1	Level of Technological Sophistication in the Industry	High	Med	Low
2	Number of Flights (Total)	High	Med	Low
2	Benefit/Cost Ratio	High	Med	Low
3	Dependence on STS	Only Launch Vehicle	--	Other Vehicles Available

TABLE 5. SCREENING AND RANKING CRITERIA FOR NON-PRODUCT RELATED SUBAREA

Screening Criteria

	Pass	Fail
Identifiable Market	Yes	No
Market Timing Too Long or Short	1980 to 1990	<1980, >1990
Identifiable Need	Yes	No
Technology is Identifiable	Yes	No

Ranking Criteria

Weight Factor	Criteria	Value of the Fit 3	2	1
2	Benefit/Cost Ratio	High	Med	Low
1.1	Geographical Diversity	Global	Continental	Local
2	State of Technological Readiness	High	Med	Low
1	Support of U. S. Congress	High	Med	Low
2	Known Use and Market	Yes	Use or Market	No
1	Magnitude of Investment Needed to Bring to Use	Small	Med	Large
2	Number of Flights (Total)	High	Med	Low
3	Dependence on STS	Only Launch Vehicle	--	Other Vehicles Available

TABLE 6. HIGHEST RANKING USE AREAS AND SUBAREAS

Communications
- Telephone Communications
- Data Transmission

Earth Resources
- Agriculture and Forestry Monitoring
- Oil and Mineral Surveys
- Extractive Industry Surveys

Weather and Climate
- Hazardous Weather Warning

Biological Materials
- Blood Components Separation

Electronic Materials
- Crystal Production

TABLE 7. SCREENING AND RANKING CRITERIA FOR PRODUCT RELATED AND NON-PRODUCT RELATED POTENTIAL COMMERCIAL USERS

Screening and Criteria

	Pass	Fail
Company Does Basic R & D	Yes	No
Financially Sound Company (Can Afford the Risk)	Yes	No
High R & D Budget	Yes	No

Ranking Criteria

Weight Factor	Criteria	Value of the Fit 3	2	1
1	Profit/Sales Ratio (Compared to the Industry)	High	Med	Low
2	Leadership in Technology	High	Med	Low
2	Perceived Level of Competence of the R & D Staff	High	Med	Low
1	Orientation Toward Growth	High	Med	Low
3	Orientation Toward Risk	High	Med	Low
1	R & D as a Percent of Sales	High	Med	Low

TABLE 8. SCREENING AND RANKING CRITERIA FOR NON-PRODUCT RELATED POTENTIAL GOVERNMENT USERS

Screening Criteria	Pass	Fail
Has Sufficient Budget	Yes	No
Has Responsibility in Subarea Identified	Yes	No

Ranking Criteria

Weight Factor	Criteria	Value of the Fit 3	2	1
2	Level of Expressed Interest in The Application	High	Med	Low
1	Budget Magnitude and Flexibility	High	Med	Low
2	Management Capability	Excellent	Good	Fair
1	Technical Capability	Excellent	Good	Fair
1	Geographic Diversity of Interest	Global	Continental	Local
2	Level of Use of Hardware Systems Versus Paper Only	High	Med	Low
3	Level of New/Innovative Ideas Adopted	High	Med	Low

TABLE 9. COMMERCIAL AND GOVERNMENT ENTITIES IN SELECTED SUBAREAS

Weather and Climate

Disaster Weather Warning

National Oceanic and Atmospheric Administration
U.S. Department of Agriculture; Assistant Secretary for Conservation, Research and Education
CPC International
General Foods
Sunkist Growers
Campbell Soup Company
Quaker Oats

Oil and Mineral Extractive Industries

Federal Energy Administration
Department of Interior - Bureau of Mines
Energy Research and Development Administration
Exxon
Texaco
Mobil Oil
Standard Oil of California
Gulf Oil
Anaconda
Kennecott
St. Joe Minerals
AMAX
American Cyanamid
Union Carbide

Electronic Materials

General Electric
International Business Machines
Litton Industries
RCA
Sperry Rand
Texas Instruments
Monsanto
Corning Glass
Fairchild Camera
Raytheon

TABLE 9. (Continued)

Agriculture and Forestry
Dept. of Agriculture-Assistant Secretary for Conservation, Research and Education
Dept. of Interior-Assistant Secretary for Land and Water Resources
Weyerhaeuser Co.
International Paper
Boise-Cascade
Georgia Pacific
Diamond International
U.S. Gypsum Corp.
Gulf and Western Foods
Quaker Oats
Campbell Soup Co.
General Foods
National Council of Farmer Cooperatives
Biological Products
National Institutes of Health
Eli Lilly
Merck, Sharp & Dohme Research Laboratories
Miles Laboratories
Upjohn
Squibb
Warner Lambert (Parke-Davis)
G. D. Searle
American Home Products
Schering-Plough
Pfizer

TABLE 10. SCREENING AND RANKING CRITERIA FOR NON-DEMONSTRATED USE AREAS

Screening Criteria	Areas	Pass	Fail
Identifiable Need or Benefit to Mankind		Yes	No
Identifiable Market		Yes	No
Market Timing Too Long or Short		1980 to 1990	<1980, >1990
Technical Approach or R&D Identifiable		Yes	No

Ranking Criteria

Weight Factor	Criteria	Value of the Fit 3	2	1
2	Value Added	High	Medium	Low
1	Legal Problems	No	--	Yes
3	Can be done On Earth	No	--	Yes
2	Level of Technological Readiness	High	Medium	Low
2	Magnitude of Effort Needed To Bring it to Fruition	Low	Medium	High
2	Continuing (Long-Term) Need	Yes	--	No
1	Benefit/Cost Ratio	High	Medium	Low

TABLE 11. SCREENING AND RANKING CRITERIA FOR PRODUCT AND NON-PRODUCT RELATED POTENTIAL COMMERCIAL USERS IN NON-IDENTIFIED USE AREAS

Screening Criteria	Pass	Fail
Over Minimum Size in Sales or Assets	Yes	No
Over Minimum R & D Budget	Yes	No
Financially Sound	Yes	No
Highly Capable Management (perceived)	Yes	No

Ranking Criteria

Weight Factor	Criteria	Value of the Fit 3	2	1
2	Degree of Business Diversification	High	Med	Low
1	Degree of Centralization of Management Structure	Centralized	Mixed	Decentralized
3	Size of R & D Budget (Millions)	>$100	$50 to $100	<$50
2	Leadership in Image	High	Med	Low
2	Leadership in Technology	High	Med	Low
1	Profit/Sales Ratio	High	Med	Low
2	Orientation Toward Risk	High	Med	Low
1	Orientation Toward Growth	High	Med	Low
2	Competence of R & D Staff	High	Med	Low
2	Basic R & D Being Conducted	Yes	--	No
1	Public Relations Oriented	Yes	--	No
1	Geographic Diversity of Interest	Global	Continental	Local

TABLE 12. SCREENING AND RANKING CRITERIA FOR NON-PRODUCT RELATED POTENTIAL (GOVERNMENT) USERS IN NON-IDENTIFIED USE AREAS

Screening Criteria	Pass	Fail
Non-NASA, Non-DOD	Yes	No
Has Sufficient Budget	Yes	No

Ranking Criteria

Weight Factor	Criteria	Value of the Fit 3	2	1
1	Geographic Diversity of Interest	Global	National	Local
1	Level of Independence From Other Government Agencies	High	Med	Low
2	Management Capability	High	Med	Low
5	Does R & D	Extensive	Some	None
1	Volume of Information Handled	High	Med	Low
1	Deals with Remote Areas	Yes	Sometimes	No
3	Receptiveness to New/Innovative Ideas	High	Med	Low
1	Communications Need (volume, number of locations)	High	Med	Low

Analysis of the Results. The results obtained in the trial application of the screening and ranking methodology are what would be logically expected, especially in the identification of the greatest potential use areas and subareas. Further, the results obtained in identifying the potential users in selected use subareas are to have been reasonably expected. Following is a brief examination of the results obtained.

Table 6 lists the five STS use areas, and related subareas of use, which passed the screening process, resulting in their ranking as having the greatest potential. This indicates that all of the uses listed have essentially equal status as recommended areas for new user development. This ranking does not imply that all other use areas not listed have no potential. The ranking provides a relative indication of the most viable, most promising use areas which, on a priority basis, can be candidate use areas for further market research and new user development.

From a space transportation system operation standpoint, a major criteria for establishing a high potential use area is a projected high utilization (flights per year and/or high utilization of the STS services per mission) of the STS. Of equal importance, however, is the selection of a use area that has or will have long term technical and economic viability and meets an industrial or national need.

All of the five major use areas and the subareas shown in Table 6 have an identifiable market, i.e., it will fill a current or developing need in some user community. The space application involved is providing or will provide a definite, positive impact on the users. A favorable benefit to cost ratio is associated with each use area. Each use area has a high projected use of the STS for development and operations and continuing research.

Of the five major areas identified as of the greatest potential in Table 6, four of them relate to basic human needs of health, safety, interpersonal relations, and indirectly to shelter and food production. The fifth area, electronic crystals production, has become virtually indispensable in the way of life of industrialized nations, permeating all aspects of government, business, and personal life. In this way the fifth area is also directly related to basic human needs.

The timing for such uses of the STS is imminent; if not satisfied immediately, the needs will continue, with only the degree and method of satisfaction changing. Currently, these needs are being partially satisfied by Earth-based technology, but there is room for much improvement in the satisfaction level and reduction in the cost per person served. These applications for the STS system are estimated by others to provide such satisfaction improvement and lower cost per person.

In addition to the above criteria, each of the five areas, except electronic and biological materials, has a high level of demonstrated use in that space systems are currently in use. In the electronic and biological materials areas, flight demonstrations (Skylab, ASTP) have been conducted to indicate high potential. These five areas are areas in which a significant number of STS flights can be expected in the first 10 years of STS use, and they will present a long-term continuing market for STS use. Further, the technology necessary to carry out activities in these areas is sufficiently developed so that, if it has not currently been brought into application it could be by the time the STS is ready for use.

The subareas receiving the highest rankings within a use area have higher levels of technological readiness than the other subareas and have, at least, partially known markets. They also exhibit higher levels of dependence on the STS as being the only or better launch system. Taken all together, these subareas are those ready for implementation and having higher potential for producing significant cash inflows to NASA for the money and effort expended in a NUD function.

Several reasons can be given for the low ranking of certain use areas after the screening and ranking process. Some of the use areas did not have clear technical approaches to the R&D or applications. Some lower ratings resulted from the technology necessary for these applications not being as well developed as for other use areas. Further, some use areas have a lower benefit/cost ratio and the potential number of flights is comparatively low. Some low-ranking use areas are those which do not relate to basic human needs of health, safety, shelter or food.

The potential users identified in the trial application have the characteristics of having sufficient financial, managerial, and technical capability to undertake projects of the size and nature of these uses of space. Further, they are organizations which have demonstrated a willingness to undertake and successfully complete the implementation of new technology and bring forth new applications of products and services.

Thus, as a result of this trial application, it can be concluded that the screening and ranking methodology can be used to help direct the activities of a NUD function in order to more effectively utilize the resources of money and manpower so as to provide the greatest inflow of non-NASA money through better targeting the markets and customers (users).

Comments Regarding the Use of the Screening and Ranking Methodology. In the development and trial applications of the screening and ranking methodology for identification of potential uses and users for the STS, several items were identified as of significant importance to the successful application of this methodology. These items are:

(1) The individuals doing the screening and ranking must be very knowledgeable of the use area. They should have a broad knowledge of the STS capabilities, past experiments, and demonstrated uses of space. They should be aware of future uses being considered and have an understanding of the driving forces in the market place, including needs and their timing.

(2) The information being used must be up to date.

(3) The process is dependent upon having sufficient information on commercial potential users such as size, financial condition, R&D activities and size, managerial capability, etc.

(4) The process is dependent upon having sufficient knowledge of potential government users such as budget size, financial flexibility, managerial capability, willingness to undertake new ventures, etc.

(5) The methodology is dependent upon establishing and using the best criteria available for screening and ranking.

At the present state of development of the STS and the NUD function, the criteria developed for the methodology probably are adequate. The criteria used for both screening and ranking should be reviewed and updated when the NUD function is actually established and operating. It is expected that the number of criteria might increase and certainly the criteria should be made more specific. At the present time, most of the criteria are qualitative and judgmental. As experience is gained regarding uses, users, and the STS capabilities and use policies, quantitative criteria should be added or used to replace the current qualitative ones. This in turn will necessitate the development of data bases, especially regarding users.

Determination of Anticipated User Acceptance/Resistance

The implementation plan for the STS New User Development must consider the factors which may influence the acceptance or resistance a NUD representative may encounter in the process of developing the STS new user communities. An effective implementation plan must develop strategy to eliminate or minimize the factors contributing to user resistance and, conversely, exploit the known factors which may contribute to acceptance. The purpose of this subtask was to develop and present an overview of the acceptance/resistance factors as a general environment in which the STS new users will be developed.

It was recognized that barriers to interaction in marketing situations, representing potential factors of resistance to marketing activities, were identified in the NUD Phase I studies. The BCL study[20] provided a list of known market related barriers which tend to reduce the effectiveness of marketing operations. Approximately 40 percent of the barriers listed were regarded as applicable barriers or factors of resistance to be encountered by NASA, or a NASA representative, in developing the STS non-NASA user community. A discussion of each applicable barrier was included regarding the applicability to NASA and the STS situation. Those barriers listed are still considered valid. The study report noted that many of the barriers determined as not applicable to the NASA/STS case can be considered as factors contributing to acceptance. This is especially true of those listed as not applicable under the assumption that, with the proper use of lead time, NASA would be able to overcome the barrier.

User Categories. The Phase I NUD studies concluded that real barriers will exist in the development of the STS non-NASA/non-DoD user community which, individually or collectively, will represent various degrees of resistance by the potential user to the NUD representative. Full acceptance of the representative should not be anticipated, at least initially. The potential user community for STS use has the possibility of being very broad, but for the purpose of a general discussion of the factors contributing to or influencing anticipated resistance, the users can be grouped into three categories:

Category 1 - The group of user organizations who will be actively involved in space research/operations currently using expendable launch vehicles. This group will include organizations such as INTELSAT/COMSAT, NOAA, Global Satellite, Inc. (RCA), Western Union, and spacecraft manufacturers (Hughes, TRW, Aeronutronic-Ford, GE, RCA).

Category 2 - The group of users who are knowledgeable of space benefits and the current space programs and who will be on the verge of committing resources to a space program. DOMSAT user organizations (such as Satellite Business Services and American Satellite Corporation), future Earth resources consortiums, and future maritime or weather consortiums are included in this user category.

Category 3 - The group of potential users who have yet to participate significantly in space programs and who are relatively unknowledgeable of the benefits of space. Potential users in the space processing program characterize this user group.

The above user categories, simply stated, cover the spectrum of users from those in the space business, those on the verge of entering the space business, and those not in or knowledgeable of the space business. The identification of user organizations within each category will change with time as the STS becomes initially operational and evolves into a mature operation. In addition to the above user categories, it is recognized that certain factors of resistance can be uniquely associated with industry and with domestic government agencies/organizations.

Category 1 (The Space User). The users in this category represent various degrees of sophisticated space users who will view the STS as a potential means toward product/system improvement, system expansion or variations, and product/system derivatives. The resistance these users will present to the NUD representative will be in terms of their comparison or evaluation of the STS to their current space operations and space transportation system, i.e., the expendable launch vehicles. Their resistance or acceptance of the STS will be very dependent upon the competitiveness of the STS, not only as space transportation, but as a complete competitively structured launch service. Their sensitivity to STS user charge policy and terms and conditions of use will involve a direct comparison with those associated with their current space launch operations. Advertised performance and system flexibility benefits to be provided by the STS will be evaluated or resisted in terms of the benefits/costs. These users will be very sensitive to expendable vehicle-to-STS transition planning, availability of the STS, demonstrated reliability, implications of committing to STS and the availability of alternate (and competitive) launch systems. The users who are fully committed to space programs understand the space technology applications and appreciate the cost/benefits of the space operations to comparable terrestrial systems. Their resistance or acceptance to STS will be in terms of the impact (near-term or long-term) on profits. The NUD representative will meet a very sophisticated and opinionated group of users in this category who will have significant experience in operating a space business as a direct comparison to what STS may offer. Some will have specific issues or concerns which are based upon less than satisfactory previous experience with NASA. They will be looking for a realistic prepayment plan and cost monitoring techniques for the STS to eliminate problems they experienced with the expendable launch vehicle programs. In many cases, their expendable vehicle experience will be a major factor in their acceptance attitude.

Category 2 (The About-to-be Space User). These users can be considered as very knowledgeable of the applicable space technologies and space programs, but will be still evaluating the cost/benefit of committing to a space system in comparison to a terrestrial system. Inherently, they will present much of the same resistance to STS as users in Category 1, but will view STS and its cost as part of a total front end investment in a large complex space venture. They will be in a position to accept STS as a major fixed (hopefully) price element for their consideration in the economic assessment of their comtemplated venture. In view of this, the resistance or acceptance to the NUD representative will be dependent on his ability to effectively describe how the user can use the STS (user charge, terms and conditions of use, schedules, user interface with NASA/STS, etc.) as a basis for a venture assessment.

Category 3 (The Unknowledgeable, Yet-to-be Space User). This group of users will include those organizations which have had little prior interest or involvement with the space program and, therefore, conceivably must be educated as to the benefits of space and the application of the STS. Initial resistance to the NUD representative may be in terms of misunderstanding or lack of understanding of space/STS. Subsequent resistance can be measured by their ability to comprehend and to relate the benefits to their needs, problems, operation, and organization. The resistance of the potential users in space processing may also be dependent upon an evolving, perhaps yet to be fully flight demonstrated, technology. Acceptance may be high if a process under zero-g conditions will produce results not possible on Earth or will represent a significant improvement on a product's characteristics (purity, homogeneity, immiscibility, electrical and magnetic properties). In this case, further acceptance will depend upon the economic assessment of the projected market, cost of R&D, cost per flight, cost of the total (Earth and space) processing, and facility and resource investments. The expected resistance to the long-term availability of STS (earliest will be 1983) can be minimized by identifying early program means of early research involvement, such as the space processing sounding rocket program. Some indication of NASA initial funding, as a cost of marketing, may be needed to encourage interest of some users who typically do applied research as compared to fundamental research.

User Communities. In addition to the resistance/acceptance associated with users who are involved to various degrees in space programs, unique factors of resistance can be associated with the industry sector and with non-NASA/non-DoD domestic government agencies.

Industry. One of the major areas of resistance to a NUD representative interacting with industry can be associated with the basic difference in objectives between industry and government (NASA in this case). While NASA strives to serve the best interests of the public, industry must serve the best interest of the stockholder. This represents an emphasis on technical, as opposed to economic, considerations. Industry will, therefore, be very sensitive to the economics of space involvement and the STS application and terms and conditions of use. STS policy on proprietary rights, confidentiality of research/information, allocation of risks/liability, and assurance of access to STS services will have a significant influence on resistance/acceptance. The sensitivity of the industry user to STS terms and conditions and their projected response (resistance or acceptance) has been previously discussed in detail in a Battelle memorandum(16) prepared for the STS User Charge Policy Working Group (NASA/JSC).

Also, industry over the years has developed an inherent mistrust and resistance to business involvement with the government. Some of the mistrust is unfair and not based on real situations, but on the other hand the image of government red tape, control policies, budget constraints, etc. contribute to industry resistance. Just the complexity of dealing with a complex operation, such as STS, will be resisted by industry. Regulations and anti-trust policies on the pharmaceutical industry have alienated that industry relative to working with another government agency (NASA).

Domestic Government Agencies. Must of the resistance anticipated with industry, which is based upon dealing with any government agency, will not be experienced in NUD contacts with non-NASA/non-DoD government agencies. Other government agencies are appreciative of governmental control and business policies, objectives, etc. The Phase I NUD study conducted by SRI(21) indicates that other government agencies will resist a NASA approach that doesn't leave the direction and responsibility for the overall problem solving program with the potential user agency. Interagency feelings on charter responsibilities, budget allocations, prestige and Congressional backing, etc., represent barriers to developing the STS user to other government agencies. Resistance to dealing with NASA may be influenced (more <u>or</u> less) by agencies which have had previous program involvement with NASA. Sensitivities to STS launch costs and charge policy will be just as real (considering budget constraints) as commercial users' concerns considering profit incentives.

<u>Competitiveness of the STS</u>. A significant factor in the resistance/acceptance of the potential user to a NUD representative will be his awareness and assessment of the competitiveness of the STS. This competitiveness assessment will be of primary concern to the sophisticated space user who must compare STS to current expendable space transportation systems and will ultimately be of concern to the "yet to use space" user. The STS is being developed as a new

capability in space transportation to provide routine, low-cost space operations. With its versatility and reusability features, it is intended as a replacement for the existing expendable launch vehicles at an anticipated equal or lower cost per launch. The STS will have operational benefits, such as on-orbit payload checkout and servicing and payload recovery and return to Earth. Additionally, payload design benefits are anticipated through a relaxtion of constraints on payload mass and volume and the ability to service and update payloads in orbit. While all of these cost and operational advantages of the STS may evolve as the STS develops into a mature, routine space transportation system, it can be assumed that the benefits will not fully exist in the early years of operation. This will impact the competitiveness of the STS from the potential user's viewpoint and will affect the user's acceptance of the NUD representative.

A recent Battelle report[17] has addressed the question of what the projected competition to the STS may be and the conditions under which it might exist. In addition, the report assesses several characteristics or features of the STS and its operation which will be considered in an evaluation, by a user, of its competitiveness. Major inputs to the analysis were the results of several contacts with current space users (INTELSAT, GE, RCA, Hughes, Aeronutronic-Ford, and Telesat-Canada) and their views on the projected competitiveness of the STS. These contacts can be considered as a preliminary indication of the resistance a NUD representative can anticipate from the sophisticated space users (Category 1), at least in today's environment. Some of the significant findings and user responses are summarized in this report as applicable to anticipated resistance/acceptance.

Launch Vehicle Competition. By the time of the STS IOC (early 1980's), it is expected that NASA/STS will face potentially serious space transportation system competition, primarily from European and Japanese launch vehicles. The French ARIANE performance is now being developed to equal or exceed that of the Atlas/Centaur. The Japanese plan to upgrade their N vehicle to be competitive (performancewise) to the Delta 3914. Additionally, launch vehicle competition from the Soviet Union and U.S. commercial organizations may also develop. The Soviets have flown French and Indian cooperative payloads. Some of the space user organizations contacted by Battelle have indicated that the Soviets have been contacted as to reimbursable launch possibilities. Boeing's utilization of Minuteman technology is the primary example of a U.S. commercial venture into a commercial launch service. The potential non-NASA/non-DoD payloads (both domestic and foreign) are considered to be susceptible to capture by this competition. This launch vehicle competition may be somewhat compromised by lack of demonstrated reliability, availability, constraints on launch site access, and full launch operations, as compared to the ETR/WTR. The expected characteristics of the potentially competitive launch systems are summarized in Table 13.

Costs. All of the users contacted except one (Aeronutronic-Ford) indicated that cost was their most fundamental concern. This concern stems from three major sources. First, increases in launch vehicle costs and reductions in spacecraft costs have resulted in space transportation costs becoming an increasingly larger percentage of overall program costs. Second, launch vehicle costs are of concern because they are the largest single cost item that is beyond the control of the users. Users are able to exercise reasonable control over spacecraft costs through design, innovation, learning, etc.; but, at present, they must pay the going price for launch vehicles from a single supplier. Third, launch vehicle costs are of concern because they increase the head-end costs of establishing new space systems. Space systems (e.g., communications) have the characteristics of requiring significant initial investments before they become operational. The magnitude of these initial costs affects the salability or potential profitability of proposed new systems; hence, an additional source of concern over launch vehicle costs.

Fixed Price. One comment made by virtually all of the users contacted with direct experience in using NASA's space transportation services is the desirability of a fixed price for launch services. The basis of this comment is the difficulty of doing their own planning and pricing when the final cost of the launch is not known in advance. This concern has been aggravated by recent events in which NASA, under pressure from the GAO, has had to go back to some of its users to collect additional charges for previous launches, some of which had occurred several years previously (in one particular case, the launch was a failure). Additionally, one contractor, based on their space communication launch program experience, was very emphatic about the need for a realistic prepayment plan and adequate financial management/cost accounting by NASA for the STS.

TABLE 13. LAUNCH SYSTEMS POTENTIALLY COMPETITIVE WITH STS

NAME	OPERATIONAL DATE	CAPABILITY		ESTIMATED PRICE (CIRCA 1980)	COMMENTS
		SHROUD DIA. (FT)	GEOSYNCHRONOUS PAYLOAD (KG)		
ARIANE	1980 - 81	10	900 (Kourou launch)	\$15M - \$30M	SEVERAL U.S. SPACECRAFT MANUFACTURERS CLOSELY FOLLOWING PROGRAM.
JAPANESE N N - 2 O	1975 1982 1985	8 8 8	130 330 450 (all for Tanega Island launch)	(\$10M --\$15M)	LIKELY TO REMAIN A NATIONAL PROGRAM FOR SEVERAL YEARS. U.S. SUPPORT FOR UPGRADING QUESTIONABLE. O WOULD HAVE TWICE PL CAPABILITY OF N.
VOSTOCK	Now		600 (Tyuratam launch)	(\$15M - \$30M)	SOVIETS HAVE INDICATED A WILLINGNESS TO AT LEAST CONSIDER LAUNCHING OUTSIDE USER SPACECRAFT.
ATLAS/CENTAUR	Now	10	900 (ETR launch)	\$30M	SPECIFIED VEHICLE FOR INTELSAT V and FLEETSATCOM.
BOEING LV	1978	4.3	135 (Kourou launch)	\$6M	MARKET VERY UNCERTAIN - VEHICLE IS BASED ON MINUTEMAN, PERFORMANCE IS APPROXIMATELY EQUIVALENT TO JAPANESE N - MAY BE TOO SMALL.
DELTA 3914 (NASA Launched)	Dec.1975	8	450 (ETR launch)	\$15M	U.S. SPACECRAFT MANUFACTURERS DESIRE TO USE. COULD EXIST INTO 1980's.
SCOUT	Now	3.2	25 (for San Marco launch)	\$5M	SCOUT MAY BE RETAINED AFTER STS IOC, PARTICULARLY TO MEET COMMITMENT TO ITALIANS AT SAN MARCO.
ATLAS E/F	Now	8	NO GEOSYNCHRONOUS CAPABILITY WITHOUT UPPER STAGE	\$4 - \$5M	AT CURRENT LAUNCH RATE WILL BE EXHAUSTED IN EARLY 80's. SPECIFIED VEHICLE FOR TIROS-N AND FOLLOW-ON ITOS MISSIONS.
OTHER COMMERCIAL LAUNCH VEHICLES	?	DELTA OR ATLAS/CENTAUR CLASS			IDEA HAS BEEN STUDIED BEFORE - MANUFACTURERS RELUCTANT - LOW RETURN, HIGH RISK.
TITAN AGENA	Now	10'	750 (ETR launch)	\$20M - \$30M	AF ATTITUDE UNCERTAIN. DSARC SHOULD HELP CLARIFY.
TITAN III C	Now	10'	1300 (ETR launch)	\$30M - \$60M	

Third-Party Liability. Third-party liability refers to liability for damages incurred by a third party during a NASA launch of a spacecraft for a non-NASA/non-DoD user. For most of the period in which NASA has conducted outside NASA user launches, the third-party liability was assumed by NASA as the operating agency during the launch. Recently, however, a decision was made that the outside users would be made to bear this liability as a part of their contract with NASA. This decision has been resented by the users, who feel that they are being held liable for a process over which they have little or no control. It seems certain that the assumption of the third-party liability by NASA would increase the competitveness of the STS. There is no current indicatation of what the European and Japanese attitudes regarding third-party liability will be but, if their programs become as actively competitive as expected, then it would be anticipated that they would be willing to assume this risk to increase their competitive position.

Reliability. Launch vehicle reliability is an obvious concern of users since it influences the number of spares and backup launches they must procure. Although there seems to be a general satisfaction with the current state of vehicle reliability (e.g., INTELSAT feels that its policy of buying four spacecraft and launches to be sure of getting three spacecraft in orbit is workable and acceptable), there is little doubt that increased reliability would be desired, provided that the cost was not too high. Thus, it can be expected that, eventually, users will find the expected high Shuttle reliability to be a definite advantage and will probably change some of their spares policy to reflect it. The key word here, however, is eventually. At the present, Shuttle reliability is an estimated quantity, and spacecraft designers and space system planners, who for very good reasons are conservative in their approaches, are not likely to change their methods of operation until they feel that the expected Shuttle reliability has been demonstrated.

One other aspect regarding reliability has become clear; to a number of users, reliability is more than a matter of launch success or failure--it also includes the ability of the launch vehicle system to provide its services when needed. In fact, it is timeliness of launch availability that is the area of greatest apparent user concern regarding Shuttle reliability. This is particularly true for communications satellite systems, where a loss of service means a loss of revenue, and where the ability to schedule replacement launches is of importance. The users' concern regarding the Shuttle takes two forms: concern that they will not be able to get the proper scheduling priority to meet their schedules without paying for a dedicated Shuttle launch and concern over the possible effects of a Shuttle accident. One potential user, in particular, asked, "What if the Shuttle has an accident like the Apollo fire and the Shuttle fleet is grounded for an extensive period--say, perhaps, a year--while extensive investigations are conducted and subsequent design changes required to return it to a man-rated condition are made? Will there be a backup available, or will I have to wait a year to get my spacecraft up?"

Guarantee/Insurance. Partially as a result of the guaranteed orbital placement concept of several years ago, commercial insurance covering the cost of the launch vehicle and spacecraft is now available to users. The rates for this insurance are quite reasonable (they appear to be close to the "fair game" price based on historical launch vehicle reliabilities), and most of the users seem quite satisfied with it. The only contrary indication was from Telesat of Canada, who indicated that the commercial insurers "do not understand the business", and that they would prefer that the launch vehicle agency provide the insurance.

The availability of commercial insurance for the entire vehicle plus payload eliminates the attractiveness of the original guaranteed orbital placement concept (replacement launch(es) provided without cost to user). A more comprehensive and reasonable guarantee could be offered by the STS because of its payload return capability. The inability to return the spacecraft was the major weakness of the previous guarantee policy proposals. The actual return of the payload, rather than the refunding of its cost, could be of much greater value to the users. However, at least during the intial years when the IUS is in use, the ability to return payloads will be limited to the orbiter. Thus, for geosynchronous or Sun-synchronous/polar orbits, the two largest classes of outside user missions, the payload return capability will be limited to cases where spacecraft or Shuttle malfunctions occur during the boost to low Earth orbit only. This type of limited return capability will not likely give the STS a major competitive edge over insured expendable launches.

On-Orbit Servicing/Spacecraft Retrieval and Return. The situation regarding spacecraft on-orbit servicing is similar to that regarding STS reliability; it is a potential major competitive advantage for the STS, but is undemonstrated at present and so is not being incorporated in most current outside user plans. Almost all of the outside users contacted had examined the possibility of on-orbit servicing, but did not consider that it would be widely incorporated, at least during the 1980s. Among outside users, the Canadians and COMSAT seem to have given the concept the most thorough examination. The STS's potential capability for spacecraft recovery and return for refurbishment (as contrasted to return during launch due to a spacecraft or STS failure) seems to have little competitive appeal. The users interviewed all seemed to feel that demonstrated current spacecraft reliability (on-orbit lifetimes are now approaching seven years and may, eventually, reach ten years) was quite satisfactory and that return of a seven or ten-year-old spacecraft, based on antiquated technology, would not be particularly useful. On-orbit servicing to guarantee a specific lifetime (e.g., by replacement of failed subsystems or depleted expendables) seemed to be a much more reasonable option. The major factors governing its acceptability are the feasibility of the concepts (requires actual on-orbit demonstrations, such as through the GSFC standardized spacecraft program), the cost of designing for servicing and the cost of transporting and/or maintaining a service, particularly at geosynchronous orbit.

Available Payload Volume. One area in which the STS should have a definite competitive advantage is in the Shuttle payload bay size. The available payload volume and diameter of current and potential future competitive launch vehicles is limited and is a constraint on spacecraft design. For spin-stabilized spacecraft, the length-to-diameter ratio must be held below a specific limit or else the spacecraft is not stable in the spinning mode. The large diameter of the Shuttle bay will allow larger spin-stabilized spacecraft to be built. The only factor holding designers back from taking advantage of this capability is uncertainty as to when the Shuttle will be available and fully operational and what the price of using it will be. Once confidence in the Shuttle is established in the mind of spacecraft designers (this may be several years after the Shuttle IOC date), the bay diameter should be a strong plus for the Shuttle relative to competition, in a number of mission areas. A conflict or compromise exists with this apparent competitive advantage of STS, however, in that a user must consider multiple payload sharing to take advantage of reducing his launch cost. This could mean that the full payload volume of the STS cannot be taken advantage of. This is a factor for cost/design tradeoffs.

Payload Capacity. The large Shuttle payload capacity (65,000 lb maximum to low Earth orbit) has frequently been cited as a major competitive advantage for the STS. The rationale used is that this capacity, available at a reduced price, will free spacecraft designers from weight constraints on their designs, allowing considerable reduction in the cost of spacecraft. This rationale has even been incorporated into the mission and payload model, capture, and economic analyses being conducted at MSFC.

There is little indication, at this time, that the Shuttle payload capability is having any serious impact on spacecraft design or planning. The same problem is faced here as in the areas of Shuttle costs, reliability, etc., i.e., that these are all presently undemonstrated and, therefore, unlikely to strongly influence planning or design at this time.

The large Shuttle payload capability is, at present, probably considered more of a potential problem than a benefit by a number of outside users. The problem arises because the Shuttle payload capability is significantly (two, three, or more times) greater than that of the expendable vehicles the users are currently purchasing. If that full capability were available at the same price as the current vehicles, it would not be a problem but simply a side benefit which might be used to increase weight margins or, in some cases, to cut launch vehicle costs by launching multiple payloads. However, if the cost of a dedicated Shuttle launch is significantly greater than the price of the current vehicles (e.g., Delta or Atlas/Centaur), then multiple payloads must be used to keep the cost per payload at a competitive level. Multiple payloading, although reasonable for most effective transportation system utilization and, perhaps, necessary to offer attractive prices, does not confer any advantages on users. Instead, it presents them with a number of problems in the areas of control of schedule, interfaces, and risk. Therefore, the large Shuttle payload capability will not give the STS a competitive advantage with many users unless it can be managed so as to give them a reduced launch cost per payload without unreasonably complicating their design and operations aspects.

STS Service Arrangements. The comment offered by the Telesat representative that the space transportation supplier should be "easy to deal with" is representative of a general concern with the total services (preliminary planning, scheduling, data interactions, ground handling, payload integration) aspect of space transportation. This is one aspect of competitiveness that is frequently overlooked, and yet it is an area that can generate considerable user satisfaction or irritation and, at least in the preliminary planning aspects, is an area where good performance is achievable without an excessive investment in cost and effort. At present, for example, the outside users feel a strong need for preliminary, but reasonably comprehensive, information on the STS performance, design constraints and costs, and would be greatly encouraged to plan for STS use if NASA were more actively seeking their participation. At present, potential STS competitors, with the exception of the Boeing commercial launch vehicle group, are not exceptionally active either; however, this could change in the future.

Although the concern over ease of use of the STS currently is focused on the initial planning aspects of this interaction, there is a more general need for minimizing the complexity of interactions of the user with the STS (both mission planning and ground and flight operations). To accomplish this, competitively structured STS service arrangements (e.g., KSC launch host concept) will have to be actively developed, keeping user needs in mind as much as possible. Again, as in the more narrow area of planning/marketing services, the STS may face strong competition from the user service arrangements of the Europeans, Japanese, etc. For example, the Boeing commercial launch vehicle concept is being marketed as Boeing Launch Vehicle Services, indicating that Boeing recognizes the importance of the total services aspects of space transportation.

Spacelab. The overall competition projected for the STS should appropriately include an assessment of the competitive (non-NASA) planning for utilization of the Spacelab, a major element of the STS. NASA, on its part, has extensive plans for multidiscipline utilization of the Spacelab and is in the process of designing and developing payloads for various Spacelab modular configurations. The space science, space application, and space technology missions planned for these payloads are predominantly NASA. In most cases, these payloads (AMPS, Space Processing, LST, LDEF) may represent a unique monopoly in their particular category of research facility, available to governmental agencies, institutions and industry on an international basis. European projects being planned to utilize the facilities are being coordinated through the European Space Agency (ESA).

Competition for NASA sortie mission use of Spacelab capabilities in certain space application areas is, however, evolving as evidenced by the announced plans for the Federal Republic of Germany (FRG) to own and operate a Spacelab. The FRG space program efforts are being directed both in support of ESA programs and in setting up a separate FRG Spacelab program. The FRG Space Program is under the responsibility of the Federal Ministry for Research and Technology - Bundesminister fuer Forschung und Technologie (BMFT). The planning and development responsibility for the German Spacelab Utilization Program has been placed with the Deutsche Forschungs - und Versuchsnstalt fuer Luft - und Raumfahrt (DFVLR) -- the German equivalent to NASA.

The German Spacelab Utilization Program is presently based on 370 experiment and utilization proposals from the German user community (universities, institutes, and industry) covering all disciplines in research and technology. A paper(22) presented at the AAS "Space Shuttle Missions of the 80's" meeting in Denver, Colorado, provides a detailed discussion of these proposals and indicates a broad scope of proposed research similar to NASA programs.

The emphasis on technological application areas represents a very significant characteristic of the German Spacelab Utilization Program when considering its projected competition to NASA/STS Spacelab programs in space applications. During Dr. Fletcher's visit to West Germany in June, 1975, the views of MBB management(23) clearly stated that "pure scientific space projects do not have high priority in the FRG", and that "the current trend is now toward economically justifiable application oriented programs. To be economically justified, these programs will stress profitable use of existing space technology and system know-how, therefore, emphasis has been placed on strong engagement in space applications". The guidelines being followed in the planning of the German Spacelab Utilization Program are:

- Emphasize application oriented disciplines
- Give highest priority to space processing with the goal of 1 mission per year
- Fly an operational space processing lab beginning in 1985.

A working group, SL Utilization "ASN", has been formed with three German space companies (Dornier, MBB, VFW/Fokker/ERNO) and the DFVLR to promote the program and to concentrate effort to gain new user markets. The objective of the working group is to harmonize proceedings in the evolving user market and to provide necessary support to FRG and international agencies and governments. One last quote from MBB[23] is of interest:

> "We hope to have the understanding and good will of the U.S. and the NASA when on one hand German Industrial desires for equitable access to the Shuttle System may on the other hand lead to later international competition in the World Market."

It would appear that the German program will result in a complete (module and pallet) Spacelab configuration to serve as a general purpose laboratory. Several dedicated missions are planned in space processing, while most other disciplines will utilize portions of the Spacelab for joint missions. From a configuration standpoint, the full-up Spacelab may represent competition to the general purpose lab concept of the NASA/LaRC Advanced Technology Laboratory (ATL). The strong emphasis in the area of space processing is a significant research area competition. One interesting point to note is the difference in space processing payload design approaches between NASA and the FRG. The German approach will take advantage of the complete (module and pallet) Spacelab configuration, leading to dedicated flights. The NASA approach is to configure smaller payloads, such as a furnace facility, which can be automated, or flown as free-flyers. The NASA design concept, then, is to have autonomous payloads which can be installed on many multidiscipline missions on a non-interference basis. They do not envision a dedicated space processing mission, at least not for several years. Time will tell as to which payload approach (NASA or FRG) will result in the most cost-effective, competitive capability to an industrial user.

In summary, the German Spacelab Utilization Program appears to be as realistic as NASA's, with a definite emphasis on economically justifiable application oriented programs. This, in their view, may lead to international competition in the world market. There appears to be a broader and higher degree of industry involvement in the German program than in NASA's, and an industry/space agency working group has been formed to promote and market the program to gain new users. At the present time, NASA is only in the planning phase for such a group or comparable effort.

Determination of Informational Needs

The objective of this subtask was to determine and develop the informational needs of a NUD Program representative as he prepares for and, subsequently, conducts a call on a prospective new user of the STS. The informational needs include both what he needs to know about a prospective user and what he needs to provide to the user. The results of this subtask are documented in two separate volumes of this final report. Volume IV - Guidance/Instructions for Representatives, covers the type of information and background he needs to know about a prospective user and general guidance relative to conducting a call. Volume V - Informational Materials, covers the data, and in what form, which should be provided to the user. Recommendations as to the use of available material, how informational material should be derived and maintained and organizational recommendations are included in that volume. The use and need for different categories of information are also discussed in Volume III - The Implementation Plan, as an integral part of the user development process.

Information Required About the Prospective User. In general, the information needed about a new, prospective user will be directly related to understanding why STS can benefit his needs, why the organization qualifies as a potential user and the factors which will influence the acceptance or resistance to the representative's contact. Thus, a profile of the user organization should be developed. In many ways, the information needed and obtained about a specific user organization will in turn help determine the marketing strategy to be used and the preparation of the "customized" information to be provided to the user.

The information needed about a user organization should first of all include a general, broader understanding of the user community in which the prospective user is operating. This information will include the following:

- Structure of the community - major industry groups or government agencies which are considered a part of the community
- Markets served or local/national needs served
- Research and development history, status and trends; applied, fundamental, operations research breakdown
- Involvement in space or related technology programs
- A summarization of status, concerns and potential role of the community as to the future use or impact of the STS.

An example of this last mentioned category of information could be applied to the space communication operations community. First, it would be recognized that the community is made up of both systems operations organizations (INTELSAT, COMSAT, American Satellite Corporation, Global Satellite, Inc., Western Union, Satellite Business Services, etc.) and spacecraft manufacturers (RCA Astro/Electronics, Hughes, TRW, GE, Aeronutronic-Ford, etc.). The profile of the community, as a whole, would clearly point out that they, collectively, are very much concerned over the substitution of a new space launch system over which they have little control, little input to and limited options. The overall relative competitiveness (cost, availability, ease of access, etc.) of the STS to the current expendable launch vehicle (ELV) and assurance of smooth transitioning (both design and operations) from the ELVs to STS are issues. The past, present and future influence and regulatory controls of government agencies (such as the FCC) should be identified. Primarily, then, the community is concerned about the business risk of committing to the STS and the projected effect upon their present service and cost.

The user community information will provide a background for the information needed about a specific, prospective user. Again, as an example, within the space communication community a specific profile could be made up on Western Union or a spacecraft manufacturer (Hughes). The WESTAR involvement of Western Union, the type of service they provide by FCC regulation, their business operations policy of "procuring everything" and their past experience with and views of NASA should be described. In the case of a specific manufacturer of spacecraft, information relating to their past designs, expertise, actual satellites sold and operational should be specified. It should be recognized by the NUD representative that, at the present time, the major burden of what to do about STS lies with the spacecraft manufacturers. The business decisions of what redesigns or new designs to undertake and the timing of such actions have to be made in terms of what (and how much) can be passed on to the space system operators and how much of a market can be captured.

The above described user community/user organizational general profiles can be applied to any potential user community and organization or government agency. The makeup of an agency, such as the Department of Interior and the specific user (United States Geological Survey) can be treated similarly. The areas of research covered, problems being addressed, regional center responsibilities, all provide needed information.

A major part of the information needed about a prospective user is of a business/financial nature. Budget allocations, how and when dispersed, approval chain for new projects, etc., can be delineated for a government agency. A simplified, but adequate, business profile of an industry organization can be usmmarized from annual reports, SEC 10-K forms (annual financial reports) submitted to the Securities Exchange Commission, and directories such as Moody's Industrial Manuals. The information summarized should include:

- Sales and profit (total, and that related to potential space interest area)
- R&D expenditures (applied versus fundamental, if known, and past ten-year expenditure history)
- Dependency on outside services
- Financial capability and commitments
- Business role and business performance.

With some prospective user organizations, a financial/business profile is not available or practical to obtain. An example of this could be a newly formed consortium. During the study program a profile of the relatively newly formed Public Service Satellite Consortium (PSSC) was obtained; it is included as Appendix B to this volume as an indication of what can be put together on a non-profit organization.

Information To Be Provided the Prospective User. It was determined that the information to be provided to a user should be considered in two categories. A set of basic information, maintained to reflect current data, is needed to provide an overview of the STS, policy related to its use and charge, mission availabilities, uses and space facilities provided, etc. This basic package will include film, brochures, and presentation material and will be continuously coordinated with NASA public relations activities and the STS operations. The preparation of the material should have the user needs and interests in mind, primarily. If an analogy can be made, the material should tend to be of a Consumer's Report nature as compared to hardware specifications. The STS Users Handbook, being developed by NASA/JSC, will be a key part of the basic information package and, by structure, will lead a user to the element of the STS he will interface with and to more detailed design oriented data. In general, the types of information to be covered should include:

- Overview of STS concept/program
- Cost per flight
- User charge/sharing policy
- Methods of determining charge/design tradeoffs related to charge
- Terms and conditions of use
- STS planned availability/accessibility
- Method of interfacing with STS (applicable technology and operations)
- STS benefits/constraints
- ELV to STS transition plan
- Means of potential early involvement for use
- Specific follow-on steps
- Informational contacts within NASA
- Long range, future space planning (e.g., space station).

It is realized that the basic package may be overdesigned for certain users who are currently involved in space operations. The user development strategy will consider the role of a user and the need for what information and how much should be presented.

The type and effectiveness of basic STS information was continually evaluated during the study. Several contractor brochures on the STS and Spacelab were obtained and used very effectively. A film on the STS and one on the Spacelab were edited and combined, and were found to be a very effective method of giving an overview to the users.

The second category of informational material to be provided a user is the "customized data" prepared specifically for a particular user. A presentation most likely would be designed for a user which recognizes his specific space market role, the projected use of space/STS beneficial to his needs, some form of economic benefit projections, and a summarization of the applicable technology and research status. This information package can only be developed as a result of significant homework matching a STS service, a space application, and a beneficial economic projection to the user's need. The information must reflect what is known about the user and must coordinate the current research and use area developments within NASA as they apply to the user.

The NUD representative should be prepared to provide follow-up information in direct response to problems identified, new ideas, and desire for more detailed technical information as the development of the user process evolves.

TASK III - DEVELOP/EVALUATE THE IMPLEMENTATION PLAN

Objective

The objective of Task III was to develop and evaluate the required New User Development Plan. An integral part of the effectiveness of a plan is the attendant informational material to be used in the process of developing the new users. Therefore, the performance of this task included an evaluation of the informational material needed.

Procedure and Results

The general procedure followed during the study was to develop an outline of an implementation plan user development strategy, prepare supporting informational material and then evaluate the effectiveness of the strategy and information by conducting test cases. The final version of the recommended plan is described in a separate volume (Volume III - The Implementation Plan) of this final report. Additionally, the final recommended informational material is also described in a separate volume (Volume V - Informational Material). The implementation plan described in Volume III includes a recommended organizational approach for NASA which resulted from an analysis of the best application of varied resources of NASA, other government agencies, and the commercial sector in promoting the STS New User Development function. Task III, therefore, involved four subtasks:

- Develop an Implementation Plan
- Prepare/Assemble Informational Materials
- Conduct Test Cases
- Determine Best Application of Varied Resources.

The mid-program review was scheduled to coincide with the completion of Tasks I and II and the midpoint in the nine-month study. Therefore, the mid-program review was held at NASA/MSFC on November 19, 1975. The progress of the study was reported by means of a presentation of the results of Task I and Task II. In addition, future planning was presented and discussed by outlining a preliminary implementation plan, identifying available informational materials being reviewed and assembled, identifying proposed test case candidates, and describing problems/strategy relating to the actual conduct of the test cases. In general, most discussions with NASA after the mid-program presentation centered on the implementation plan and the test cases as reported in a BCL NUD meeting memorandum.[24] The impact and resultant actions are referred to in the discussions of those two subtasks. All of the subtasks in Task III are discussed separately in the following sections.

Develop an Implementation Plan

It was recognized that The Implementation Plan for STS New User Development must be an all encompassing document addressing the requirements, strategy, organization, the relationship to outside activities, timing, etc. Key to the plan, however, is the actual interfacing with the prospective user, the strategy used, the material presented and the preparation needed preceding the first call. As stated, this user development portion of an overall plan is the vital part of the plan when made meaningful, effective and productive by preceding market research and strategy analyses. Therefore, the major emphasis during this subtask was to initially outline a total plan approach but, subsequently, to concentrate on defining, evaluating, expanding and refining an effective user development strategy portion of the plan. After the results of the test cases were evaluated, then the total plan was formulated and documented in Volume III of this report.

The major theme assumed was to implement a proactive user development strategy which will initially gain the interest and enthusiasm of management level personnel in an organization/agency, but will ultimately result in direct "idea generation" and specific use/mission discussions with research and development personnel. The stimulation of innovative, new ideas from those user individuals who can relate their needs to STS capabilities and services will determine the success of user development. The entry point and path, within a prospective user organization/agency, to get to that creative group must involve a carefully planned contact and cultivation through the appropriate management and financial levels to achieve acceptance, interest, and enthusiasm at those levels.

A preliminary implementation plan was initially prepared and was presented at the mid-program review meeting. The plan described a total framework of functional elements necessary to a viable program and included a product management/direct sales structure supported by market research and market administration functions. The program was described as dynamic in nature, and involved an iterative process over a significant time period in some cases. The process by which a representative acts upon a prospective user organization was outlined.

Subsequent to the mid-program review a new diagram was prepared to more effectively describe the implementation plan and to better correlate the total implementation planning to specific new user development functional requirements. The new diagram (Figure 4) shows the NUD function as a service marketing functional operation. The relationships and interactions between the NUD operation and several other supporting activities outside the NUD function are shown. The figure was used as the primary diagram in the subsequent presentations and discussions during the test cases.

While the general plan and organization for NUD can be shown by Figure 4, the plan must be described as one requiring a specific user development strategy for each prospective new user which reflects the following:

- The projected STS use area in which the prospective user will be interested (Earth resources, space communications, space processing, etc.)
- The specific match of STS benefit to the user needs or product area (use of Spacelab for space satellite development as a commercial venture, use of electrophoretic separator for space separation of isoenzymes, etc.)
- The specific STS payload carrier of interest as an interface to the user (orbiter pressurized compartment, orbiter bay with attachment points or spin table, IUS, Spacelab space processing furnace, LDEF experiment tray, etc.)
- User involvement in space (none, to presently operating a space communication system)
- Status of technology involved in projected user's interest area (satellites for space communications to silicon ribbon growth or electrophoretic separation in space processing)
- Role of user organization in user community (spacecraft operator, spacecraft manufacturer, a data user, a product marketer, a representative of a collection of users)
- Type of user organization (government agency, regional center, research laboratory, industry organization, a consortium, a broker, trade association, educational institute).

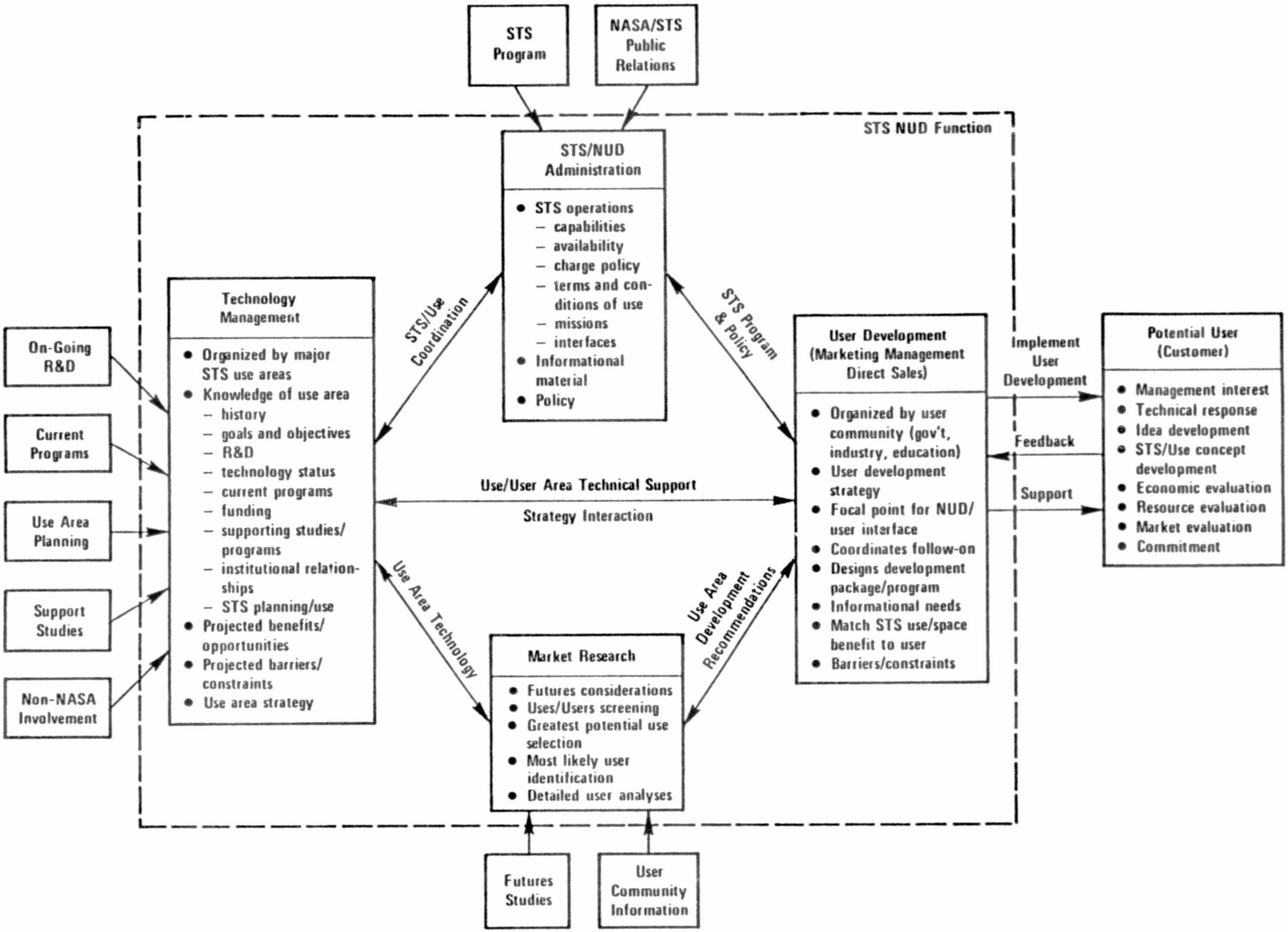

FIGURE 4. STS/NEW USER DEVELOPMENT PLAN

The thrust of the actual user development will be initiated with an initial management level contact accompanied by adequate informational material and background assessment to achieve the interest and a follow-on commitment to a technical working session with the user's technical personnel. The NUD operation will be responsive to the necessary support of the user's new idea generation working sessions or plans to use a STS service and the feedback resulting from these sessions. A final user commitment to using the STS will be the ultimate objective of the user development strategy.

During the mid-program review meeting, NASA requested that Battelle review the preliminary implementation plan presented to identify the need for different emphasis or different approaches if NASA was the NUD representative, especially in the area of interfacing with another government agency. In conjunction with this comment, an activity was initiated to critique the plan with respect to user development in the industrial, government, and educational sectors by either a government or an industrial organization. The objective was to determine specifically how the STS New User Development should be modified to address the different user sectors with attention to the differences attendant to development by a government agency or a non-government organization. Several meetings were held within Battelle at Columbus, Ohio, and with NASA and Battelle personnel in Washington, D.C. These meetings were with individuals involved in and experienced in "marketing" and interfacing with government agencies, either representing NASA or a private concern (Battelle). The meetings with the NASA Office of Applications personnel and with the Battelle Washington Operations staff[(5)] resulted in several comments and opinions related to the development of other government agencies (by NASA and by a contractor). In general, there was agreement as to the projected effectiveness of the strategy reflected in the STS NUD preliminary plan. One comment was that active marketing of STS may not be necessary with some government agencies. The present involvement and working relationships with NOAA, as an example, may provide a natural, effective evolution to STS applications. Therefore, the mechanism for development of NOAA as a continual user of space, transitioning from ELVs to STS, will in most part utilize existing interagency committees, technical teams, etc. There are significant differences between developing users in industry as compared to government agencies, but these differences can be compensated for within the NUD operation by individuals experienced in and familiar with each sector. As with each industry sector, each government agency is different from another, but unlike industry, they are more difficult to define or tie down. Industry firms have organizations, designated responsibilities, paths of authority, etc., which are known, easy to identify and relatively easy to interface with. This means that more emphasis will have to be placed on preliminary and exploratory work to assess government agency organizational structures, entry points, objectives, etc. Experienced personnel and supporting organizations will be invaluable. Therefore, it is believed that the general approach developed within the NUD Implementation Plan will apply equally to government agencies and industry since the plan necessitates specific strategies for each at a user organization development level. The market research and user development strategy required for each potential use area, each user community and each user organization, accompanied by general and user customized informational material, will make the plan applicable, effective and responsive to a wide spectrum of potential new user development needs.

Prepare/Assemble Information Needs

The objective of this subtask was to prepare and/or assemble the material which can be generally supplied to prospective users in the future and would be supplied to user organizations contacted as test cases. The general approach to this subtask was to assemble available material from NASA and several contractors to provide the overview of the STS and to supplement that material by specially prepared presentation material tailored to each test case.

Several brochures and promotional documents were obtained directly from contractors and, in some cases, coordinated through NASA. In all cases, contractors were very cooperative in supplying material. An informational package was put together primarily from a Rockwell International Space Division STS promotional package enclosed in a folded jacket. Several documents were added so that the total package included the following:

- "Space Shuttle Transportation System", July 1975, Rockwell International, Public Relations Department
- "Space Shuttle - For Down to Earth Benefits", Rockwell International Space Division
- "Space Shuttle - Model Information", Rockwell International Space Division

- "Space Shuttle - What it Will Do", Rockwell International Space Division
- "Space Shuttle", February 1975, NASA/JSC, U.S. Government Printing Office: 1975 - 671-199/1608
- "Data Guide for Space Processing Applications Payloads - Space Shuttle/Spacelab", TRW Systems Group
- "ESA Spacelab", European Space Agency
- Five 8-1/2" X 11" color photos of Shuttle, Spacelab.

A film on Shuttle and Spacelab was prepared by editing/splicing and combining a Rockwell International film (Film Report No. 5108, "The Space Division") and a European Space Agency (ESA) film. The resultant 12-minute film provided a very informative, effective overview of the STS and the Spacelab and provided credibility by showing orbiter hardware design and manufacture status. Kept current, such a film can be continuously effective. The film should be prepared with minimum contractor promotional material, current hardware status, and with a theme of telling the user what STS can do for them.

A presentation was prepared for each test case. Vugraphs were used for the presentations and copies of the vugraphs were bound and provided as handouts. The presentation material attempted to present the basic material, standard for each test case, and supplementary material tailored for the specific user. It was found, however, that the basic material necessitated revisions between each test case to reflect responses of the test case personnel, changes in presentation techniques, more current information, elimination of detailed information in favor of summaries, etc. In general, the basic information presented included the following:

- Introductory material on the program background, the Phase II study objectives and method of approach, and the strategy of the test cases
- STS/Spacelab - this information (used in conjunction with the film) provided an overview of the STS; mission descriptions, flight rates, terms and conditions of use and charge policy were included.

The material prepared for a specific test case organization included an outline of the recommended user development approach, information making the approach applicable to the test case user, information on space programs/STS use applicable to the user, etc. Copies of a set of vugraphs for one test case (with a pharmaceutical company) are included in this volume as Appendix C to provide an example of the presentation material prepared. It should again be noted that the presentations were changed for each test case. The final recommended informational material, resulting from the test case evaluations, is described in Volume V of this final report.

Conduct Test Cases

The strategy or approach to be taken in conducting the test cases was discussed at the mid-program review meeting with NASA. It was recognized that the ideal situation of actually conducting a "for real" marketing call on a prospective user organization in order to completely evaluate its effectiveness was not achievable. The lack of technical credibility and STS programmatic reality, applicable to a user's area of interest, is a major compromise. The planning phase status of the STS NUD program, as compared to the desired operational status of the NUD function yet to be achieved, means that the in-depth market research and user development strategy determination required for a productive, real-case market call is also lacking. Additionally, the all-important STS program response and follow-on to a user's anticipated interest and technical information needs are, at this time, not available.

It was agreed at the mid-program review meeting that the approach to conducting the test cases would be to consider each test case organization as a consultant. Each organization would be completely informed of the overall STS NUD program planning, the present Phase II study objectives and approach, and the test case purpose and approach. After an initial telephone contact, a follow-up presentation would be made to the test case organization. The "real case" marketing plan would be presented by describing the overall general approach and specifically describing the approach developed uniquely for the test case user. Informational material would be provided or outlined to the user. After the presentation, the test case organization would be asked to provide an oral critique of the plan and material to assess effectiveness, need, adequacy and completeness. Additionally, the point of entry into the user organization, which was chosen by the NUD study team, would be assessed as to its correctness, usefulness and future applicability.

Further, the selection of test case candidates was to provide a variation of potential STS users covering industry, other government agencies, and the educational sector. The selection would attempt to cover various use areas (space communications, space processing, etc.) and would provide a mix of user organization types (consortium, space broker, industrial company, research laboratory, university, government agency, regional center, etc.) A summary of the actual test cases conducted is shown in Table 13.

The actual selection of the test cases followed certain guidelines and logic which contributed to the selections. In addition to the major objective of obtaining a variation of organization types, use areas, and user communities, it was also decided to attempt to make two test cases in some areas, where feasible, to counterbalance possible personal bias on the part of a company or agency. Originally, it was planned on using NOAA and USGS as the two government agencies. After a meeting with NASA/OA it was decided that the present NASA/NOAA working group relationships would compromise the methodology evaluation intent of the test cases. This is not to infer that the NUD function should not include the requirement to market to NOAA in the future. Therefore, the Department of Transportation was substituted, and a contact was made with a known, key office in Systems Development and Technology. While the second government agency chosen was USGS, it was decided to evaluate the feasibility of interfacing with a regional center. It was also recognized that USGS Headquarters was contacted by SRI during the NUD Phase I Study.

The choice of the PSSC satisfied an interface with the educational sector and a contact with a consortium. A preliminary contact with the Joint Council on Educational Telecommunications, a member of the PSSC, confirmed that the consortium was evolving into a coordinating organization for educational telecommunications.

The subsequent selection of The Ohio State University as a test case carried the educational sector to the institution level and also permitted the exploration of the university's role of purchasing service from the STS.

Since space processing of electronic materials represents a future, high-value added, high-potential opportunity for industry, it was decided to present the technical and economic aspects of silicon ribbon processing in

TABLE 14. STS NUD TEST CASE SUMMARY

TEST CAST ORGANIZATION	LOCATION	DATE	BCL-NUD REPORT	USER TYPE	USER COMMUNITY	STS APPLICATION OF INTEREST
Department of Transportation - Systems Development and Technology	Washington, D. C.	1/23/76	MM-76-2	Government Agency - Headquarters	Earth observations, weather, communications, navigation	Multi discipline - satellite/Spacelab
Public Service Satellite Consortium	Washington, D. C.	1/30/76	MM-76-3	Consortium	Telecommunications	Educational use of satellites/Spacelab
Department of Interior - United States Geological Surveys	Menlo Park, California	2/4/76	MM-76-5	Government Agency Regional Center	Remote Sensing, communications	Research support - satellites/Spacelab
* Earth/Space	Palo Alto, Calif.	2/5/76	MM-76-4	Space broker	Potentially all	All
Fairchild Camera and Instrument Corporation	Mountain View, California	2/5/76	MM-76-6	Private company	Semiconductor Industry	Space processing - electronic materials
Texas Instruments	Dallas, Texas	2/10/76	MM-76-7	Private company	Semiconductor Industry	Space processing - electronic materials
Merck, Sharp and Dohme	Rahway, New Jersey	2/25/76	MM-76-8	Private company - research labs	Pharmaceutical Industry	Space processing - biological applications
Warner Lambert (Parke-Davis)	Detroit, Michigan	2/27/76	MM-76-9	Private company - research labs	Pharmaceutical Industry	Space processing - biological applications
* NUS Corporation	Washington, D. C.	2/19/76	MM-76-11	Private engineering and consultant firm	Utilities	Remote Sensing - environmental impact assessment
* RCA Astro/Electronics	Princeton, New Jersey	3/10/76	MM-76-12	Private company	Space communications	Spacecraft manufacturer
* Western Union	Upper Saddle River, New Jersey	3/11/76	MM-76-13	Private company	Space communications	System operator
* Ohio State University Research Foundation	Columbus, Ohio	3/15/76	MM-76-14	University	Education	Space research, space education, Spacelab

* No formal presentation was made. Informal meeting was substituted.

space as a test case. A survey of the semiconductor industry identified Fairchild and Texas Instruments as both growers of silicon crystals and component/product organizations. A similar objective to present the opportunities related to the biological applications area of space processing, coupled with a desire to follow up on the less than satisfactory results of the October 8, 1975, NASA/PMA/NSI meeting, led to a survey of the pharmaceuticals industry. The two selected (Merck and Parke-Davis) were among the top drug research laboratories in ethical (prescription) drugs.

The NUS Corporation meeting resulted from a previous meeting at Battelle and explored the potentials of a future commercial venture using STS services.

The meeting with Earth/Space was a test case planned from the early phases of the study. Earth/Space has been very active for the past 1 to 2 years in promoting the space broker concept in today's space program environment with a growth into the STS era.

Finally, the meetings with RCA and Western Union brought the test cases to the space communications community and present space users. Additionally, RCA Astro/Electronics represents a spacecraft manufacturer as differentiated from a system operator - Western Union.

As noted in the test case summary (Table 13), several test cases were conducted by an informal meeting instead of making a formal presentation. This alternative approach was found to be more appropriate and productive in some instances. In two of the alternative approach cases (Earth/Space and NUS Corporation), a single individual was involved, and in the other three cases, the approach taken represented a time constraint in setting up and conducting a formal presentation. The test cases conducted, as seen by the summary, accomplished the major objective of covering a wide variation of use areas, user communities and user organization types.

The preparation for each test case involved a limited market research and user development strategy activity for the particular organization. The organizational structure was evaluated to identify an entry point, and then preliminary telephone calls were made to set up the presentations/meetings. In the case of the PSSC, several contacts were made to thoroughly understand the makeup and objectives of the consortium. A preliminary assessment of each user was made to match a space benefit or area of interest as the primary topic of discussion. In all cases, the organizations used as test cases were quite cooperative, resulting in very beneficial meetings. In one case, a pharmaceutical company declined to be a test case due to a prior attendance at a NASA/Pharmaceutical Manufacturers Association meeting.

The conduct of the test cases was found to be a valid, effective technique for verifying the implementation plan and attendant informational material. The results of the test cases verified the general approach of the implementation plan, the validity of strategy developed for each test case organization, the accuracy of entry point selection in the test case organization and the effectiveness of using STS overview and user customized informational material. Technical credibility of projected space benefits (primarily in space processing) was questioned and was a subject for significant discussion in the semiconductor and pharmaceutical test cases. Interest in STS and space applications was definitely stimulated in all test cases. The existence of a wide spectrum of potential user categories, with which the NUD function must deal, was established. Additional, more specific, findings included the following:

- User development to a government agency most likely should be initiated at a headquarters level, compared to a regional center, although prior contacts at a regional center can provide valuable insight into technical research needs.
- Prior homework (market analysis, user analysis, user development strategy) will have significant payoff in productive user development.
- Use of consortiums (PSSC) and trade associations (PMA) can be and should be made as effective/accepted coordinating organizations for their respective members.
- The "educational community" will be difficult to delineate as a prospective user community. A feasible role for a university as a purchaser of STS services can be defined and is of potential interest.
- Properly prepared informational material can be very effective in stimulating interest. The use of a short, current information film was well accepted.
- User development for STS must recognize that in some cases the interest is at a space process level, with Spacelab as a future interest and STS of remote interest. This was

especially true of the pharmaceutical companies. Minimum informational material is needed on STS policy, operations, and availability. Most material is needed on space processing.

- Informational needs for existing space users are primarily related to impacts on their costs and services currently being provided. Cost per flight, charge policy, terms and conditions of use, availabilities, etc., are required.
- Knowledge of the Spacelab was found to be lacking with most users. The Spacelab capability and applications as a commercial venture has not been given much thought, but did stimulate thinking.
- Cost/effectiveness information can be useful. This was found to be very true with the pharmaceuticals and less true with semiconductor companies. In general, it is recommended that the customized informational material include economic benefit projections of some kind.
- The concept of a space broker must be considered as a potential user type in the future.
- Awareness of the space processing sounding rocket program as a means (even with NASA funding) of early involvement in research leading to STS applications was lacking.
- The concept of NASA/STS new user development must
  (1) Understand the industry/agency and the environment in which it functions
  (2) Understand the operating problems, needs, and objectives of the company or agency
  (3) Show how the needs can be satisfied, cheaper, better, or whatever, or how a new business in similar markets can come about.
- Development of a particular user of the STS may be a lengthy process requiring significant transfer of information both to the potential user from NASA and from the potential user to NASA. The interactions must take place in a climate of total sensitivity to the needs of the potential user, and the

environment in which the user functions. The development activity will actually be paced by the potential users' ability to absorb information and generate internal responses leading to concepts for STS use. (The development activity also depends on the ability of NASA to respond with meaningful information inputs and become aware of the real needs of the user.)

- Proprietary rights and confidentiality of research are major factors to industrial firms in considering any user development program. In some firms (notably pharmaceutical) the very methodology of research is as proprietary as the end result. High-technology, rapidly advancing industries (biological, electronic), are characterized by high proprietariness, and these are the very industries most likely to find STS of high value. Within the pharmaceutical industry, there is a significant anti-government sentiment due to FDA and other regulatory bodies, in addition to the fear of losing control of trade secrets on product and methodology. These organizations may be reluctant to work directly with NASA. The present policy on invention rights and funding options, applicable to the space processing sounding rocket program*, was very germane to the presentations to the pharmaceuticals.
- Beyond a general overview of Shuttle and Spacelab operations which can be provided in a short film to orient a potential user, what are really needed to interest an industrial firm in the STS are actual experimental results that the firm sees as having commercial potential. To a glass manufacturer, this could be more pure material. To a pharmaceutical company, it could be a separated component of a complex biological material. To an electronics firm it could be a new semiconductor. Generally, the firm will need hard technical and cost data from NASA, but will only trust its own internal market and financial analysis before committing funds. The important point is that an

* Announcement of Opportunity, Space Processing Rocket Experiment Project, A.O. No. OA-76-02, February 6, 1976.

industrial firm won't commit funds on experimental concepts; it will commit only on demonstrated results. The cost of such basic research to demonstrate feasibility will likely have to be borne by NASA as part of the marketing effort.

- It is possible that content and direction of basic research can be guided by working with the academic community and industry groups such as the PMA. It is important, however, that NASA also work with industrial companies who can provide significant inputs to the content and direction of further research in this manner. The problem of immediacy is overcome. Though the STS is not available for several years, the individual company can become involved now in basic research inputs. If some degree of control does not reside in the end user, the results may not fit the needs of the company and may not be commercialized. These firms will not, in general, fund the research effort until demonstrated results can be shown; but they will very likely work with NASA in outlining research programs, funded by NASA, which will have significant commercial potential if feasibility and practicality can be demonstrated.

The several test cases conducted provided adequate background information to permit preliminary profiles on some user communities and user organizations. These profiles provide an insight into the issues and concerns of STS potential use as the user views it. The profiles have been included in Volume IV of this final report as typical of information a STS NUD representative should know about users.

Determine Best Application of Varied Resources

It is recognized that the resources of both government and industry can be applied in varying degrees of magnitude, timeliness, and effectiveness to achieve the objectives of the STS NUD program. The objective of this subtask was, therefore, to assess the resources of NASA, other appropriate government agencies, and the commercial sector to determine if, and in what manner, they could be applied to support the development of new users for the STS.

The definition and understanding of the overall requirements of a New User Development Function are basic to the conduct of an analysis of what, and how, resources (financial, technical and facilities) of different agencies, communities and organizations can best be applied. Figure 4 was prepared as a means of defining the functional requirements associated with a NUD function as a primary element in the preliminary implementation plan to be presented and evaluated by the test cases. The plan was found to be valid, and Figure 4 is still an accurate representation of the functional requirements of the NUD function. The relationships and interactions between the NUD operation and other supporting activities outside the NUD function are shown. Therefore, the analysis conducted and the resulting recommendations are based on an NUD function as shown in Figure 4.

The obvious approaches to implementing the NUD function would, at one end of the spectrum, have NASA undertake the entire functional/organization responsibility and, at the other end of the spectrum, have NASA utilize an outside organization to undertake the entire functional/organization responsibility. There could be many variations of this latter approach, ranging from a subcontractor arrangement to the creation, probably by legislation, of an independent, regulated monopoly (similar to COMSAT) to conduct the user development task as a commercial venture. Another variation could comprise an initial subcontractor arrangement evolving over time to the COMSAT-like organization. There is no clear cut, outstanding advantage to any of these approaches and it is obvious that many major, complex issues would have to be addressed prior to a final decision as to which way to go.

It is felt that none of the above approaches should be recommended, at least in the immediate future. First of all, this study has confirmed that the development of non-NASA/non-DoD users of the STS will be a very large, complex undertaking for any agency or organization. Such a development program must be initiated soon if other government agency and industrial interest and use is to be achieved in the 1980's, concurrently with the maturing STS. This dictates an approach which blends the capabilities and experience of both NASA and industry. The implementation plan developed in this study stresses the use of industrial marketing techniques and know-how. It is very apparent, however, that marketing of the product (STS) must be directly supported by STS knowledgeable personnel and space use development activities, clearly a function and responsibility NASA must retain in the NUD function. It is also believed that it would be more cost-effective for NASA to obtain the experienced, qualified personnel who will be required to do the market research and user development functions from outside NASA.

Referring to Figure 4, it is recommended that NASA establish the overall NUD function as shown and employ industry resources to accomplish the "Market Research" and "User Development" functions. It is, however, recognized that, where lines of communications already exist between NASA and an agency (e.g., NOAA) or an organization (e.g., COMSAT), it may prove to be more practical for NASA to be responsible for those specific user developments.

The recommendations to utilize industrial marketing experience, the key factors for such recommendations and the characteristics of the industrial firms required were discussed in great detail in two of the Phase I studies[20, 25] and, therefore, are not repeated in this report. The issues identified and the points made in those reports are considered to be still valid.

RESULTS AND CONCLUSIONS

This study was successful in developing an overall STS New User Development Implementation Plan and a set of informational materials to be used in conjunction with the plan. The plan and informational materials were evaluated through the use of test cases in which selected test case organizations were used as consultants to establish the effectiveness, the adequacy and the need for the user development strategy and attendant informational material. The test cases were conducted over a broad variation of STS use areas, user communities and types of user organizations. The Implementation Plan is documented in a separate volume (Volume III). Guidance and instructions for a NUD representative and informational materials to be provided to a user are also documented in separate volumes (Volume IV and V, respectively).

The Implementation Plan reflects a dynamic, iterative approach to selecting the most promising STS use areas, conducting detailed market research within those use areas, evolving a specific strategy for developing a prospective user organization, preparing informational material to support that strategy and actively developing the user. The thrust of the actual user development involves an achievement of initial interest with management level personnel in a user organization, eventually resulting in direct idea generation and specific use/mission discussions with the user's research and development personnel. The NUD Function must be responsive with meaningful information inputs and technical support as the potential customer moves from initial interest to idea generation, evaluation and finally a commitment to use the STS. The NUD function is, therefore, established as the mechanism to obtain new users for the STS services and related space uses being developed by NASA. Inherent in such a responsibility is the need for the STS NUD operation to have close, effective working relationships with STS development and operations areas and related space use development areas.

The resources of both government and industry can be applied in varying degrees of magnitude, timeliness, and effectiveness to achieve the objectives of the STS NUD program. The obvious approaches to implementing the NUD function would, at one end of the spectrum, have NASA undertake the entire functional/organization responsibility and, at the other end of the spectrum, have NASA utilize an outside organization to undertake the entire functional/organization responsibility. Neither of these approaches are recommended. First of all, this study has confirmed that the development of non-NASA/non-DoD users of the STS will be a very large, complex undertaking for any agency or organization. Such a development program must be initiated soon if other government agency and industrial interest and use is to be achieved in the 1980's, concurrently with the maturing STS. This dictates an approach which blends the capabilities and experience of both NASA and industry. The Implementation Plan developed in this study stresses the use of industrial marketing techniques and know-how. It is very apparent, however, that marketing of the STS must be directly supported by STS knowledgeable personnel and space use development activities, clearly a function and responsibility NASA must retain in the NUD function. It is also believed that it would be more cost-effective for NASA to obtain the experienced, qualified personnel who will be required to do the market research and user development functions from outside NASA. Referring to Figure 2, it is recommended that NASA establish the overall NUD function as shown, and employ industry resources to accomplish the "Market Research" and "User Development" functions. It is, however, recognized that where lines of communication already exist between NASA and an agency (i.e., NOAA) or an organization (i.e., COMSAT) it may prove to be more practical for NASA to be responsible for those specific user developments. The key determining factor would be demonstrated experience in a particular user community and knowledge of a specific agency or organization.

REFERENCES

1. Battelle's Columbus Laboratories (Contract No. NAS8-30529).
Stanford Research Institute (Contract No. NAS8-30533).
University of Alabama at Huntsville (Contract No. NAS8-30737).
A. D. Little (Contract No. NAS8-30739).
Integrated Report, Stanford Research Institute (Contract No. NAS8-30533).

2. McDowell, J. R., "Visit to NASA Headquarters, July 25, 1975", BCL-NUD-MM-75-2, August 4, 1975, Battelle's Columbus Laboratories.

3. Marx, William R., "Feasibility Study of Commercial Space Manufacturing, Final Report", MDC E1400, December 20, 1975, McDonnell Douglas.

4. McDowell, J. R., "Meeting with McDonnell-Douglas Astronautics Company, St. Louis, Missouri, March 3, 1976", BCL-NUD-MM-76-10, March 4, 1976, Battelle's Columbus Laboratories.

5. McDowell, J. R., "Meetings in Washington, D. C., December 15, 1975", BCL-NUD-MM-75-6, December 22, 1975, Battelle's Columbus Laboratories.

6. McDowell, J. R., "Visit to NASA/Office of Applications, December 22,1975", BCL-NUD-MM-76-1, January 6, 1976, Battelle's Columbus Laboratories.

7. McDowell, J. R., "Visit to National Space Institute, October 23, 1975", BCL-NUD-MM-75-4, October 28, 1975, Battelle's Columbus Laboratories

8. Dupnick, Edwin G., "Discussions With Potential STS Users Concerning Charge Sharing for STS User Charge", FM34(76-46), March 1976, NASA/JSC.

9. Edgecombe, D. S., and Nippert, D. A., "Visits to Spacecraft Manufacturers, July 16-17, 1975", BMI-NLVP-MM-75-35, July 24, 1975, Battelle's Columbus Laboratories.

10. Edgecombe, D. S., and Nippert, D. A., "Trip to Washington, D. C. for Discussions with ESA, INTELSAT, and Boeing Representatives", BMI-NLVP-MM-75-47, September 30, 1975, Battelle's Columbus Laboratories.

11. Edgecombe, D. S., and McDowell, J. R., "Visit to General Electric Valley Forge Space Center, September 24, 1975", BMI-NLVP-MM-75-51, October 10, 1975, Battelle's Columbus Laboratories.

12. Edgecombe, D. S., and Nippert, D. A., "Visit with Canadian Space Program Representatives, September 18, 1975 (in Ottawa, Ontario, Canada)", BMI-NLVP-MM-75-49, September 30, 1975, Battelle's Columbus Laboratories.

13. Edgecombe, D. S., and Nippert, D. A., "Trip to Princeton, New Jersey, September 30, 1975, to meet with RCA Representatives", BMI-NLVP-MM-75-48, September 30, 1975, Battelle's Columbus Laboratories.

14. McDowell, J. R., Conlon, R. J., and Bushek, K., "Outside Users Payload Model", (Preliminary Data), BMI-NLVP-IM-75-7, August 22, 1975, Revision, Battelle's Columbus Laboratories.

15. Pittenger, J. L., and Buckeye, D. L., "Outside Users Payload Model", BMI-NLVP-IM-76-1, December 29, 1975, Battelle's Columbus Laboratories.

16. McDowell, J. R., "Terms and Conditions Policy for STS Use", BMI-NLVP-IM-75-10, August 19, 1975, Battelle's Columbus Laboratories.

17. Edgecombe, D. S., "External Competition for the Space Transportation System (STS)", BMI-NLVP-TM-74-2, November 4, 1975, Battelle's Columbus Laboratories.

18. "The Space Applications Program 1974", NASA/OA, May 1974.

19. "Practical Applications of Space Systems", Space Applications Board, Assembly of Engineering, National Research Council, NAS, 1975.

20. Gripshover, Paul J., "Final Report on Space Shuttle Transportation System Technique for User/Use Development", NASA Contract No. NAS8-30592, June 30, 1974, Battelle's Columbus Laboratories.

21. Archer, J. L., Beachamp, N. A., and MacMichael, D. C., "Final Report on Development of Methodologies and Procedures for Identifying STS Users and Uses", NASA Contract No. NAS8-30533, June 20, 1974, Stanford Research Institute, Huntsville, Alabama.

22. Schreiber, Horst, "Spacelab Payload and Program Planning in Germany", AAS Paper No. 75-243, AAS Twenty-First Annual Meeting, August 26-28, 1975, Denver, Colorado.

23. Letter to Douglas Lord, Director Spacelab Program - NASA from Dr. Davidts and Dr. Moritz, Messerschmitt - Bolkow-Blohm (MBB), June 18, 1975, "MBB Presentation on the German Spacelab Utilization Program to Dr. Fletcher on June 13, 1975".

24. McDowell, J. R., "NUD Study Mid-Term Presentation at NASA/MSFC, November 19, 1975", BCL-NUD-MM-75-5, November 25, 1975, Battelle's Columbus Laboratories.

25. Krebs, William A. W., "Final Report - An Approach to Developing the Market for Space Shuttle Payloads (Business/Public Policy Issues and International Marketing Considerations)", NASA Contract No. NAS-8-30739, August 31, 1974, Arthur D. Little, Inc., Cambridge, Massachusetts.

APPENDIX A

STS NEW USER DEVELOPMENT STUDY DATA BASE

APPENDIX A

STS NEW USER DEVELOPMENT
STUDY DATA BASE

Shuttle Space Transportation System

Modes of Use

I. Earth or Parking Orbit Booster

- Spacecraft plus one or more propulsion stages (IUS/TUG)
- Geostationary, eccentric orbits and planetary missions

II. Establish and maintain automated observatories in space

- Spacecraft only (no additional propulsion other than OMS)
- Polar and low inclination, low altitude orbits
- Repair, replacement and refurbishment of components, subsystems, or entire spacecraft
- Lifetimes of spacecraft in orbit - 10 years

III. Sortie mode

- Support a program of multidisciplined exploratory research and instrument/technology development
- Spacelab/pallet (modular design provides configuration flexibility)
- Research may be manned, automated or a combination of both
- Instruments, equipment-experiments
- 1-7 payload specialists (scientists, engineers, technicians)
- Dedicated labs, experiment modules, carry-on experiments, free-flyers
- Mission duration 7-30 days in low earth orbits (100-160 n mile)
- Space environment for research
  - Zero-g
  - Very hard vacuum
  - Total solar spectrum

- Space radiation
- Isolation from terrestrial environment (vibration, seismic and acoustic noise, contamination)
- Launch/reentry conditions

STS Characteristics

- Multidisciplined science and applications missions
  - Astronomy
  - Solar Physics
  - High energy astrophysics
  - Atmospheric and space physics
  - Life sciences
  - Communications and navigation
  - Earth and ocean physics
  - Materials science and space processing
  - Space technology
  - Advanced applications (energy, colonization, etc.)
- Planned user involvement
  - Supports wide range of scientific, defense and commercial users
  - Perform research for a user
  - Provide space facility for user use (research or applications)
  - Obtain data for users (earth observations)
  - Provide a space "system" test/demonstration facility
  - Encourages early user involvement and commitment of resources in STS use
  - National and international spectrum of users
- Provides low cost transportation as an economical extension of on going manned and unmanned space programs in science, applications and technology
- Payloads
  - Automated
  - Sortie

- STS operational modes
  - Payload delivery
  - Payload retrieval
  - Payload repair/servicing
  - Manned orbiting lab/workshop (sortie mode)
- STS provides access to unique space environment
  - Zero-G
  - Low level vibration
  - Unconfined vacuum
  - Contamination free
  - Thermal
  - Solar spectrum
- STS provides benefits
  - Reduced space program costs through relaxed payload design constraints
  - New materials processing (space processing)
  - Commercialization of space (space manufacturing)
  - Observations (Astronomy, Solar, Planetary, Earth, etc.)
  - Advanced technology R&D
  - Solve energy crisis (Solar energy - find oil)
  - Solve pollution problems (violators, monitoring)
  - Communications/navigation
  - Accurate placement of payloads
  - Advances in science
  - Advances in educational techniques.

Product (STS/Spacelab) Uniqueness

- PRODUCT AND ITS UTILITY ARE ALMOST UNKNOWN TO MOST POTENTIAL NON-NASA/NON-DoD USERS
- RELEVANT USES AND BENEFITS ARE NOT AND WILL NOT BE READILY APPARENT TO THESE POTENTIAL USERS
- ECONOMIC BENEFITS (AND METHODS OF DERIVING) ARE OBSCURE TO A USER AND WILL BE DIFFICULT TO DETERMINE
- PRODUCT CAPABILITY IS VERY BROAD
  - REIMBURSABLE SPACE TRANSPORT SERVICE (LAUNCH AND RETURN)
  - FACILITY FOR RESEARCH AND DEVELOPMENT (LAB FACILITIES, SYSTEM TESTING)
  - NATIONAL SCIENCE FACILITY (SPACE TELESCOPE, INFRARED OBSERVATORY)
  - REMOTE SENSING (EARTH RESOURCES, WEATHER DATA)
  - MEANS LEADING TOWARD COMMERCIAL MANUFACTURING IN SPACE
- SIGNIFICANT PRODUCT KNOWLEDGE GAP TO POTENTIAL USERS
- DEVELOPER (NASA) NEW/INEXPERIENCED/UNKNOWN IN SALES FIELD
  - HISTORICALLY A BUYER, NOT A SELLER
- MISTRUST OF DEVELOPER (NASA) AS A U.S. GOVERNMENT AGENCY EXISTS AMONG POTENTIAL U.S. INDUSTRY AND FOREIGN USERS
- FULL OPERATIONAL CAPABILITY IS LONG-TERM (1980's)
  - MEANS FOR EARLY INVOLVEMENT OF USERS IS NOT CLEAR
  - INTERIM USER INVOLVEMENT MUST BE DEVELOPED
- EFFECTIVE MATCHING OF PRODUCT USE/BENEFIT TO USER WILL BE DIFFICULT
- GREATEST POTENTIALS PROBABLY YET TO BE DEVELOPED -- OR, PERHAPS, EVEN CONSIDERED

Reference Documentation

1. Space for Mankind's Benefit, NASA SP-313, November, 1971, NLVP Library 73-236.

2. Proceedings of the Space Shuttle Sortie Workshop, NASA GSFC, July-August, 1972, NLVP Library 72-469.

   Vol. I -Policy and System Characteristics
   Vol. II-Working Group Reports

3. Space Shuttle Presentation to Space Sciences Summer Study, Woods Hole, Massachusetts, July, 1973.

4. Space Shuttle System Payload Accomodations - Level II Program Definition and Requirements, JSC 07700, NLVP Library 73-494.

5. Space Shuttle Program Requirements Document, Level I, NASA OMSF, May, 1973, NLVP Library 73-307.

6. The 1973 Space Shuttle Traffic Model, NASA MSFC, July, 1973 (NASA TMX-64751), NLVP Library 73-496.

7. The 1973 NASA Payload Model, Space Opportunities 1973-1991, NASA June, 1973, NLVP Library 73-435.

8. Integrated Mission Planning, First Two Years of Shuttle Missions (1979-1980), NASA MSFC, July, 1973.

9. Sortie Lab User's Guide, NASA MSFC, April, 1973, NLVP 73-489.

10. Sortie Lab User Requirements, NASA MSFC, April, 1973.

11. Space Shuttle Presentations for ESRO, NASA JSC, April, 1973.

12. Spacelab Guidelines and Constraints for Programme Definition, Level 1, NASA MF-73-1, September, 1973.

13. The Design and Utilization of a Spacelab for Sortie Missions, Douglas R. Lord, Presentation at the XXIV International Astronautical Congress in USSR, October, 1973, NASA.

14. Final Report of the Space Shuttle Payload Planning Working Groups, NASA GSFC, May, 1973, NLVP Library 73-315.

    Executive Summaries
    Astronomy - Vol. 1
    Atmospheric & Space Physics - Vol. 2
    High Energy Astrophysics - Vol. 3
    Life Sciences - Vol. 4

Solar Physics - Vol. 5
Communications & Navigation - Vol. 6
Earth Observations - Vol. 7
Earth and Ocean Physics - Vol. 8
Materials Processing and Space Manufacturing - Vol. 9
Space Technology - Vol. 10

15. Summarized NASA Payload Descriptions - Automated Payloads, NASA MSFC, October, 1973, NLVP Library 73-549.

16. Payload Descriptions, Volume I, Automated Payloads, NASA MSFC, October, 1973, NLVP Library 73-550.

17. Summarized NASA/ESRO Payload Descriptions (Sortie Payloads), NASA MSFC, October, 1973, NLVP Library 73-497.

18. Payload Descriptions, Volume II, Sortie Payloads, NASA MSFC, October, 1973, NLVP 73-498.

19. A Shuttle Compatible Advanced Technology Lab., W. E. Sivertson, NASA Langley, AIAA Paper No. 73-611.

20. Study for Identification of Beneficial Uses of Space (Phase I), Final Report, General Electric, December, 1972.

    Vol. I - Executive Summary
    Vol. II - Books 1-4 Technical Report

21. Economic Analysis of Crystal Growth in Space, Final Report, General Electric, July, 1972.

22. Space Processes for Extended Low-G Testing, General Dynamics, CASD-STT-73-005, June, 1973.

23. Requirements and Concepts for Materials Science and Manufacturing in Space Payload Equipment Study, TRW, July, 1973.

    Experiment Functional Requirements - Vol. IIA
    Equipment and Instrument Identification - Vol. IIB
    Experiment/Equipment Review - Vol. IIC
    Payload Equipment - Vol. IID
    Operations Analysis - Vol. IIE
    Programmatics - Vol. III

24. Mission Requirements for a Manned Earth Observatory, Final Report, TRW, March, 1973.

25. Plasma Physics and Environmental Perturbation Laboratory (PPEPL), TRW.

    Executive Summary and Performance Reviews 1, 2, 3.

26. Space Shuttle Mission and Payload Capture Analysis (includes report on BRAVO-Business Risk and Value of Operations in Space), The Aerospace Corp., June, 1973, ATR-73(7311)-1.

Executive Summary - Vol. 1
Final Report - Vol. 2.

27. Discipline Working Group Atmospheric and Space Physics, Draft of Woods Hole Conference, July, 1973, NASA.

28. High Energy Astrophysics Discipline Group Report (Woods Hole), Study on the Scientific Use of the Space Shuttle, NAS, July, 1973.

29. Space Shuttle and Planetary Missions, NASA, May, 1973.

30. Study of Airborne Science Experiment Management Concepts for Application to Space Shuttle, ASSESS Program, NASA ARC, TMX-62, 287, July, 1973.

31. A Plan for the Use of the Basic Atmosphere Explorer Spacecraft System as a Subsatellite of the Shuttle, NASA GSFC, May, 1973.

32. Sortie Lab Hitchhiker Experiment Module System, NASA GSFC, May, 1973.

33. Manufacturing in Space, Hans F. Wuenscher, NASA MSFC, September, 1972.

34. Proceedings of the Second Conference on Payload Interface With Shuttle or Tug, McDonnell Douglas MDC-G4818, September, 1973, NLVP Library 73-480.

35. Study for Identification of Beneficial Uses of Space, GE BUS Study, Phase III, Final Performance Review, NLVP Library 75-340.

36. Future Space Transportation Systems Analysis Study, Boeing, G. R. Woodcock, April, 1975, NLVP Library 75-334, 75-331, 75-246, 75-127, 75-25.

37. A User Assessment of Services in Geostationary Orbit, COMSAT, Gary D. Gordon, NLVP Library 75-321.

38. Manned Orbital Systems Concepts, McDonnell-Douglas, NLVP Library 75-249, 75-319, 75-179, 75-87, 74-401.

39. Space Station and Space Transportation System Program Projections for the 1980-2000 Time Period, NASA/MSFC, January, 1975.

40. Preliminary Technology Assessment Satellite Power System Concepts, NASA/Code N, W. B. Lenoir, NLVP Library 75-300.

41. Study Orientation Meeting, STS Utility to the Space Communications Community, Hughes, Gaugle & Bronstein, NLVP Library 75-297.

42. Meeting Reports for Inter-Center STS User Charge Working Group Meeting, (Monthly), NLVP Library 75-244, 75-272, 75-284, 75-346, 75-399.

43. Terms and Conditions Policy for STS Use, Battelle, August, 1975, BMI-NLVP-IM-75-10.

44. Outside Users Payload Model, Battelle, July, 1975, BMI-NLVP-IM-75-7 (Revised August 22, 1975).

45. Study of the Commonality of Space Vehicle Application to Future National Needs, Aerospace, March, 1975, NLVP Library 75-250.

46. Outlook for Possible Trends and Situations for the 1980's-2000, Hearth Committee, March, 1975, NLVP Library 75-190, 75-20.

47. Business Risk and Value of Operations in Space (BRAVO), Final Briefing, 1975, Aerospace, NLVP Library 75-177.

48. STS Reimbursement Policy, NASA, J. F. Yardley, 1975, NLVP Library 75-161.

49. Shuttle User Analysis (Study 2.2) Final Report, Aerospace, Pritchard & Sitney, NLVP Library 75-142.

50. Implications for European Space Programmes on the Possibilities of Manned Missions, ESRO Summer School 1973, NLVP Library 75-89.

51. Space Shuttle/The New Baseline, Astronautics and Aeronautics, M. S. Malkin, January, 1974.

52. Of Man's Role in Space, NASA/OMSF, Input to "Outlook for Space" Hearth Committee, December, 1974, NLVP Library 75-18.

53. Space Shuttle Mission and Payload Capture Analysis, Final Report, Aerospace, E. I. Pritchard, June, 1974, NLVP Library 74-496.

54. Advanced Shuttle Payloads Study, NASA/LARC, McDonnell-Douglas, November, 1974, NLVP Library 74-453.

55. Hearing Before the Committee on Aeronautical and Space Sciences, U.S. Senate--Space Shuttle Payloads, October, 1973, NLVP Library 74-442.

56. Planetary Mission Planning for the Next Decade, NASA, D. H. Herman, 1974, NLVP Library 74-402.

57. Presentation - OSS Early Shuttle Mission Payload Planning, NASA, N. W. Hinners, August, 1974, NLVP Library 74-354.

58. STS Planetary Mission Operations Concepts Study, JPL, July, 1974, NLVP Library 74-334.

59. Statement on Department of Defense Activity Related to the NASA Space Shuttle, DOD, M. R. Currie, 1974, NLVP Library 74-234.

60. 1973 Mission Model-Option: Space Shuttle Case (725 Flights), NASA, 1974, NLVP Library 74-180.

61. Tariff Structure for Shuttle Usage, NASA Hq., February, 1974, NLVP Library 74-141.

62. Summarized NASA Payload Descriptions - Automated Payloads and Sortie Payloads, NASA/MSFC, October, 1973, NLVP Library 74-104.

63. The October 1973 Space Shuttle Traffic Model, NASA TM-X-64751, NASA/MSFC, January, 1974, NLVP Library 74-100.

64. The October 1973 NASA Mission Model Analysis and Economic Assessment, NASA TM-X-64798, January, 1974, NLVP Library 74-102.

65. Testimony by D. W. Keller, Mgr., Advanced Programs Space Division, GE Co., (before the Senate Committee on Aeronautical and Space Sciences), October, 1973, NLVP Library 74-23.

66. Space Shuttle and Planetary Missions, NASA, Niehoff & Grivas, May, 1973, NLVP Library 74-24.

67. A Business Man Views Commercial Ventures in Space, G. E., Scarff & Bloom, January, 1973, AIAA Paper 73-78, NLVP Library 74-16.

68. The Space Applications Program 1974, NASA/OA (includes Appendices), Inputs to NASA/NAE Summer Study, NLVP Library 75-412.

69. Preliminary Report on Results of NASA/NAE Summer Study 1974, Letter and Report, NAE to Dr. James Fletcher, November, 1974, NLVP Library 75-411.

70. Practical Applications of Space Systems, Space Applications Board, Assembly of Engineering, National Research Council, NAS, 1975, (Final Report on NASA/NAE Summer Study in Aspen, Colorado, 1974), NLVP Library 75-416.

71. Conference on "Communication Satellites for Health/Education Applications", AIAA, Denver, Colorado, July 20-24, 1975, RPD No. BCL-SS and AS-75-107. Preprints filed under BCL-SS & AS Library No. 75-1.

72. Conference on "Space Shuttle Missions of the 80's", AAS, Denver, Colorado, August 26-28, 1975, RPD No. BCL-SS & AS-75-120. Preprints filed under BCL-SS & AS Library No. 75-4.

73. Interim Report of the Astronomy Spacelab Payloads Study, NASA/GSFC, July, 1975, NLVP Library 75-410.

    Volume 1 - Solar Physics
    Volume 2 - Ultraviolet and Optical Astronomy
    Volume 3 - High Energy Astrophysics
    Volume 4 - Mission Analysis
    Volume 5 - Engineering.

74. Earth Orbiting Stations, Astronautics and Aeronautics, September, 1975, Patterson, Gurr, Butler.

75. Spacelab Users Guide, ESRO, September, 1974, NLVP Library 75-413.

76. Spacelab Program Requirements, ESRO, September, 1974, NLVP Library 75-414.

77. Materials Processing in Space - A Look Toward the Future, Ernst Stuhlinger (NASA/MSFC), Astronautics and Aeronautics, May, 1975, page 20.

78. Materials Processing in Space - New Challenge for Industry, James H. Bredt (NASA/Hq.) and Brian O. Montgomery (NASA/MSFC), Astronautics and Aeronautics, May, 1975, page 22.

79. Space Processing Applications, Testimony of Dr. Harry Gatos, MIT, before the Manned Space Subcommittee of the House Committee on Science and Astronautics, 1974.

80. Spacelab Payload Accommodation Handbook, ESA/ESRO, October, 1974, NLVP Library No. 75-418.

81. Letter to Douglas Lord, NASA Spacelab Program from Messerschmitt-Bolkow-Blohm (MBB), "Presentation to Dr. Fletcher on German Spacelab Utilization Program", June, 1975, NLVP Library No. 75-419.

82. Europe in Space, ESRO, March 1974, NLVP Library 75-423.

83. Total Earth Resources System for the Shuttle Era (TERSSE), General Electric, March 1975.

84. Application of Satellites to Geologic Exploration, Lawrence C. Rowan, American Scientist, July-August 1975, NLVP Library 75-429.

85. Feasibility Study of Commercial Space Manufacturing, Final Report, McDonell-Douglas, December 1975. (Three volumes)

86. External Competition for the STS, Battelle, November 1975, BMI-NLVP-TM-75-2.

87. Utility of Space Transportation System to Space Communication Community, Hughes, October 1975, NASA Contract NAS8-31435.

88. Study for Identification of Beneficial Uses of Space (Phase III), Final Report, General Electric, November 1975, NASA Contract NAS8-28179, BMI-NLVP Library 76-19.

Shuttle Parameters - Cross Referenced to Documentation

1. Space/Space Benefits

   Reference 1

2. Shuttle Overview, Policy, Mission Description

   References 2, 3, 5, 11, 42, 43, 48, 51, 61, 72, 83, 86, 87

3. Mission Planning/Models

   References 6, 8, 26, 29, 47, 53, 56, 57, 58, 59, 60, 63, 64, 66, 68, 69, 82, 83, 84

4. Payload Accommodations (Performance, Crew, Mission, Avionics, Attitude Control, Induced Environments)

   References 3, 4, 34, 37

5. Payload Planning/Models

   References 2 (Vol. II), 7, 14, 27, 28, 30, 44, 72, 83

6. Sortie/Spacelab

   References 2 (Vol. I), 9, 12, 13, 75, 76, 80, 81

7. Payload Descriptions/User Requirements

   Sortie Payloads - References 10, 17, 18, 19, 23, 24, 25, 32, 49, 50, 55, 62, 68, 69, 70, 71, 73, 83
   Automated Payloads - References 15, 16, 31, 37, 41, 47, 49, 55, 62, 68, 69, 70, 71, 83, 84, 85, 87

8. Beneficial Uses of Space

   References 1, 20, 21, 22, 33, 35, 65, 67, 71, 77, 78, 79, 82, 83, 84, 85, 88

9. Advanced Programs/Capabilities

   References 36, 38, 39, 40, 45, 46, 52, 54, 74, 83, 88

APPENDIX B

PROFILE ON PUBLIC SERVICE SATELLITE CONSORTIUM

BOARD OF DIRECTORS

H. REX LEE - Chairman
Adjunct Professor, San Diego State University

DONALD R. QUAYLE - Vice Chairman
Senior Vice President, Corporation for Public Broadcasting

FRANK W. NORWOOD - Secretary
Executive Director, Joint Council on Educational Telecommunications

JACK M. CAMPBELL
President, Federation of Rocky Mountain States

RALPH P. CHRISTENSON, M.D.
Director, Health Information Services Division, Mountain States Health Corporation

DAVID CRIPPENS
Director, Educational Projects, Community Television of Southern California

REV. MONSIGNOR PIERRE DU MAINE
President, Catholic Television Network

CHARLES V. HECK, M.D.
Executive Director, American Academy of Orthopaedic Surgeons

PRESLEY D. HOLMES
Vice President, National Public Radio

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Director of Engineering, Mississippi Authority for ETV

WILLIAM T. REED
Director, Members Services, Public Broadcasting Service

JANE G. RICHARDS
Executive Director, Indiana Higher Education Telecommunication System

EDWARD C. ROSENOW, JR.
Executive Vice President, American College of Physicians

ROBERT M. WALP
Director, Office of Telecommunications, State of Alaska

HAROLD E. WIGREN
Telecommunications Specialist, National Education Association

ROBERT WEDGEWORTH
Executive Director, American Library Association

ELIZABETH L. YOUNG
Executive Director, Kansas Public Television Commission

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MEMBERS
as of January 28, 1976

Alabama ETV Commission
State of Alaska
Aloha System Project
American Academy of Orthopaedic Surgeons
American College of Physicians
American Library Association
Aspen Institute
Bilingual Children's Television, Inc.
Brigham Young University
California Instructional Television Consortium
Catholic Television Network
Coast Community College District
Committee on Institutional Cooperation
Communications Satellite Planning Center-Stanford University
Community Television of Southern California-KCET
Corporation for Public Broadcasting
Federation of Rocky Mountain States
Indiana Higher Education Telecommunication System
Indiana University School of Medicine, Medical Educational Resources Program
Joint Council on Educational Telecommunications
Kansas Public Television Commission
Maryland Center for Public Broadcasting
Medical University of South Carolina
Miami-Dade Community College District
Mississippi Authority for ETV
Mountain States Health Corporation
National Education Association
National Public Radio
North Dakota Educational Broadcast Council
Public Broadcasting Service
Public Interest Satellite Association
Rocky Mountain Corporation for Public Broadcasting
SALINET (Satellite Library Information Network)
San Diego County, Department of Education
San Diego State University
South Carolina Educational Television Network
Southern California Consortium for Community College Television
Southern Educational Communications Association
United Methodist Board of Discipleship
United States Catholic Conference
University of California
Univ. of Calif., San Francisco-Dept. of Public Programs & Continuing Education
University of Hawaii
University of Mid-America
University of Southern California
University of Wisconsin-Stevens Point
Virginia Public Telecommunications Council
Oregon State Department of Higher Education

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THE PUBLIC SERVICE SATELLITE CONSORTIUM

WHAT IS IT?

The Public Service Satellite Consortium is a cooperative of public service organizations interested in their own appropriate use of advanced telecommunication services, now or in the future. The Consortium is operationally oriented, actively concerned with learning the telecommunication requirements of the public service community, planning ways to meet those requirements, and assuring that effective and economical transmission services are available.

WHY WAS IT FORMED?

This new organization was created as a result of a series of meetings of educators, health care specialists, and communication experts excited by experiments conducted on NASA satellites, particularly the Applications Technology Satellite (ATS) series. The design of ATS-6, one of a series of multifrequency high-power communications satellites, made it possible for the first time to use small inexpensive ground stations, costing under $5000 -- a capability demonstrated by distribution of health and education color television courses to remote localities in Appalachia and the Rocky Mountains and two-way communication between doctors and native health aides in isolated villages of Alaska.

After a year of service to India, ATS-6 will be available for more experimentation in late 1976. A new high-power satellite, the Communications Technology Satellite (CTS), launched in January 1976 and jointly operated by the United States and Canada, will also be used.

The successful use of the relatively inexpensive receiving units of ATS-6 was a major breakthrough in the social applications of communications technology. With the return of ATS-6, the advent of CTS, and the availability of other satellites for experimentation, tremendous opportunities exist to learn more about the service possibilities of man's most advanced communication technology. The Public Service Satellite Consortium was created in order that the public service community could learn a maximum amount from these opportunities, then apply the lessons effectively in efficient, economical operational services.

WHAT DOES IT DO?

The goal of the Public Service Satellite Consortium is to permit its members to render their services more effectively and at less cost. The obvious utility of a consortium lies in its ability to aggregate a large number of diverse users into a market group which can then share the risks and take advantage of economies of scale in planning, experimentation, procurement, and operations.

- The first task of the Consortium is to determine the telecommunications requirements of its members. These determinations focus on needs rather than any specific system alternative.
- In the next four years some fundamental decisions about advanced telecommunication will be made within the Federal Communications Commission and the World Administrative Radio Conference. The PSSC will insure that the interests of the members are reflected in the deliberations.
- Potential satellite users need to share information on practical technical options, programming, funding, and costs. The Consortium acts as a clearinghouse for information to its members.
- During the next two to three years there will be an intense period of experimentation based upon CTS and the return of ATS-6. One job of the Consortium is to work with potential experimenters to help make the best use of these satellites.

. During the experiments, the Consortium will address such questions as:

If this experiment turns out to demonstrate a useful service, how can that service be moved beyond experimentation into actual operation?

How does it fit, technically and economically, with other desired services and with other available delivery systems?

What makes service delivery possible, and how can the Consortium aggregate services to make them feasible in actual operations for the purpose of serving people?

. As the experiments begin to develop, PSSC will assist in coordinating facilities and in making the most effective use of the available time.

WHERE IS IT?

At the principal office in San Diego, the staff is engaged in planning and analysis, the gathering and dissemination of information, and policy and administration.

San Diego, California 92182

714-286-6648

The Consortium technical facilities -- the network control center, the earth station, and maintenance headquarters for the scattered small terminals -- are located in Denver and operated in support of a complex of experiments. An excellent engineering staff is engaged in coordinating and providing technical support for experiments and for eventual regular operations by members.

2480 W. 26th Avenue

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The Washington office monitors legislative and regulatory matters and represents the membership on pertinent national issues. At present there is particular emphasis on policy meetings in preparation for the World Administrative Radio Conferences of 1977 and 1979.

1126 16th Street, N.W.

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HOW IS IT SUPPORTED?

The Public Service Satellite Consortium is a non-profit corporation which is supported by member service fees, augmented by funds from Government and other sources. As the organization matures, it will be oriented increasingly to supporting itself by means of services rendered.

WHY USE A SATELLITE?

Communication satellites, while relatively new, are proven and uniquely valuable elements of modern communication. As appropriate, they are used in place of or as supplements to existing terrestrial systems. Whereas the cost of land-based systems increases with the distance covered, the cost of a satellite system remains constant regardless of the distance covered. It can be an economical means of reaching or interconnecting widely separated communities of interest.

To illustrate only a few potential public service uses of satellites:

Medical: Via television, the staff of a central hospital can conduct diagnostic procedures and prescribe treatment for patients located at remote clinics or mobile units.

Physicians in widely separated locations can participate in televised instruction from a major specialty center.

Real-time consultations can be held between distant hospitals, including transfer of medical history and laboratory reports.

Educational: Materials from one learning center can be made available to many geographically dispersed schools, libraries, hospitals, industrial plants, offices, and other locations in which learning can take place. Response from students and teachers can be provided.

Schools geographically separate but educationally related can become functional units in special systems that enable them to share resources and instructional materials designed to meet their common needs.

Continuing education for teachers and other professional groups via satellite can be a cost-effective means of presenting a variety of programs to small audiences.

Libraries: Libraries and computerized data bases across the country can be linked for instant access and transfer of information.

State and Inter-State: The satellite can be used to achieve economies of scale by making it more feasible to plan coordinated systems for administration, health, law enforcement, highways, conservation, public safety, and other social services.

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- - -

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PUBLIC SERVICE SATELLITE CONSORTIUM

San Diego, California 92182

714-286-6648

APPENDIX C

STS NUD TEST CASE
PRESENTATION MATERIAL
(one case only)

SPACE TRANSPORTATION SYSTEM (STS)

NEW USER DEVELOPMENT PROGRAM

PHASE II STUDY

NASA/MSFC CONTRACT NO. NAS 8-31621

Battelle
Columbus Laboratories

SPACE TRANSPORTATION SYSTEM (SHUTTLE)

NEW USER DEVELOPMENT

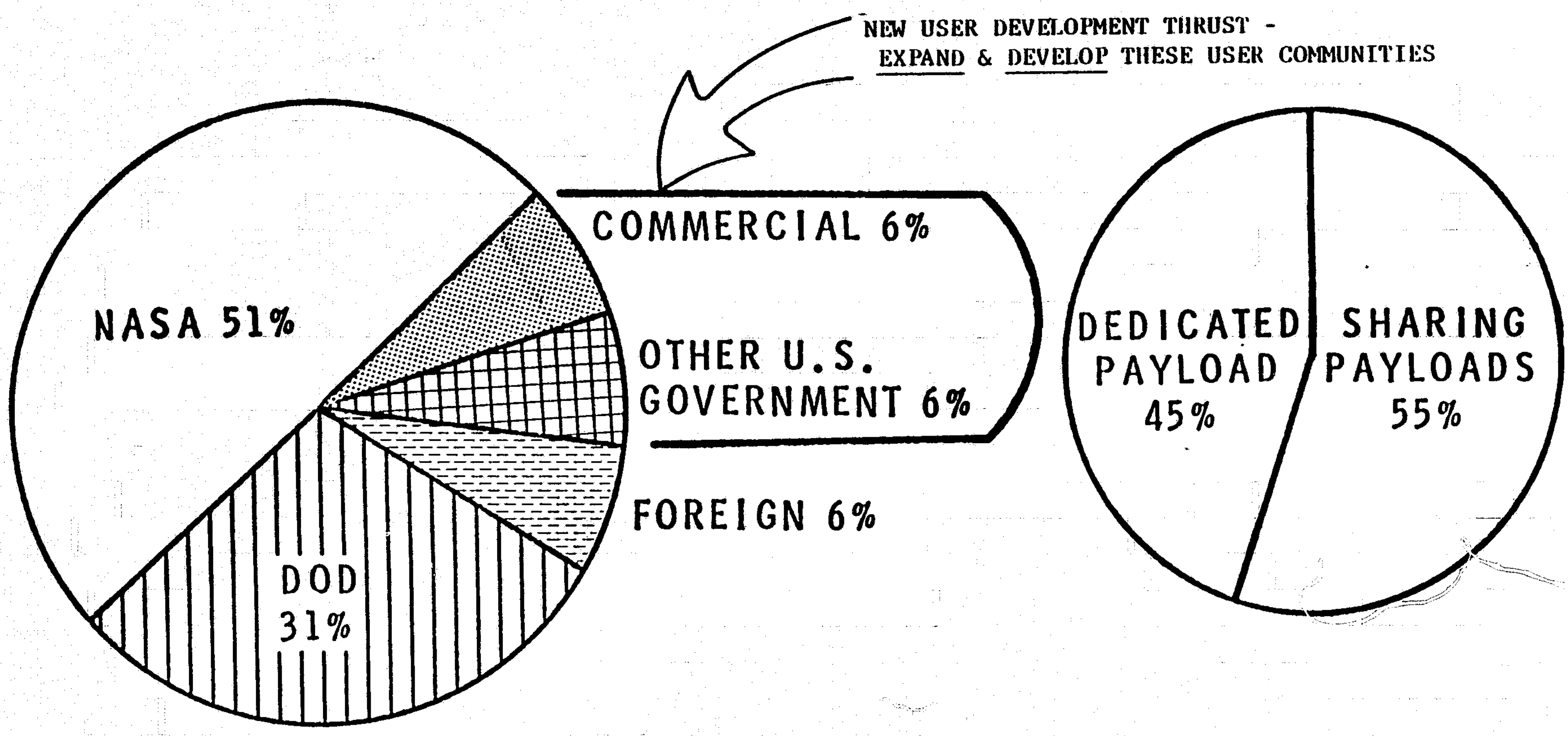
BACKGROUND

- PLANNED USE OF STS IS PREDOMINANTLY NASA/DOD ORIENTED
  - 1973 NASA MISSION MODEL
  - ONLY 18% OF PLANNED PAYLOADS ARE NON-NASA/NON-DOD
- NON-NASA/NON-DOD USER COMMUNITY
  - POTENTIAL EXTENSIVE AND WORLDWIDE
  - YET TO BE DEVELOPED

NASA GOALS

- LONG RANGE
  - DEVELOP A NEW USER COMMUNITY FOR STS TO ACHIEVE:
    A) FULL USE POTENTIAL OF THE STS
    B) ENHANCED ECONOMIC VIABILITY THROUGH OUTSIDE FUNDING
    C) INDUSTRY INVOLVEMENT IN SPACE PROGRAMS
- NEAR TERM
  - FORMULATE A PLAN TO USE IN PURSUING THE LONG-RANGE GOAL

SUMMARY OF PROJECTED STS PAYLOADS



USER DISTRIBUTION OF OCT '73 MSFC PAYLOAD MODEL– 986 PAYLOADS

OCT '73 MSFC PAYLOAD MODEL
758 NON-DOD PAYLOADS

STS NEW USER DEVELOPMENT STUDY

- **OBJECTIVE**
  - DETERMINE HOW NASA SHOULD MARKET THE STS TO USERS OTHER THAN NASA AND THE DOD

- **APPROACH**
  - PREPARE A PLAN TO DEVELOP THE NEW USER COMMUNITY
  - EVALUATE BY CONDUCTING TEST CASES
  - SOLICIT POTENTIAL USER'S COMMENTS/INPUTS

TEST CASE APPROACH

- WIDE RANGE OF POTENTIAL USERS ARE BEING CONTACTED
  - REPRESENTING GOVERNMENT AND INDUSTRY
  - PRESENTING A MIX OF ORGANIZATION TYPES (CONSORTIUM, AGENCIES, BROKER, INDUSTRIAL COMPANIES)
  - COVERING VARIOUS USE AREAS
- TEST CASE ORGANIZATIONS ARE CONSIDERED AS CONSULTANTS
- ORGANIZATIONS ARE COMPLETELY INFORMED OF:
  - OVERALL STS NEW USER DEVELOPMENT PROGRAM PLANNING
  - STUDY OBJECTIVE
  - TEST CASE STRATEGY
- PRESENTATIONS ARE MADE TO USER ORGANIZATION TO:
  - PRESENT OVERALL APPROACH
  - OUTLINE OR PROVIDE STS AND RELATED INFORMATIONAL MATERIAL
  - DESCRIBE SPECIFIC MARKETING APPROACH APPLICABLE TO TEST CASE USER
- TEST CASE USER IS ASKED TO CRITIQUE THE INFORMATIONAL MATERIAL AND MARKETING PLAN
  - THE NEED
  - EFFECTIVENESS
  - COMPLETENESS
  - ADEQUACY

SPACE TRANSPORTATION SYSTEM

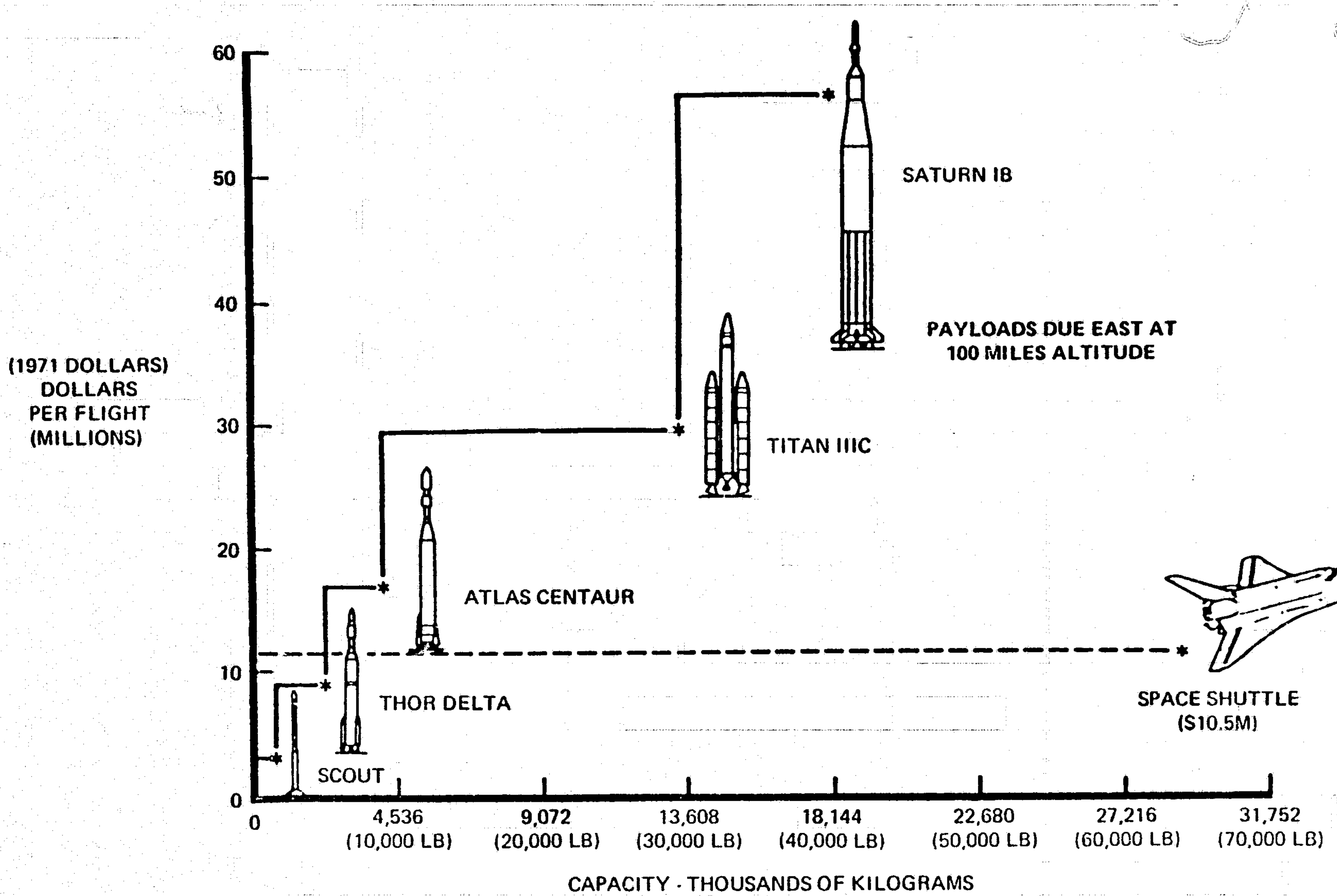
(STS)

SPACE TRANSPORTATION SYSTEM (STS)

- OBJECTIVES -

- PROVIDE A NEW SPACE CAPABILITY
  - TO SUPPORT WIDE RANGE OF SCIENTIFIC, DEFENSE AND COMMERCIAL USERS
  - TO REPLACE THE PRESENT WIDE RANGE OF EXPENDABLE VEHICLES
- REDUCE SPACE TRANSPORTATION COSTS FOR MISSIONS IN THE 1980'S
  - REUSABLE SYSTEM
- REDUCE OVERALL SPACE PROGRAM COSTS
  - RELAXATION OF CONSTRAINTS ON MASS AND VOLUME OF PAYLOADS
  - CHECKOUT, REFURBISHMENT, MAINTENANCE AND UPDATING OF PAYLOADS IN ORBIT
  - IN SPACE SENSOR, SUBSYSTEM AND SYSTEM DEVELOPMENT/TEST CAPABILITY
- INCREASE EFFECTIVENESS OF USING SPACE
  - VERSATILITY IN MISSIONS SUPPORT
  - ROUTINE ACCESS TO SPACE
  - RETURN OF PAYLOAD/EXPERIMENT FROM SPACE

Comparative Launch Costs



SPACE TRANSPORTATION SYSTEM (STS)

- PHYSICAL COMPONENTS -

- SHUTTLE VEHICLE SYSTEM
  - THE ORBITER (REUSABLE)
  - SOLID ROCKET BOOSTERS (2) (RECOVERABLE/REUSABLE)
  - EXTERNAL TANK (EXPENDABLE)

- INTERIM UPPER STAGE (IUS) OR SPACE TUG
  - REQUIRED TO DELIVER PAYLOADS TO HIGHER EARTH ORBITS
  - PLANETARY MISSIONS

- SPACELAB
  - PRESSURIZED MODULES (SHIRT SLEEVE ENVIRONMENT)
  - EXTERNAL EQUIPMENT PALLETS
  - MODULAR DESIGN PROVIDES CONFIGURATION FLEXIBILITY
  - 7 - 30 DAY MISSION CAPABILITY

SPACE TRANSPORTATION SYSTEM (STS)

- WHAT IT CAN DO -

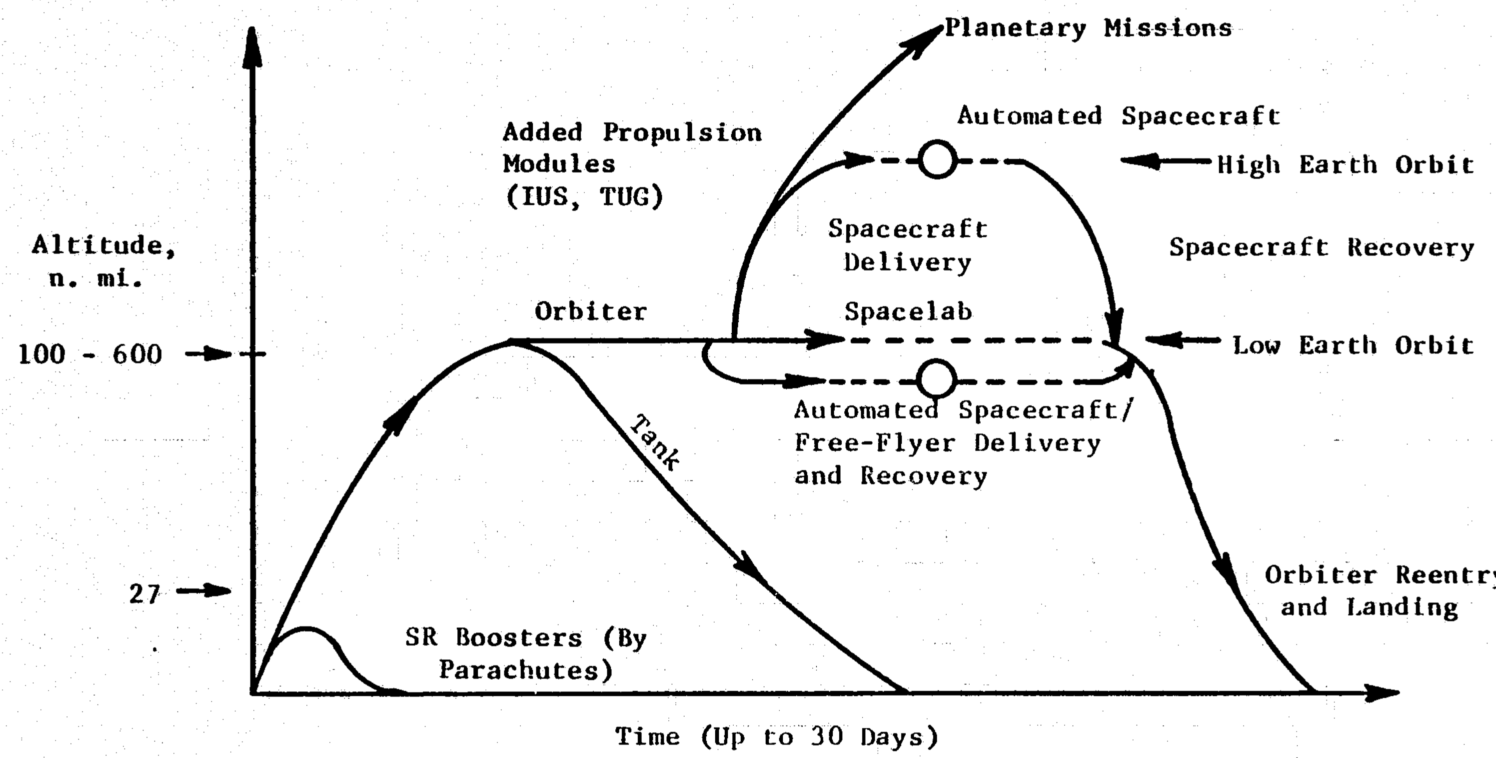
- DELIVERY AND RECOVERY OF AUTOMATED SPACECRAFT AND FREE-FLYING LABORATORIES TO AND FROM NEAR EARTH ORBITS - 1980 AVAILABILITY

- DELIVERY OF AUTOMATED SPACECRAFT ATTACHED TO PROPULSION MODULES (IUS) FOR HIGH ENERGY MISSIONS (GEOSYNCHRONOUS ORBITS, PLANETARY MISSIONS) - 1981 AVAILABILITY

- RECOVERY OF AUTOMATED SPACECRAFT FROM SYNCHRONOUS ORBITS (TUG) - 1984 AVAILABILITY

- IN ORBIT, SHIRT SLEEVE ENVIRONMENT LABORATORY OPERATIONS (SPACELAB) FOR UP TO 30 DAY MISSIONS - 1980 AVAILABILITY

STS ALTERNATIVE MISSIONS PROFILE

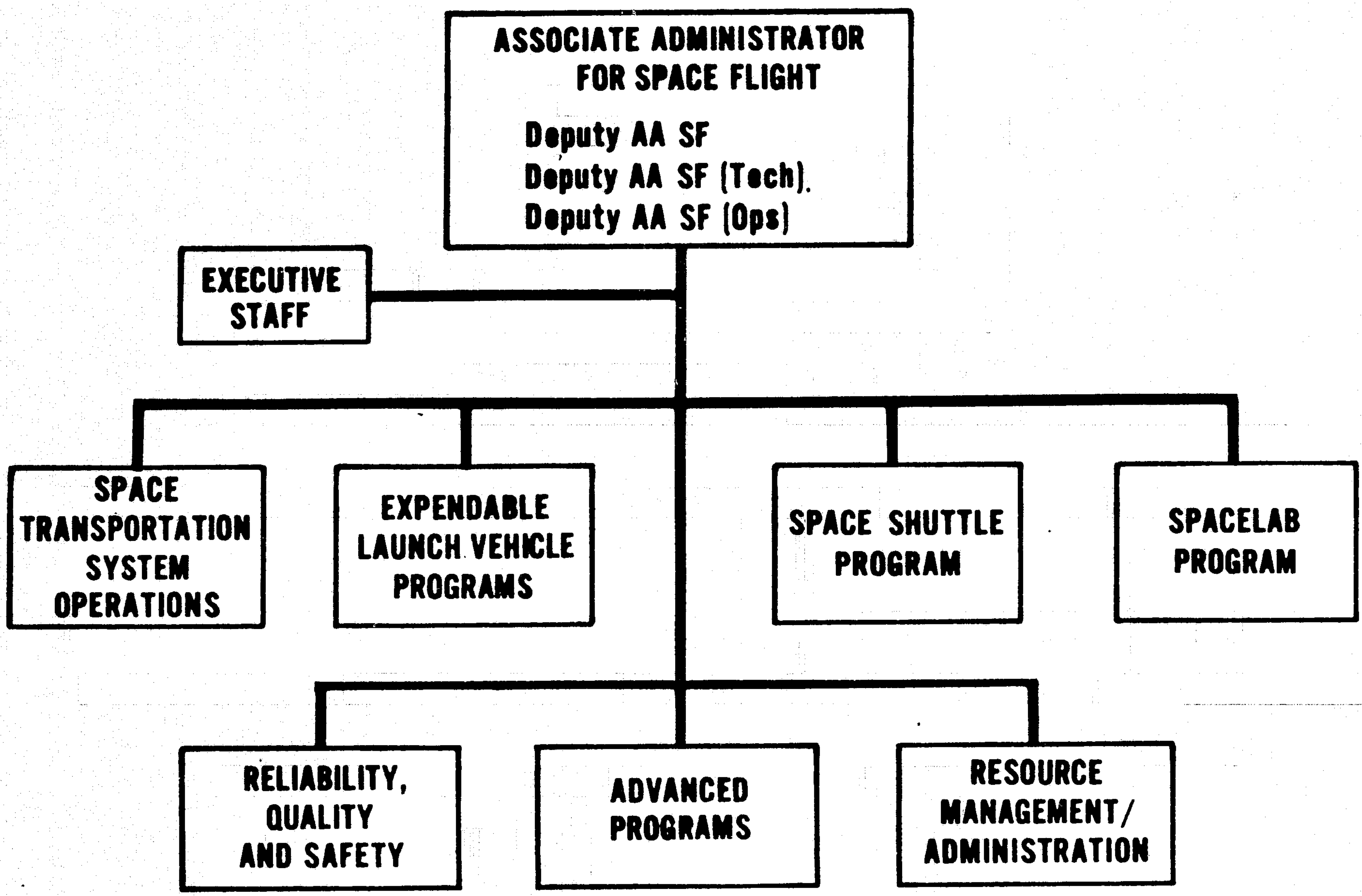


SPACE TRANSPORTATION SYSTEM

- SORTIE/SPACELAB MISSIONS -

- CHANGES CONCEPT OF SPACE R&D
  - PERMITS MAJOR PORTION OF RESEARCH, TEST AND EVALUATION TO BE DONE IN SPACE
  - SUBSTANTIAL AMOUNTS OF RESEARCH EQUIPMENT CAN BE PLACED IN ORBIT & RETURNED
  - RESEARCHERS NOT REQUIRED TO BE ASTRONAUTS
  - PERMITS SCIENTISTS, DOCTORS, ENGINEERS, TECHNICIANS IN SPACE
  - ON ORBIT STAY TIME IS SIGNIFICANT
  - EXPERIMENT HARDWARE/PAYLOAD CAN BE RETURNED TO EARTH
  - ENTIRE RESEARCH FACILITY CAN BE INTEGRATED AND TESTED BY USER
- EXTENSIVE SPACE ENVIRONMENT PROVIDED
  - ZERO-G
  - SYNOPTIC VIEW OF EARTH
  - SPACE RADIATION
  - COMBINED HARD VACUUM AND HEAT REJECTION
  - ISOLATION FROM TERRESTRIAL ENVIRONMENT (VIBRATION, SEISMIC AND ACOUSTIC NOISE, CONTAMINATION)

OFFICE OF SPACE FLIGHT



MATERIALS PROCESSING IN SPACE

PROGRAM GOAL

- **TO INITIATE ECONOMICALLY SELF-SUSTAINING UTILIZATION OF SPACE FLIGHT CAPABILITIES FOR ACTIVITIES IN MATERIALS SCIENCE AND TECHNOLOGY**
  - INDUSTRIAL RESEARCH
  - LABORATORY SERVICES
  - ORBITAL MANUFACTURING PROCESSES

MATERIALS PROCESSING IN SPACE

PROGRAM APPROACH

- **EARLY DEMONSTRATIONS OF UNIQUE EFFECTS ACHIEVABLE IN SPACE**
  - USE OF ALL FEASIBLE FLIGHT OPPORTUNITIES
  - DIVERSIFIED EXPERIMENT PROGRAM
- **CONCENTRATION ON AREAS RELATED TO HIGH VALUE APPLICATIONS**
- **BROAD PARTICIPATION FROM POTENTIAL USER COMMUNITY**
  - EXPERIMENT PROGRAM DEFINED BY USER PROPOSALS
  - MULTIPLE EXPERIMENTS IN GENERAL PURPOSE APPARATUS
- **ECONOMICAL APPROACHES TO SPACE EXPERIMENTATION**
  - MINIMUM COMBINED CAPITAL & OPERATING COSTS
  - LOW UNIT COSTS ACHIEVED THROUGH HIGH PRODUCTIVITY
- **ENCOURAGEMENT OF EARLY PRIVATELY FUNDED ACTIVITY**
  - COST LEVELS APPROPRIATE FOR INDUSTRIAL R&D
  - PROPRIETARY RIGHTS IN EXPERIMENT DATA

MATERIALS PROCESSING IN SPACE

- <u>PRINCIPAL RESEARCH AREAS</u>

  SEPARATION AND PURIFICATION PROCESSES FOR BIOLOGICAL MATERIALS

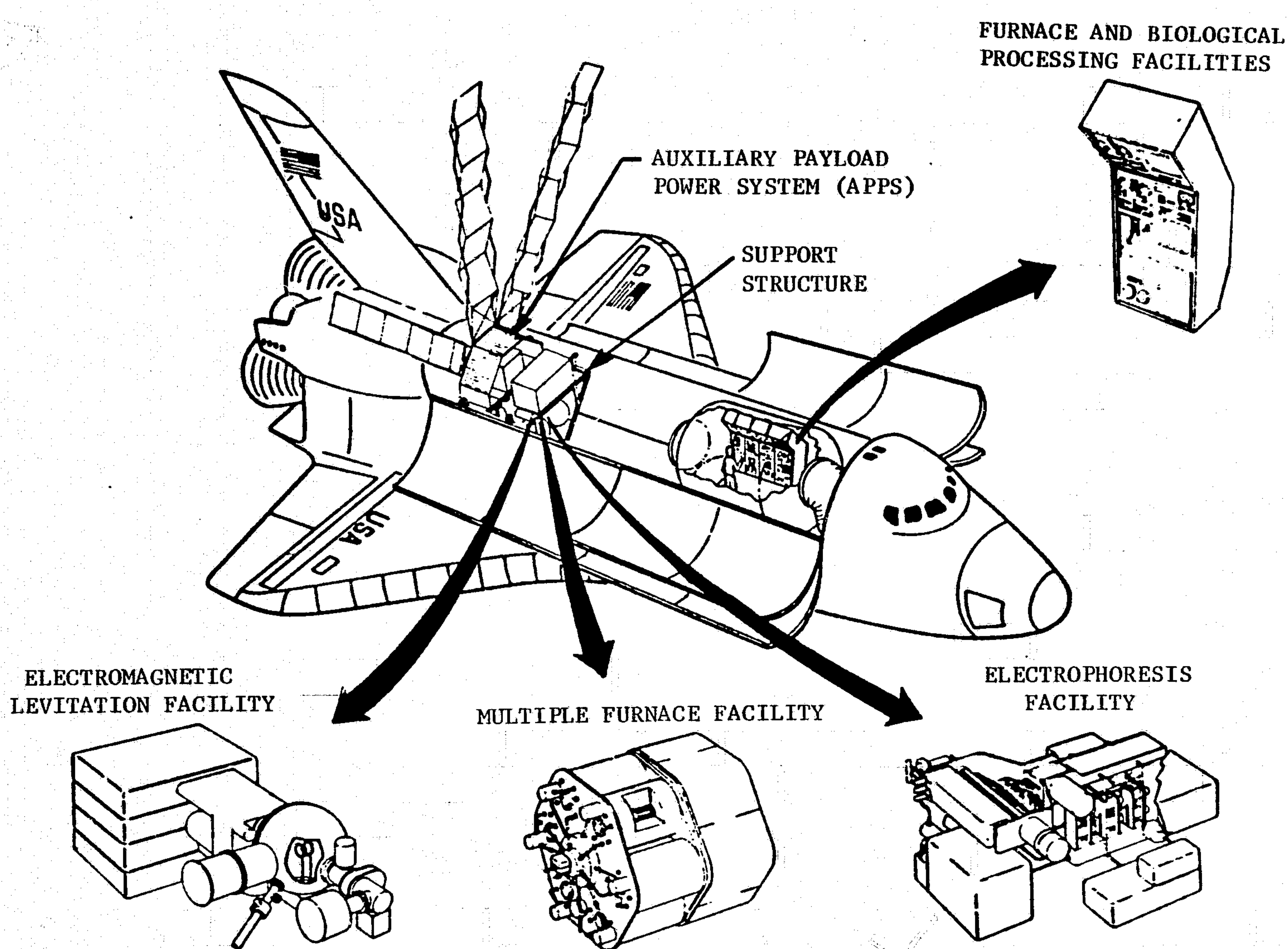
  CRYSTAL GROWTH OF ELECTRONIC MATERIALS

  CONTROL OF METALLURGICAL PROCESSES

  PREPARATION OF IMPROVED GLASS AND CERAMIC MATERIALS

  MEASUREMENT OF PHYSICAL AND CHEMICAL PROCESSES IN FLUIDS

STS/SPACELAB SPACE PROCESSING CONFIGURATION



MATERIALS PROCESSING IN SPACE

SUMMARY OF STATUS AND PLANS

- APOLLO/SKYLAB/ASTP EXPERIMENTS HAVE PROVIDED PROOFS OF PRINCIPLE
- ROCKET EXPERIMENTS BUILD DATA BASE AND EXPAND CIRCLE OF EXPERIENCED EXPERIMENTERS
- STS PAYLOAD STUDIES DEFINE LOW COST SYSTEM APPROACHES AND EXPERIMENT APPARATUS TO MEET USER NEEDS FORSEEABLE FOR 1980-81
    - SCIENTIFIC WORKING GROUP DEFINES EXPERIMENT NEEDS
    - ENGINEERING CONTRACTORS DERIVE EQUIPMENT SPECIFICATIONS
    - SEPARATE STUDY OF AUXILIARY PAYLOAD POWER SYSTEM (APPS)
- INITIAL PAYLOAD INVENTORY SELECTED FROM STUDY RESULTS
    - EQUIPMENT READY FOR FLIGHT IN 1980
    - PAYLOAD INVENTORY TO BE AUGMENTED FOR POST-1981 MISSIONS

INVENTION AND DATA RIGHTS POLICY

- NASA POSITION GOVERNED BY THE USER'S PLANS AND INTENTIONS TO COMMERCIALIZE THE RESULTS OF SPACE RESEARCH AND THE DEGREE OF PRIVATE FUNDING INVOLVED

- <u>PRIVATELY FUNDED</u> (WHERE USER PAYS FOR RESEARCH AND REIMBURSES NASA FOR PRO RATA LAUNCH COSTS)

  - NASA WILL NOT ACQUIRE RIGHTS TO USER'S INVENTIONS, PATENTS, OR PROPIETARY DATA
  - USER WILL BE REQUIRED TO FURNISH NASA WITH GENERAL DESCRIPTION AND OBJECTIVE OF RESEARCH
  - POST FLIGHT REPORT REQUIRED DESCRIBING PROGRESS TOWARD COMMERCIALIZATION OF THE RESULTS
  - INCLUSION OF PROPRIETARY DATA IS NOT INTENDED

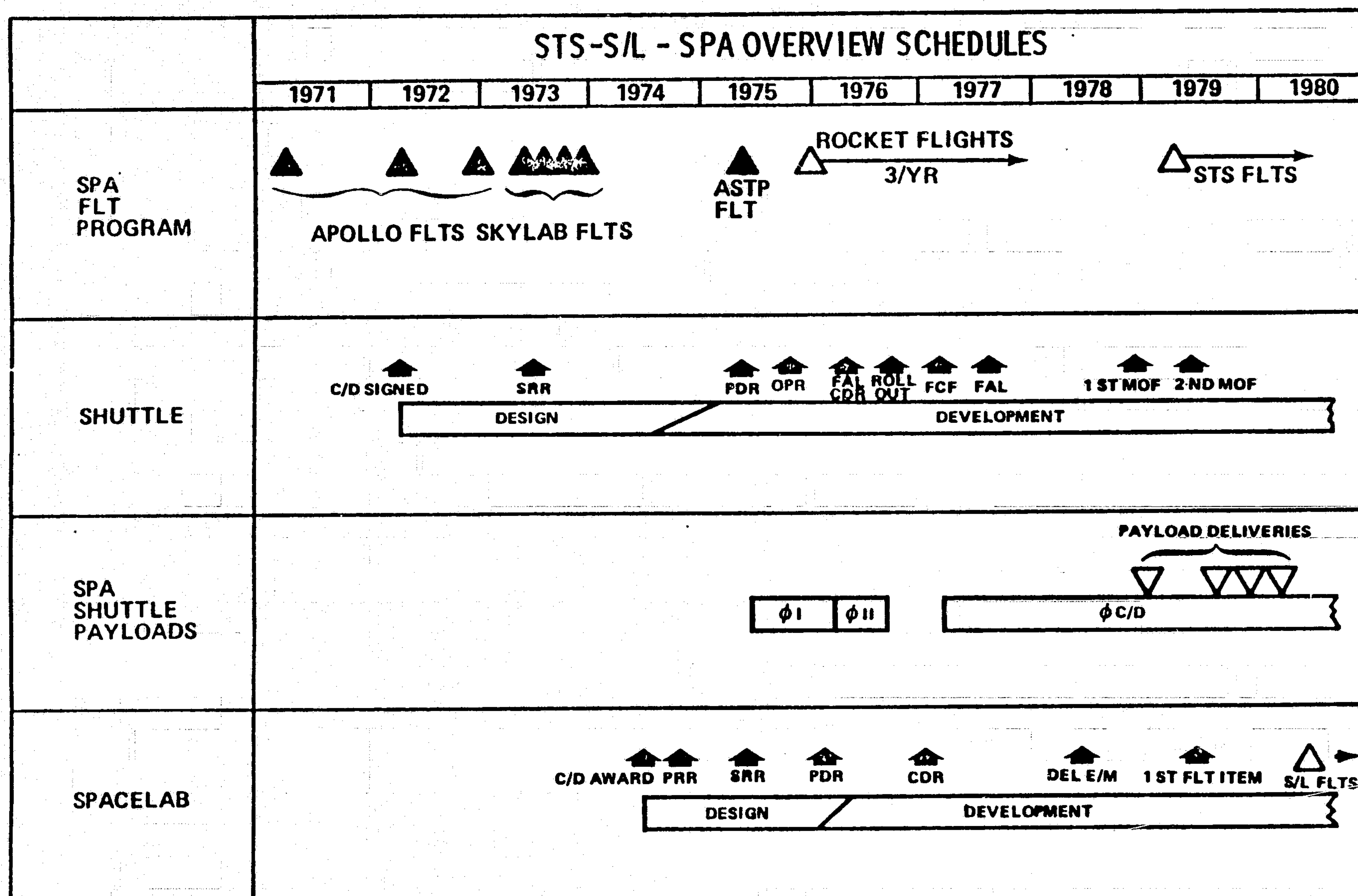
- <u>COST SHARING</u> (RESEARCH AND LAUNCH COSTS SHARED BY NASA AND USER)

  - NASA WILL BE PREPARED TO CONSIDER FAVORABLY THE NEGOTIATION OF AN ARRANGEMENT WHEREBY THE COST SHARING USER WILL BE GRANTED A CONDITIONAL EXCLUSIVE POSITION IN INVENTIONS AND DATA
  - EXTENT TO WHICH RIGHTS MAY BE GRANTED WILL BE GOVERNED BY DEGREE OF SHARED COSTS AND POTENTIAL COMMERCIAL APPLICATION OF RESULTS

- <u>NASA FUNDED</u> (NASA PAYS FOR RESEARCH AND LAUNCH COSTS)

  - NASA IS REQUIRED BY LAW TO TAKE TITLE TO INVENTIONS MADE IN DEVELOPING AND CARRYING OUT NASA FUNDED RESEARCH
  - HOWEVER, NASA WILL GIVE FAVORABLE CONSIDERATION TOWARD WAIVING TITLE TO SUCH INVENTIONS IF, IN NASA'S VIEW, THE USER GIVES PROMISE OF COMMERCIALIZING THE RESEARCH RESULTS

- ABOVE STATED POLICY ALREADY IN EFFECT ON NASA SPACE PROCESSING SOUNDING ROCKET PROGRAM


STS-S/L - SPA OVERVIEW SCHEDULES
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
SPA FLT PROGRAM
APOLLO FLTS
SKYLAB FLTS
ASTP FLT
ROCKET FLIGHTS 3/YR
STS FLTS
SHUTTLE
C/D SIGNED
SRR
PDR
OPR
FAL CDR
ROLL OUT
FCF
FAL
1 ST MOF
2 ND MOF
DESIGN
DEVELOPMENT
SPA SHUTTLE PAYLOADS
PAYLOAD DELIVERIES
ϕ I
ϕ II
ϕ C/D
SPACELAB
C/D AWARD
PRR
SRR
PDR
CDR
DEL E/M
1 ST FLT ITEM
S/L FLTS
DESIGN
DEVELOPMENT

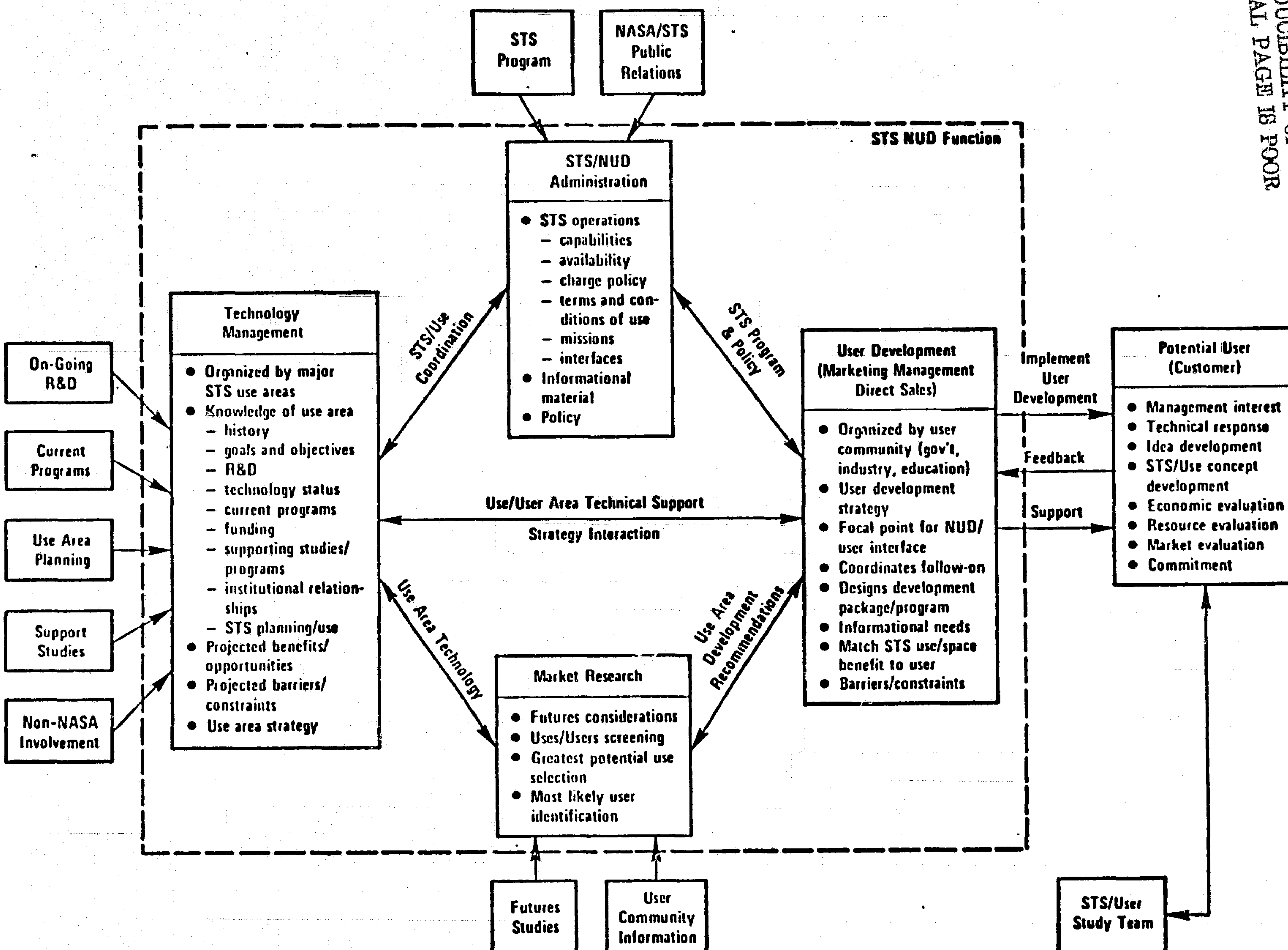
- NEW USER DEVELOPMENT
  - DYNAMIC PROCESS
  - SPECIFIC TO EACH USER ORGANIZATION
  - FUNCTIONAL OVERVIEW
  - TECHNICAL SESSION
  - INFORMATION REQUIREMENTS
- SPACE PROCESSING
  - ECONOMIC VIABILITY
  - EXAMPLES FROM PRIVATE INDUSTRY
  - ELECTROPHORETIC SEPARATION
  - EXAMPLES OF SPACE PROCESSING--BIOLOGICAL MATERIALS
- HIGH SPECIFICITY SEPARATION OF ISOENZYMES
- SOUNDING ROCKET PROGRAM

STS NEW USER DEVELOPMENT PROGRAM

- REFLECTS DYNAMIC/ITERATIVE PROCESS TO ACHIEVE INITIAL USER INTEREST AND SUBSEQUENT IDEA GENERATION WITHIN THE USER ORGANIZATION
  - PLAN DEVELOPED FOR SPECIFIC USER (NEED, BENEFIT, ORGANIZATION)
  - INITIAL MANAGEMENT LEVEL CONTACT
  - SUBSEQUENT TECHNICAL WORKING SESSION WITH USER R&D PERSONNEL
  - NUD SUPPORTED BRAINSTORMING BY USER
  - RESPONSIVE TO FEEDBACK
  - FORMATION OF STS/USER STUDY TEAM
  - DIRECT STS SUPPORT MADE AVAILABLE

- USER DEVELOPMENT STRATEGY DICTATED BY:
  - USE AREA (E.G., WEATHER AND CLIMATE, EARTH RESOURCES, COMMUNICATIONS, ETC.)
  - USER INVOLVEMENT IN SPACE (COMSAT VS ELI LILLY))
  - TECHNOLOGY STATUS (SPACE COMMUNICATIONS VS SPACE PROCESSING)
  - SPECIFIC USER ORGANIZATION (GE VS PSSC)
  - USER COMMUNITY (GOVERNMENT AGENCY OR INDUSTRY)
  - PRELIMINARY ASSESSMENT OF STS BENEFIT TO USER'S NEED

STS/NEW USER DEVELOPMENT PLAN



TECHNICAL SESSION

AGENDA

- BACKGROUND ON SPACE SHUTTLE

  VISUAL AIDS - SLIDES OR FILM

- CURRENT STATUS OF SHUTTLE PROJECT
- GENERAL BENEFITS ANTICIPATED FROM PROJECT
- PARTICULAR BENEFITS

  ILLUSTRATIONS FROM PRIOR INFORMATION ON CLIENT
  INITIAL CALL

- IDENTIFICATION OF OTHER POSSIBLE APPLICATIONS

  BY DISCUSSION AND QUESTIONS

- PROCEDURE FOR FURTHER ACTIVITY

  SUGGEST FORMATION OF STUDY TEAM

  OFFER NASA ASSISTANCE

INFORMATION TO BE PROVIDED POTENTIAL USERS

- OVERVIEW OF STS CONCEPT/PROGRAM
- COST PER FLIGHT
- USER CHARGE/SHARING POLICY
- METHODS OF DETERMINING CHARGE/DESIGN TRADEOFFS RELATED TO CHARGE
- TERMS AND CONDITIONS OF USE
- STS PLANNED AVAILABILITY/ACCESSABILITY
- METHOD OF INTERFACING WITH STS (APPLICABLE TECHNOLOGY AND OPERATIONS)
- STS BENEFITS/CONSTRAINTS (GENERAL AND USER UNIQUE)
- ELV TO STS TRANSITION PLAN
- MEANS OF POTENTIAL EARLY INVOLVEMENT FOR USE
- SPECIFIC FOLLOW ON STEPS
- INFORMATIONAL CONTACTS WITHIN NASA

SPACE PROCESSING

ECONOMIC VIABILITY:
- SPECIALIZED MATERIALS
- SMALL AMOUNTS
- HIGH VALUE ADDED
- SPACE ENVIRONMENT UNIQUENESS

MATERIAL	ENVIRONMENT
METALS	HOMOGENEITY
GLASSES	NO CONVECTION
ELECTRONIC	NO G-SEPARATION
BIOLOGICAL	PURITY
	CONTAINERLESS MELTING
	ELECTROPHORESIS IN ZERO G

MCDONNELL DOUGLAS/MONSANTO	–	SILICON RIBBON FOR SEMICONDUCTOR DEVICES
GENERAL ELECTRIC	–	X-RAY TUBE TARGETS
OWENS-ILLINOIS	–	IMPROVED LASER GLASS
ABBOTT-LABS	–	UROKINASE ENZYMES
GE/UNIVERSITY OF CALIFORNIA	–	ERYTHROPOIETIN HORMONE
GE SPACE SCIENCE	–	VACCINES
	–	LIGHT TRANSMITTING FIBER

ELECTROPHORETIC SEPARATION OF BIOLOGICAL MATERIALS

- Materials to be separated are placed in solution under the influence of an electrical field.
- Different materials move different distances in a given time since each has distinct electrical characteristics.
- Resolution of separation is limited only to gravity-caused convection of solutions.

IN SPACE, GRAVITY-CAUSED CONVECTION IS NOT A FACTOR. HIGHLY RESOLVED AND CONCENTRATED BIOLOGICAL MATERIALS ARE POSSIBLE.

- Cells
- Lipoproteins
- Enzymes
- Hormones
- Vaccines

THE PROCESS DOES REQUIRE VERY ELABORATE EQUIPMENT.

- Temperature
- Pressure
- Flow Conditions
- Concentration
- Other Parameters

APOLLO-SOYUZ TEST PROGRAM
BIOLOGICAL MATERIALS

- Lymphocytes - separation into subgroups might yield new approaches to fighting disease and stabilization of transplanted organs. (NASA MA-011)

- Lymphocytes - continuous flowing solutions to prepare materials in useful quantities are being devised, with special attention to transplanted bone marrow rejection in lukemia victims. (Max Planck Institute, FRG MA-014)

- Urokinase - kidney cells were separated from their kidney medium and returned to earth where they produced 6-7 more times urokinase than would have been possible with earth-separated cells. This substance is a naturally occurring enzyme which dissolves blood clots. (Abbott Labs MA-011)

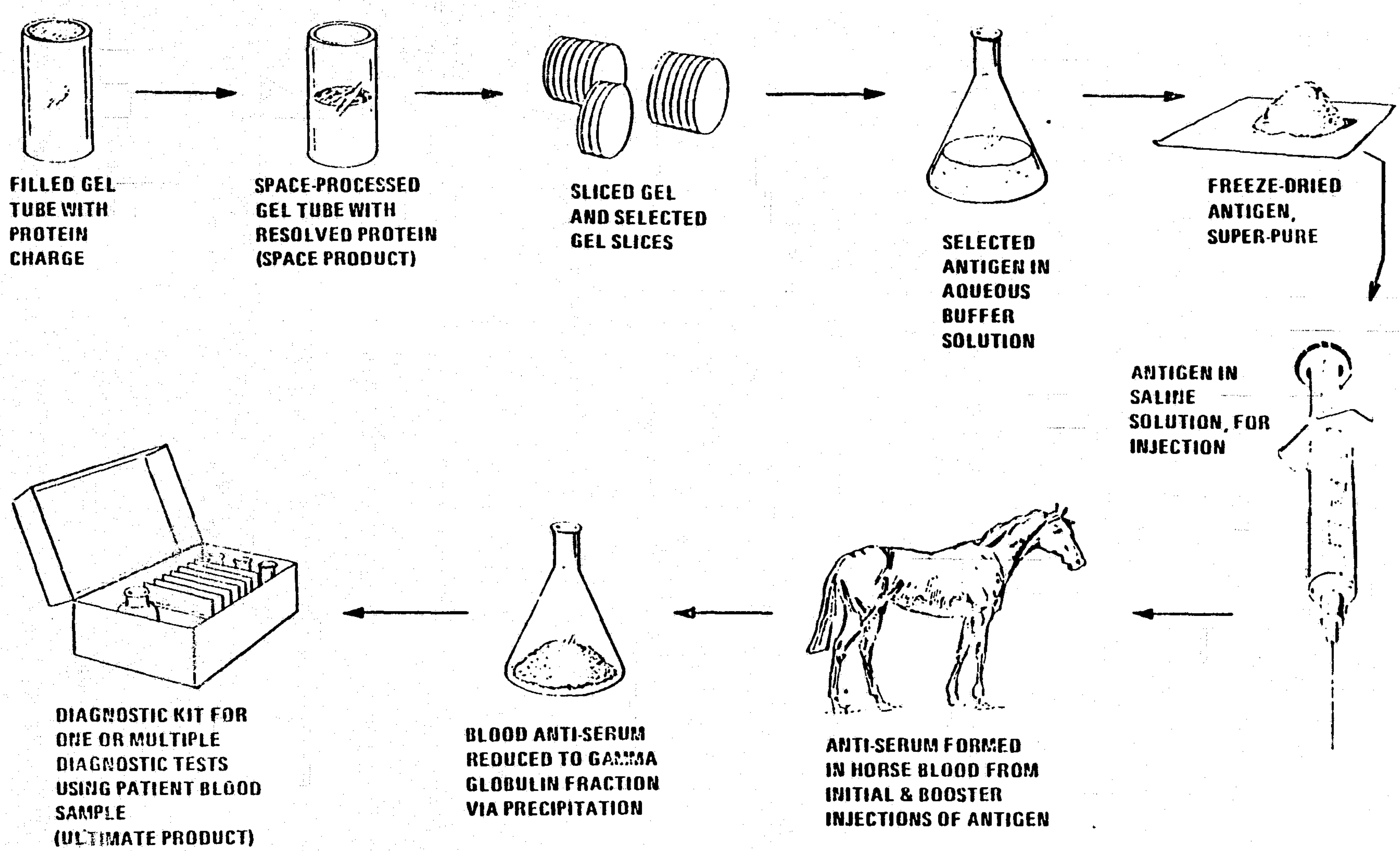
BIOLOGICAL MATERIALS
EXAMPLES OF SPACE PROCESSING

- Erythropoietin - hormone produced by kidneys which stimulates bone marrow cells to produce red blood cells. Not yet obtained in pure state on earth; still contains bacterial anti-toxins. The hormone could obviate dialysis, and enhance kidney transplant acceptance rates which suffer from pre-operative transfusions. Goal is to determine chemical structure in pure state and synthesyze. (NIH, General Electric, University of Southern California)

- Vaccines - purity and strength could be enhanced. Space environment would provide the opportunity to purify out reaction-causing agents in the vaccine.

- Space Processed Isoenzymes - filled gel tube with protein charge is space processed (resolved) and returned to earth for processing into gamma globulin fraction for use in diagnostic kits. (G.E. Bus Study)

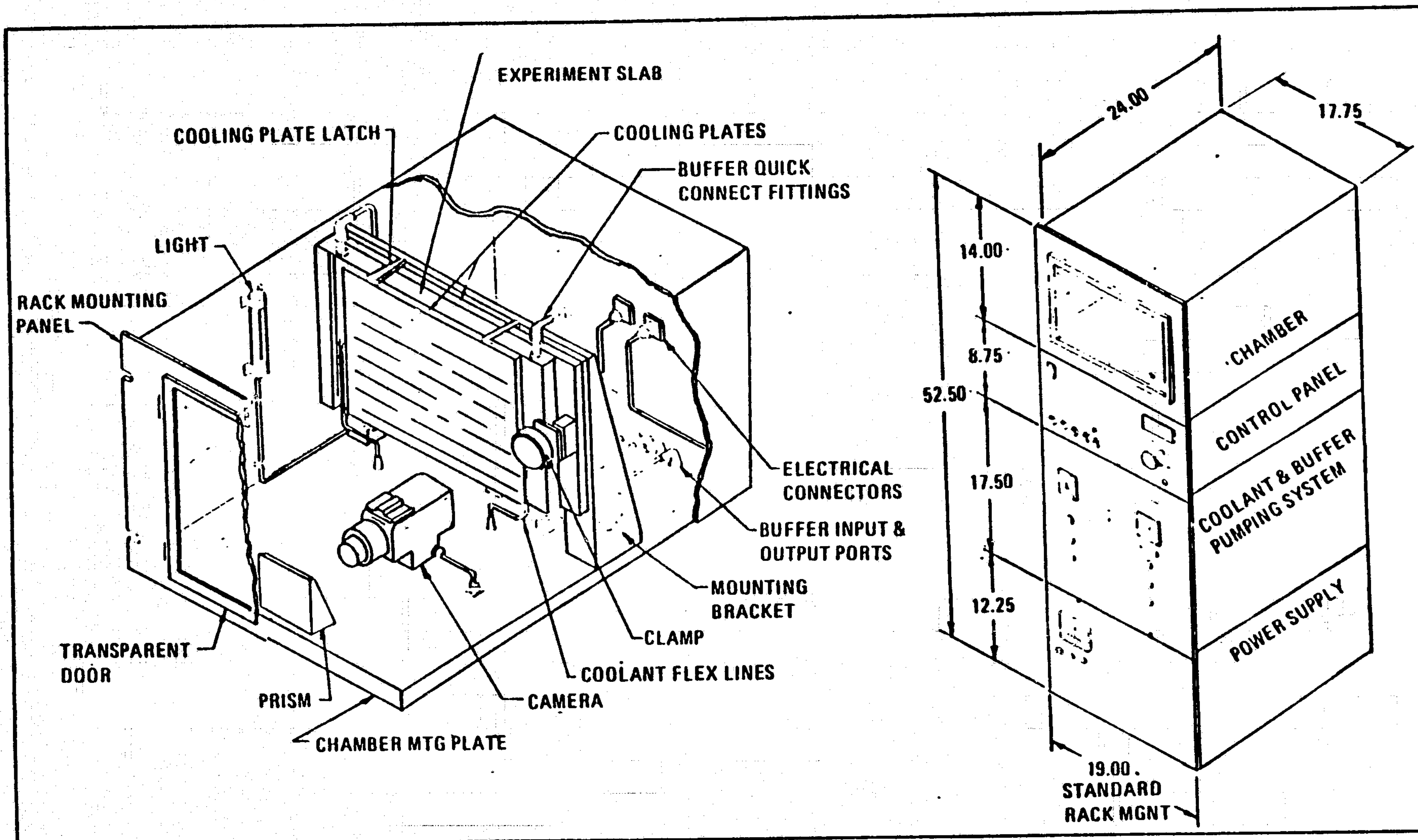
ISOENZYMES PROCESS STEPS



Decisions	Current Preferred Method
1. Choice of gel composition, density, etc.	large pore gel
2. Choice of forming and loading gel prior to launch or in space	prior to launch
3. Selection of Buffer System	Discontinuous
4. Selection of Running Conditions	batch process, small quantities
5. Selection of Separation Method	gel electrophoresis/ isoelectric focussing
6. Selection of Isolation Method	freeze gels
7. Choice of Preliminary Separation method	ammonium sulphate precipitation, columnchromatography, & dialysis
8. Choice of Preliminary Preservation method	lyophilization

Unknowns* Which Require Experiments and Tests for Resolution

1. Dissolving gel possibilities and characteristics.
2. Loss of isolation/resolution in frozen storage.
3. Migration of components under the influence of weak forces.
4. Ability of gel, etc., to withstand launch forces (g's & vibration).
5. Electrophoresis process stability at less than 10 volts/cm.
6. Effects of voltage gradient on enzyme mobility.
7. Relationship of enzyme mobility to resolution.
8. Ohmic heating rates in gels.
9. Convection rates in enzyme bands in gels.
10. Effects of electrophoresis path length on resolution of isoenzymes.
11. Relative effectiveness of large- and small-pore gel electrophoresis and isoelectric focussing.
12. Effects on total process of variations in buffers, gel types, running time, voltage gradient, etc.



Shuttle/Space Lab Gel Electrophoresis Experiment

ECONOMIC VIABILITY KEY ASSUMPTIONS

- 10 ANTIGENS OBTAINED BY GEL ELECTROPHORESIS USEFUL IN EARLY DIAGNOSIS OF 10 DISEASES SUCH AS:

Myocardial infarction	Nervous system disorders
Hepatoma	Cerebral infarctions
Muscular dystrophy	Glycogen storage
Renal disease	Infectious disorders

- POPULATION OF 200 MILLION WITH INCIDENCE OF 1 PERCENT IN EACH DISEASE = 20 MILLION CASES

Type Screening	Discovery Rate	Time Period	Kits/Year
Selective	1:5	5 yrs	20 mm
General	1:20	8 yrs	50 mm

- MARKET SHARE OF KIT SUPPLIER = 10 PERCENT

- UNIT PRICE DECLINES FROM $15 TO $6

- UNIT COST DECLINES FROM $5.30 to $2.49

- R&D COST TO FIRST SALE

  CASE A - USER PAYS ALL R&D (3.8 mm OVER 8 YRS)

  CASE B - NASA DEMONSTRATES TECHNICAL FEASIBILITY OF SEPARATION TECHNIQUE (2.4 mm OVER 4 YRS)

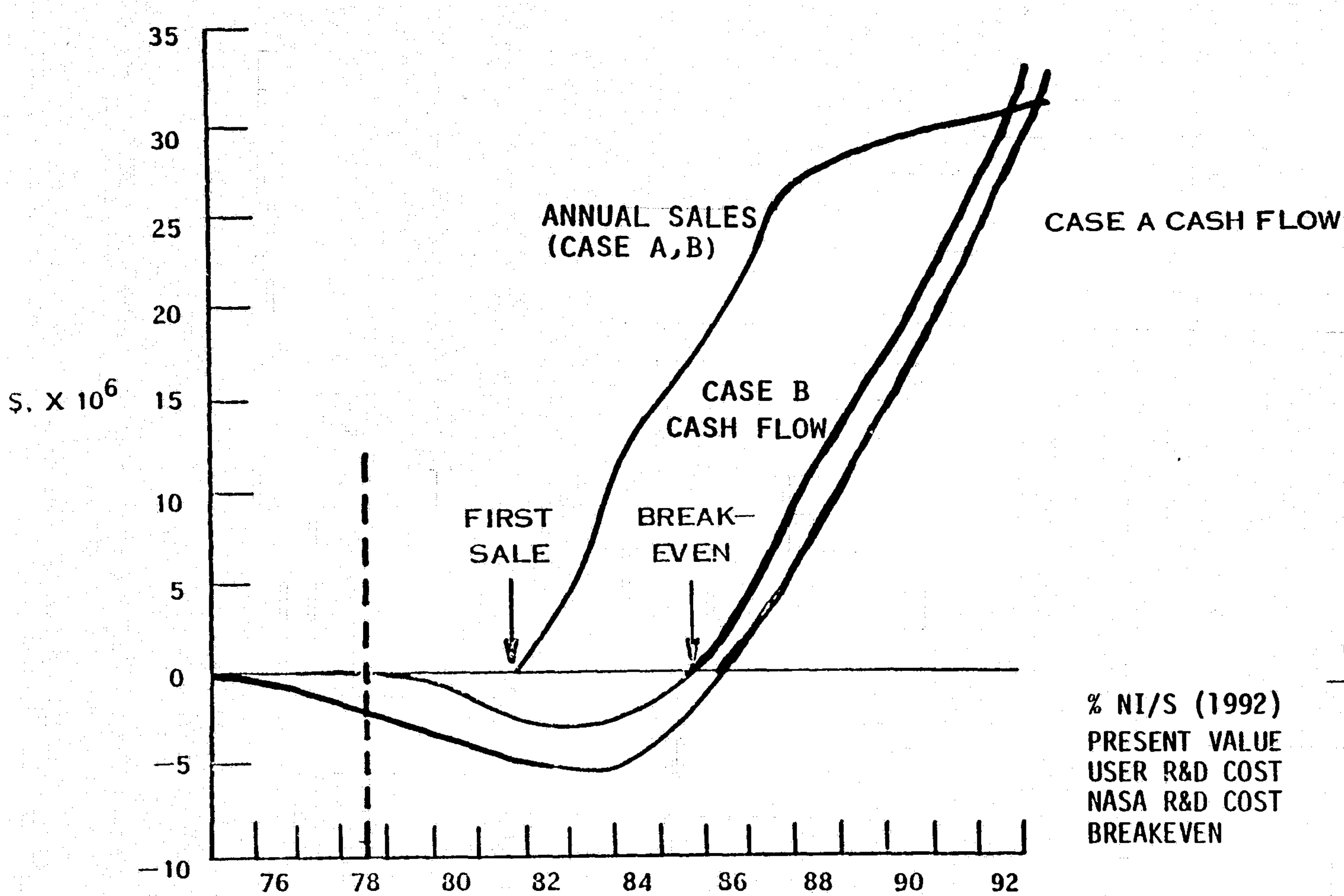
  USER PAYS TO DEVELOP PRODUCTION AND MARKET (1.4 mm OVER 4 YRS)

- 600 mg OF ANTIGENIC PROTEIN PER 7 DAY FLIGHT

  SUFFICIENT FOR 120,000 KITS

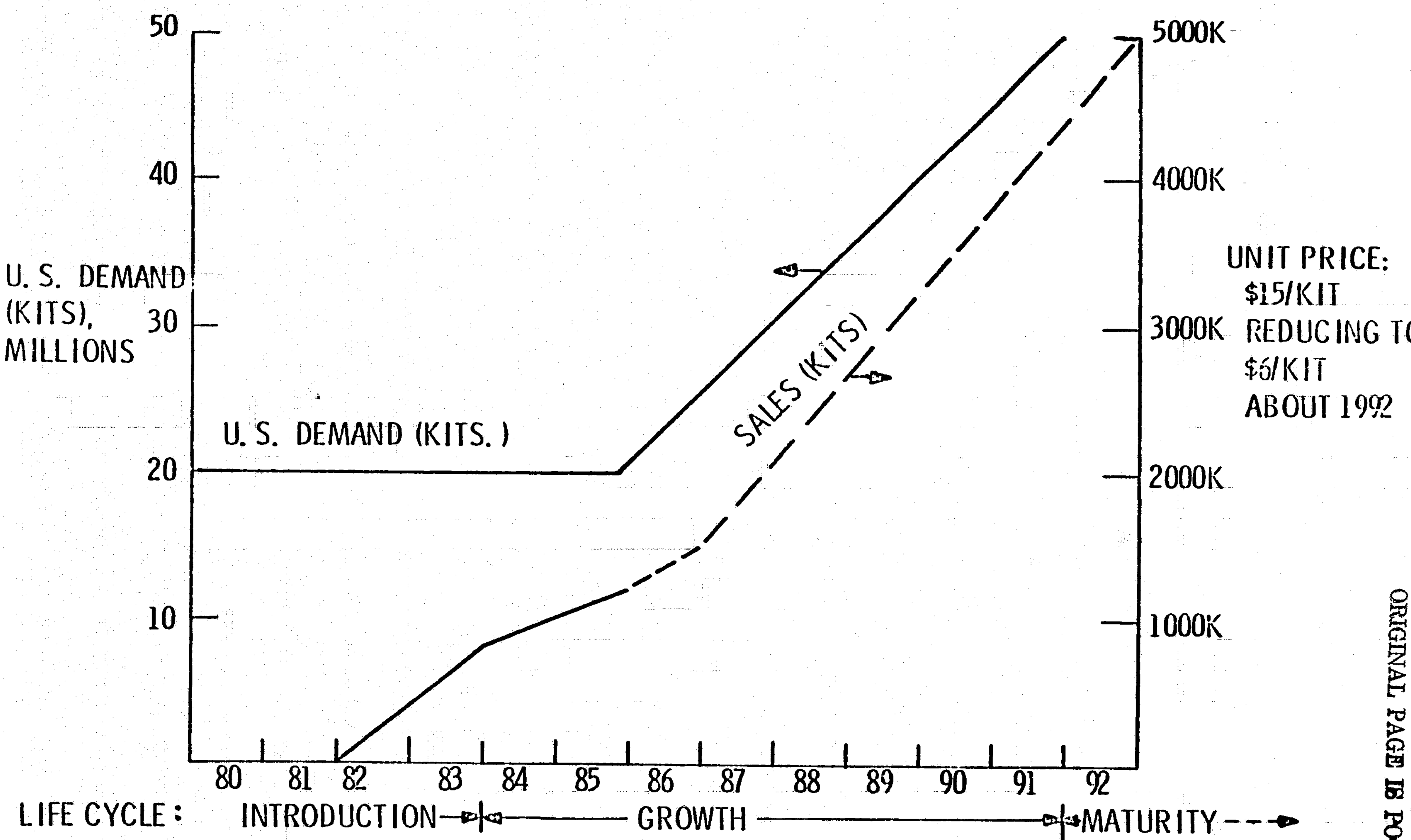
  10 FLIGHTS PER YEAR WITH 5 SEPARATORS BY 1992

ISOENZYMES CASH FLOW

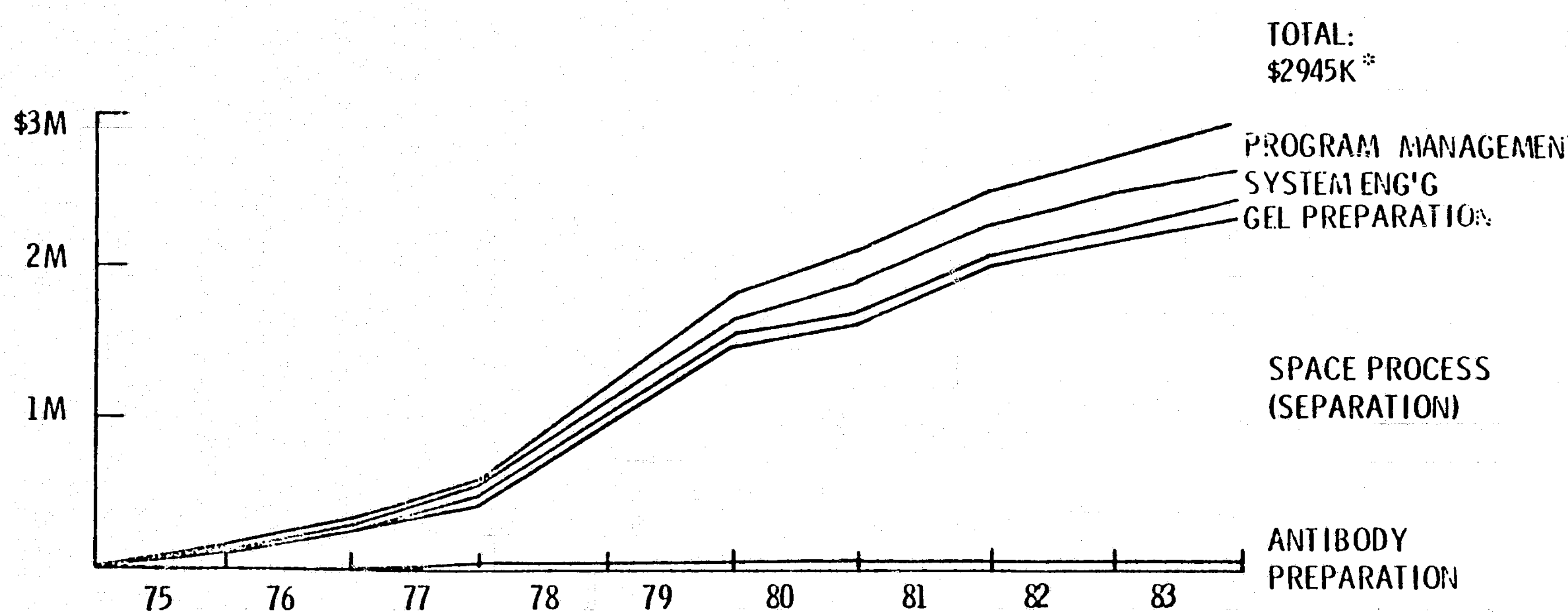


	CASE A	CASE B
% NI/S (1992)	21%	21%
PRESENT VALUE	$ 11 mm	$12 mm
USER R&D COST	3.8 mm	1.4 mm
NASA R&D COST	---	2.4 mm
BREAKEVEN	11 yrs	7 yrs

ISOENZYME MARKET ANALYSIS



ISOENZYMES RESEARCH AND DEVELOPMENT PROGRAM COSTS



*EXCLUDING $1055K SHUTTLE UTILIZATION COSTS

	1985 Unit Cost	1992 Unit Cost
Gel Prep-Pre-Space		
Labor (tube filling, 60 tubes)		
Materials (Gels, supplies, protiens)		
Overhead (100% of Labor)		
	$ 0.20	$ 0.02
Space Processing		
Labor, Ground Ops. 10 flights	.50	.08
Materials, misc.	.21	.03
Services, Shùttle (see estimate)	.89	.89
Overhead (100% of Labor)	.50	.08
	$ 2.10	$ 1.08
Gel Processing-After Space		
Labor (see breakdown)		
Material		
Overhead (100% of Labor)		
	$ 0.20	$ 0.02
Horse Farm		
Labor		
Overhead		
Material		
	$ 0.50	$ 0.28
Antibody Prep		
Labor (see breakdown)		
Overhead		
Material		
	$ 0.80	$ 0.34
Packaging Kits		
Labor (see breakdown)		
Overhead		
Material ($0.15/kit) (cap, vial, package)		
	$ 1.50	$ 0.75
TOTAL	$ 5.30	$ 2.49

STS ISOENZYMES VENTURE

CONSOLIDATED STATEMENT OF INCOME
YEAR ENDED DECEMBER, 1992

NET SALES 5 MM UNITS @ $6.00	
	$30,000,000
COST OF GOODS SOLD 5 MM UNITS @ $2.50	12,500,000
SALES & ADMINISTRATIVE	3,125,000
ENGINEERING, R&D	750,000
INTEREST EXPENSE	300,000
DEPRECIATION	461,000
	$17,136,000
INCOME BEFORE PROVISION FOR TAXES	$12,864,000
PROVISION FOR INCOME TAX	6,318,000
NET INCOME	$ 6,446,000

NET INCOME/SALES = 21%

PHARMACEUTICAL INDUSTRY AVERAGE = 9.1%

SPACE PROCESSING SOUNDING ROCKET PROGRAM

- FILLS NEED FOR SPACE PROCESSING RESEARCH/DEMONSTRATION VEHICLE PRIOR TO SHUTTLE
    - PILOT EXPERIMENTS ON 3 APOLLO MISSIONS
    - 14 EXPERIMENTS ON SKYLAB MISSIONS 1973-1974
    - SET OF 10 EXPERIMENTS ON ASTP MISSION 1975
    - SOUNDING ROCKET WILL PROVIDE RESEARCH CAPABILITY THROUGH REMAINDER OF 1970'S
- NASA SOUNDING ROCKET PROGRAM NOW UNDER WAY
    - FIRST FLIGHT IN DECEMBER 1975
    - 3 FLIGHTS PER YEAR PLANNED
    - WHITE SANDS MISSILE RANGE LAUNCHES WITH LAND RECOVERY
- BLACK BRANT VC CURRENT VEHICLE
    - UP TO 7 MINUTES OF WEIGHTLESSNESS
    - MULTIPLE EXPERIMENTS PER FLIGHT
    - COST TO USER AS LOW AS $25,000 PER FLIGHT
- ADVANCED VEHICLE (ARIES) MAY PROVIDE UP TO 12 MINUTES LOW-G
- FLIGHT SYSTEM PROVIDES
    - HEATING AND COOLING APPARATUS
    - LEVITATION DEVICES (ACOUSTIC AND ELECTROMAGNETIC)
    - ELECTROPHORETIC SEPARATION

SPACE PROCESSING SOUNDING ROCKET PROGRAM

Most materials-oriented companies have never considered the possibilities of the sounding rocket program. NASA wants to get industry interested.

Initial experiments are being funded almost totally by the government. Budgets currently are 1.7 mm/1976, 2.0 mm/1977, 3.0 mm/1978.

Announcements of flight opportunity (AO's) are released on a yearly basis. The first AO resulted in 62 proposals of which 15 were accepted:

U.S. Government	10	Metallurgy	33
Academic Community	20	Electronic	7
U.S. Industry	28	Fluid Mechanics	6
Foreign Government	4	Biological	9
		Glass & Ceramics	6
		Other	1

Once evidence of commercial benefits is obtained, industry will develop stronger interest to pay for launch, recovery, and integration hardware.

The problems associated with a government agency permitting proprietary operations under its jurisdiction are being addressed by NASA.

SPACE PROCESSING SOUNDING ROCKET