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TECHNOLOGY TRANSFER – A SELECTED BIBLIOGRAPHY

Revised Edition

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16. Abstract

The purpose of this revised edition is to provide a selective listing of literature on the subject of technology transfer and to identify key literature in the field. It is based on a screening of the available literature. The bibliography is concerned with technology transfer in the following sense: Technology is considered to be technical information and capability, including scientific knowledge, making possible the conception, development, design, production, and distribution of goods and services. Transfer here means the movement of science or technology (in either an embodied form or as information only) from one known place to another. The bibliography includes 564 citations, 65 abstracts of key technology transfer literature, an author and a KWIC (key word in context) index.

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This is a report in a series prepared for the Office of Technology Utilization, National Aeronautics and Space Administration (NASA). It presents the results of research on technology transfer conducted by the Industrial Economics Division of the University of Denver Research Institute (DRI).

Material presented in this bibliography was gathered and analyzed as a part of the Project for the Analysis of Technology Transfer (PATT). PATT was established in November 1967 to provide a better understanding of the technology transfer process by examining nonspace applications of NASA-developed technology. To achieve this goal PATT has the following objectives:

1. To operate a Technology Transfer Data Bank.

2. To document actual and potential cases of transfer of space-related technology to secondary uses.

3. To suggest for NASA's consideration programs or mechanisms to improve the effectiveness and to reduce the costs of NASA's technology transfer activities. This objective is partially met by the accomplishment of specific research tasks dealing with various aspects of the Technology Utilization Program.

4. To maintain contact with sources of technology, with channels of technological communication, and with users of technology in order to stay in touch with developments affecting performance of these participants in the technology transfer process.

5. To maintain awareness of past and ongoing research contributions to the understanding of the technology transfer process, and to contribute to this knowledge base.

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INTRODUCTION

This revised edition of Technology Transfer--A Selected Bibliography is an updating and expansion of a bibliography published in November 1968.* Its purpose remains the same: to provide a comprehensive listing of literature on the subject of technology transfer. Additionally, this edition attempts to identify key literature on technology transfer.

Background

One goal of the Project for the Analysis of Technology Transfer (PATT) is to maintain awareness of past and ongoing research contributions to the understanding of the technology transfer process. In support of this goal, the PATT Library was established in 1968. This facility acts as a resource of information concerning technology transfer and related areas. It serves three primary functions: 1) to support current operations and research; 2) to maintain an awareness of the state-of-knowledge of technology transfer, related disciplines, and areas of study; and 3) to act as a source of materials pertinent to the structuring of future research activities. The library presently contains over 1,700 items. A statement of library policy and scope is appended to this report.

The University of Denver Research Institute (DRI) has conducted several major studies since 1961 which have direct relevance on the subject of technology transfer.** Substantial information on technology transfer was gathered in performing those studies. With the establishment of the PATT Library, an intensive data collection effort was begun. Material has been assembled relating to the process of technology transfer, the factors affecting the process, and related areas of study which are pertinent to an understanding of the process and the factors affecting it.

Several interviews were conducted in 1968 and 1969 to assist in collecting information and to gain broader insights into the literature on technology transfer. Visits were made to technical information people

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* M. Terry Sovel, Technology Transfer--A Selected Bibliography (Denver, Colorado: University of Denver Research Institite, 1968; N69-26359).

** University of Denver Research Institute, "Summary of Technology Transfer Research" (Denver, Colorado: 1969).

in the Department of Defense and its Defense Documentation Center, Atomic Energy Commission, National Aeronautics and Space Administration and its Scientific and Technical Information Facility, Office of State Technical Services, Small Business Administration, Clearinghouse for Federal Scientific and Technical Information, and Federal Council for Science and Technology. Interviews were held with people in the Legislative Reference Service and National Referral Center for Science and Technology (Library of Congress), the National Science Foundation, and the Science Information Exchange. In addition, several collections were surveyed including the New York Public Library Economics Division, Dewey Library of the Massachusetts Institute of Technology, Harvard University Program on Technology and Society, Columbia University Bureau of Applied Social Research, and the Dag Hammerjöld Library of the United Nations.

Material has also been acquired for the library by reviews of bibliographies on technology transfer, letters to major authors in the field, personal contacts, and monitoring of several abstracting services.

Scope

The bibliography is concerned with technology transfer in the following sense: Technology is considered to be technical information and capability, including scientific knowledge, making possible the conception, development, design, production, and distribution of goods and services. Transfer here means the movement of science or technology (in either an embodied form or as information only) from one known place to another.

Citations have been included on the process of technology transfer and factors affecting the transfer process. Additionally, some related areas necessary to an understanding of the transfer process, such as R&D management, public policy issues, technological forecasting, and technology assessment, have been included on a limited basis.

The items presented represent a screening of the available literature. To the extent possible, all material has been reviewed. Outdated information with little historical value has been eliminated and, when possible, only primary sources have been included. Only a few bibliographies are listed.

Key technology transfer literature. Abstracts are included in this report which, in the opinion of DRI staff, represent key technology transfer literature. Selection was based on the following criteria:

(1) Does the work have some value to researchers in the field of technology transfer?

(2) Does the work appear to be of lasting value?

(3) Does the work make a contribution to the body of knowledge on technology transfer?

The abstracts, which emphasize contributions to an understanding of technology transfer, were prepared by members of the Industrial Economics Division, DRI.

Format

The bibliography is arranged in four sections: an alphabetical listing, abstracts of key technology transfer literature, an author index, and a KWIC (key work in context) index. An asterisk in the alphabetical listing indicates the entry is abstracted in the following section. The PB, AD, and NASA numbers, when known, are given in the alphabetical listing. The author index includes primary and secondary as well as corporate authors. The KWIC index is a computer prepared permuted title index. The computer printout was edited to eliminate words which appeared to be insignificant.

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Within the Industrial Economics Division, DRI, Dean C. Coddington, Project Supervisor, PATT, and John G. Welles, Head, Industrial Economics Division, assisted in reviewing the literature for quality and applicability. Paul Bortz, James E. Freeman, John Kelley, Eileen R. Staskin, and Robert W. Joselyn, prepared abstracts on key literature. Mrs. Kristie Reifenberg prepared the KWIC index.

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INTRODUCTION

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SECTION II. KEY TECHNOLOGY TRANSFER LITERATURE ABSTRACTS

KEY TECHNOLOGY TRANSFER LITERATURE

ABSTRACTS

Allen, Thomas J. "The Utilization of Information Sources During R & D Proposal Preparation: Research Program on the Organization and Management of R & D." Working Paper #97-64. Cambridge, Massachusetts: M.I.T. Alfred P. Sloan School of Management, 1964.

The effect of technical information sources on the rated technical quality of a proposal team's effort was examined in this study. Twenty-two proposal competitions for government R & D contracts, involving 156 proposal teams, were considered. Three sources of technical information were considered: 1) literature search; 2) use of in-house staff specialists; 3) use of outside expertise (consultants, professional societies, potential vendors, etc.). Of these three sources of information, only the second one appeared to be positively related to technical quality of the proposal, and this relationship was weak. Technical quality was inversely related to the extent to which outside information sources were used.

Allen, Thomas J., and Stephen I. Cohen. Information Flow in an R & D Laboratory. Cambridge, Massachusetts: M.I.T. Alfred P. Sloan School of Management, 1966. (PB 173-524)

The paper presented the results of an in-depth study of a small industrial R & D laboratory (34 professional staff members). The purpose of the research was to relate factors such as productivity, use of external channels of scientific and technical information, and informal and formal relationships among the research staff. The authors concluded that there were two distinct classes of individuals within the laboratory. The majority had few information contacts beyond the bounds of the organization. A small minority, in contrast, had rather extensive outside contacts, and served as sources of information for their colleagues. Six of seven such individuals acted as "technological gatekeepers" for the rest of the laboratory staff. It was found that two of these six of seven people were responsible for introducing all four of the "most important technical ideas" that had been introduced into the organization during the preceding year.

Allison, David (ed.). The R & D Game; Technical Men, Technical Managers and Research Productivity. Cambridge, Massachusetts: M.I.T. Press, 1969.

Several articles which appeared in International Science and Technology during its golden years are brought together, reprinted, and discussed. They are organized under the topics of the industrial scientist, the growth of ideas, and science and the organization. The articles by Jack Morton and Jack Goldman are useful source pieces for understanding technological processes in corporations.

Browne, Theodore D., et al. Project for the Analysis of Technology Transfer; The Initial Year, 13 November 1967 - 12 November 1968. Denver, Colorado: University of Denver Research Institute, 1968.

The report provides feedback to NASA's Technology Utilization Division on the characteristics of users of the Tech Brief - Technical Support Package program. It describes how the users learned of the availability of the Technical Support Package, what uses were made of the information, and how the information was evaluated. The report results are based on more than 5,000 questionnaires and nearly 300 interviews.

Burns, Tom, and G. M. Stalker. The Management of Innovation. Chicago: Quadrangle Books, 1962 (Copyright 1961).

This book is based on studies of twenty concerns in England and Scotland, mostly engaged in the development of electronic devices and systems. The core of the studies is "a description of what happens when new and unfamiliar tasks are put upon working organizations." The authors look at the external circumstances surrounding the concerns, organization and change within, and the direction and shaping of management conduct.

Carter, Launor, et al. Recommendations for National Document Handling Systems in Science and Technology. Santa Monica, California: System Development Corporation, 1965. (PB-168-267) [Also available from John Wiley & Sons, Inc., 1967] 2 volumes.

Volume I of this report contains a summary and set of recommendations for a national document-handling system in science and technology. It discusses the importance of scientific and technical documentation and information in the United States and the problems related to it; presents basic propositions and system requirements; and presents a preferred system and four alternative approaches. Volume II is the background study for the report. It describes the current scientific and technical information and documentation system; gives statistical data on manpower, documents, costs, and institutions; and reviews user studies, legislation and executive orders, selected plans for a national information system, three current information systems, and equipment and software capabilities.

Coddington, Dean C., et al. Project for the Analysis of Technology Transfer; 1969 Annual Report. Denver, Colorado: University of Denver Research Institute, 1970.

This report describes the characteristics of users of NASA's Tech Brief system, summarizes the results of three special studies, and attempts to place the NASA Technology Utilization activities within the perspective of a total flow of technology from the space program. The report concludes that the measurable benefits to industry in the form of cost savings from the Tech Brief - TSP program approximate $3 to $4 million per year (as compared to the cost to taxpayers of the program of $2 million per year). The report notes that over 60 percent of the users of Tech Briefs rely upon use of the information to keep current with developments in their field. Roughly half of all TSP requestors are from businesses with 500 or less employees. Special studies summarized in the report include experimental use of the services of a Regional Dissemination Center, a market study of Apollo and Gemini photographs, and an analysis of certain facets of the NASA-sponsored Biomedical Applications Team Program.

Coleman, J. S., E. Katz, and H. Menzel. Medical Innovation; A Diffusion Study. Indianapolis: Bobbs-Merrill, 1966.

This book, a case study of the diffusion of innovation, reports the history of a new drug's introduction and its acceptance, through time, by physicians. Physicians adopting the drug early were more likely than other physicians to have extensive personal and professional ties within the medical community. Formal transmittal of information (e.g., journals and reports) was not sufficient to result in general adoption of the drug. Informal, person-to-person communication was most effective.

Cuadra, Carlos A. (ed.). Annual Review of Information Science and Technology. Volumes 1-4, 1966-1969. Volumes 1 and 2; New York: Interscience. Volumes 3 and 4; Chicago: Encyclopedia Britannica, Inc.

This series, sponsored by the American Society for Information Science, is intended to be a progress review in the information sciences field and is the only one of its kind. It is directed primarily to those interested in the processes by which individuals communicate and to those interested in new computer applications for information handling. Chapters are individually authored and are primarily reviews of the literature for a particular year. Extensive bibliographies are included. A combined index for all volumes is included in Volume 4. Of particular interest to technology transfer researchers are the chapters on "Information Needs and Uses" by H. Menzel (Volume 1), S. and M. Herner (Volume 2), W. J. Paisley (Volume 3), and T. J. Allen (Volume 4).

Danhof, Clarence H. "Technology Transfer By People Transfer; A Case Study." Staff Discussion Paper 403. Washington: The George Washington University, Program of Policy Studies in Science and Technology, 1969.

People transfer as a mode of technology transfer is often generalized on, but rarely studied. This paper reports a survey of 354 ex-NASA personnel who were queried on their ability to apply NASA-related technology in their new positions. About half of the respondents did report transfers of technology. The transfers were most often of management procedures (although the respondents were all scientific and

technical personnel); occurred more often when the work situation was substantially different from respondent's NASA experience; and were most commonly communicated to others through a written document.

Denison, Edward F. The Sources of Economic Growth in the United States and the Alternatives Before Us. New York: Committee for Economic Development, 1962.

Denison's paper was prepared at a time when there was substantial national concern over the question of economic growth in the United States. Denison systematically analyzes a number of factors that influence economic growth such as labor, land, capital, productivity, and advances of knowledge particularly as applied to production. He calculates that between 1929 and 1957, approximately 20 percent of the measured growth rate of total product in the United States could be ascribed to the increase of knowledge and its application (new technology). Looking to 1980, Denison anticipates that new technology will contribute one-third to economic growth anticipated during this time period, and that it will be the second most important factor in achieving future growth.

Di Salvo, Joseph. ARAC; Final Five-Year Report, Experiment to Transfer Technology from a University-Based Center. Bloomington, Indiana: Aerospace Research Applications Center, 1968.

Since the Aerospace Research Applications Center (ARAC) is the oldest and most successful of the NASA-sponsored Regional Dissemination Centers, lessons it has learned over the past five years are of significance to those interested in the technology transfer process. During the last five years ARAC has experimented with the prices charged for its services, the packaging of its services, and a personalized approach to transferring technology. The report concludes with a discussion of the dual objectives of the RDC program--transferring technology and achieving financial independence. The author concludes that the two objectives are not necessarily consistent and that by necessity, ARAC has had to place more emphasis on achieving financial support.

Doctors, Samuel I. The Role of Federal Agencies in Technology Transfer. Cambridge, Massachusetts: M.I.T. Press, 1969.

Doctors' book, based on his doctoral dissertation at Harvard, presents a comprehensive review of technology transfer, with particular emphasis on the NASA Technology Utilization Program. The foreword, written by Harvey Brooks, gives thoughtful discussion of the importance of technology transfer, and the many issues involved in it. The chapter dealing with NASA's patent/license policy and its effect on transfer is an excellent presentation of the intricacies of the world of patents. Although complimentary of many of the steps taken by NASA to disseminate new technology, Doctors also has some biting criticism of the TU Program. He states that political pressures on the TU Program as a device for partial justification of the NASA budget have been detrimental. However, some of his specific recommendations appear to be aimed more at the Regional Dissemination Centers than at the TU Program in general, perhaps reflecting Doctors' earlier experiences as a staff member of an RDC. In concluding his criticism he says, "a successful transfer program must be free to experiment, testing numerous methods and levels of transfer within the framework of a carefully designed applied social science research project."

Downie, Currie S., and Ernest P. Luke. Technological Barriers Documentation Project of the Office of Aerospace Research, United States Air Force. Colorado Springs, Colorado: U.S. Air Force Academy, 1968. (AD 674-050)

The technological barriers documentation project is part of a program of action by the Office of Aerospace Research directed toward improving the coupling between science and technology. The approach proposed is similar to that followed by the biomedical and technology applications teams sponsored by NASA: problem abstracts are prepared and then an effort is made to find applicable technology bearing on these problems. In the Office of Aerospace Research project, the problem abstracts are to be given widespread distribution throughout various Air Force research facilities and contractors with the hope that a coupling might occur between the problem and the available technology.

Eckman, Philip K. (ed.). Technology and Social Progress--Synergism of Conflict? AAS Science and Technology Series, Volume 18. Tarzana, California: AAS Publications Office, 1969.

A symposium, with three papers particularly relevant to technology transfer: Bisplinghoff's "Designing a Space Program" identifies NASA's technological strengths and relates them to non-space needs; Silk discusses "Direct and Indirect Effects of Large Technology Programs"; and the Gordon and Shef paper relates technological growth to social and economic indexes which reflect beneficial and negative trends in society.

Gilmore, John S., et al. The Channels of Technology Acquisition in Commercial Firms, and the NASA Dissemination Program. Washington: NASA, 1967. (NASA CR-790)

The knowledgeable people in research or engineering groups in five industries who mediate between the external sources of technological information and the needs of their group were studied. They were found to fit three categories: research-oriented, product-oriented, and technical management; and their acquisition activities were found to be in either problem solving or current awareness modes. Acquisition behavior of each group, in each mode, was compared. The results emphasized the importance of commercial sources, e.g., suppliers, trade press, and familiar sources such as textbooks and handbooks.

Glaser, Peter E., et al. Space Technology Transfer and Developing Nations. Washington: NASA, 1968. (NASA CR-1222)

This report is a limited examination of the technology needs of a developing nation (Brazil) and their potential match with space-generated technology. Ways to possibly transfer the advanced technology are considered. For those interested in developing countries use of technology, this document is one of several worth reviewing.

Griliches, Zvi. "Hybrid Corn; An Exploration in the Economics of Technological Change," Econometrica, 25 (October 1957), pp. 501-522.

An analysis of the adoption of hybrid corn varieties in the United States is presented as a case study of the generation and propagation of technological change in U.S. agriculture. The growth in the use of hybrid corn in several states was modeled mathematically. Profitability of entry and profitability of the shift from open pollinated to hybrid varieties of corn were identified as important variables in explaining the varying shape of the use curve for hybrid varieties in different states. The author concludes that the process of innovation is amenable to economic analysis.

Gruber, William H., and Donald G. Marquis (eds.). Factors in the Transfer of Technology. Cambridge, Massachusetts: M.I.T. Press, 1969.

This book is the proceedings of the 1966 M.I.T. Conference on Human Factors in the Transfer of Technology. Fourteen revised papers are presented in three sections: 1) Innovation: The Development and Utilization of Technology; 2) The Process of the Development of Technology; and 3) Government influences on the Diffusion of Technology. The editors' summary paper attempts to integrate the findings presented, examine the policy consequences that follow from the findings, and enumerate the critical unknowns.

Harbridge House, Inc. Government Patent Policy Study; Final Report. Washington: Government Printing Office, 1968. 4 volumes.

The FCST Committee on Government Patent Policy commissioned Harbridge House to study and prepare reports on three policy questions on government patent policy: 1) its effect on industry participation in government R & D programs; 2) its effect on commercial utilization of government-sponsored inventions; and 3) its effect on business competition in commercial markets. The three phase study included a questionnaire survey of commercial utilization of government-sponsored inventions patented in 1957 and 1962 and five groups of case studies. "Volume I summarizes results on the research on the three study questions"; Volumes II - IV are detailed reports on each of the study questions.

Heller, M. Terry (Sovel),and Dean C. Coddington. A User's Evaluation of a NASA Regional Dissemination Center. Denver, Colorado: University of Denver Research Institute, 1969.

DRI enrolled as a member of a NASA Regional Dissemination Center (TAC of the University of New Mexico) for a six-month (experimental) period to gain a better understanding of the usefulness of an RDC to a user organization. Fifteen retrospective searches received by DRI researchers were closely monitored and were found to be of substantial value. The major advantages and negative aspects of using such a service are discussed and conclusions are drawn.

The Illinois Institute of Technology Research Institute. Technology in Retrospect and Critical Events in Science (TRACES). Chicago: 1969, 2 vols.

The TRACES study provides insights into the flow of non-mission and mission-oriented research into the development and application process by tracing the development of five innovations--magnetic ferrites, video tape recorder, oral contraceptive pill, electron microscope, and matrix isolation. IITRI researchers were able to identify and categorize 341 key research and development events. Of the key events documented, approximately 70 percent were non-mission research, 20 percent mission-oriented research, and 10 percent development and application. The study also presents evidence on the time lag from conception to demonstration of an innovation and the relationship of this time period to the proportion of non-mission research that had been accomplished in previous years. The study concludes that interdisciplinary communication is very evident in, and important to, the achievement of innovation.

Institute of Public Administration,and Teknekron, Inc. Public Urban Locator Service (PULSE); Background and Conference Proceedings. Washington: 1968. (PB180-116)

An everyone-contributes-a-paper conference was held, bringing competing suppliers and user representatives together to discuss applications of advanced technology to a vehicle locator system. This simultaneous sharing of design concepts, analysis, and anticipated uses was made a requirement for any supplier desiring eligibility for subsequent R & D contracts.

Jantsch, Erich. Technological Forecasting in Perspective; A Framework for Technological Forecasting, Its Techniques and Organisation, A Description of Activities and Annotated Bibliography. Paris: Organisation for Economic Cooperation and Development, 1967.

Technological forecasting is defined as "...the probabilistic assessment of future technology transfer." A multidimensional model of transfer is postulated. Interviews with 250 individual organisations and governments in 12 OECD countries, supplemented by evaluation of 400 literature references, formed the basis of this extensive "state of the art" study of technological forecasting. The applications and techniques of technological forecasting in basic research, technological innovation, planning, social technology and information science are reviewed. The author states that technological forecasting "is not yet a science but an art...human judgement is enhanced, not substituted by it."

Jewkes, John, David Sawers, and Richard Stillerman. The Sources of Invention. New York: St. Martin's Press, 1958.

This book deals with the sources of and stimulus for invention. In particular, it explores the effects of increasing institutionalism on the innovation process. The basic conclusion is that innovation requires a variety of methods and organizational structures. The book includes case histories of fifty inventions, ranging from the ball-point pen to zerography.

Katz, Elihu. "The Social Itinerary of Technical Change; Two Studies on the Diffusion of Innovation," Human Organizations, Summer 1961, pp. 70-82.

The author reviews and compares two studies on the diffusion of innovation which trace "...the movement of: 1) a given new practice; 2) over time; 3) through specific channels of communications; 4) within a social structure." The adoption of hybrid seed corn by farmers in two Iowa communities and the response of doctors in four communities to the availability of a new drug were the two cases. Several similarities in the results of the two studies were found. Information alone was not enough to result in general adoption of the innovation. Informal, person-to-person communications were most

likely to lead to adoption,while commercial and formal sources tended to serve the purpose of information only. Early adopters of the innovations read journals and bulletins more regularly and were in closer contact with others in their occupation than later adopters

Lesher, Richard L.,and George J. Howick. Assessing Technology Transfer. Washington: NASA, 1966.(NASA SP-5067)

This publication is an abridgement of a report prepared for the National Commission on Technology, Automation, and Economic Progress in November 1965 (see entry 357). The original paper was based on a literature search and interviews with persons in government agencies with technology transfer programs and information dissemination centers. Lesher and Howick offer recommendations and conclusions on "assessing effective means of channeling new technologies in promising new directions." They consider questions such as "Is technology available for transfer and utilization? Is government-generated technology relevant? Why technology transfer? What is government's role?" They also look at the transfer process, some existing programs, proposed mechanisms for transfer, and the elements of a transfer system. The publication includes brief reviews of technical information programs of selected Federal agencies.

Little (Arthur D.) Inc. Patterns and Problems of Technical Innovation in American Industry. Cambridge, Massachusetts: 1963. (PB 181-573)

This report to the National Science Foundation summarizes a study of the "patterns and problems of innovation" in five industries. Primary emphasis was on the "mature" industries of textiles, machine tools, and building and construction. The other two industrial areas studied, appliances and semiconductors, were investigated to show the contrasting characteristics of innovation that arise from the mass consumer marketing and high technology content, respectively, of these two areas. The major finding of the report is that the principal source of innovation in mature industry is the flow of technology from one industry to another. Problems of innovation are identified within these industries that result in major change being initiated primarily from the outside.

Machlup, Fritz. The Production and Distribution of Knowledge in the United States. Princeton, New Jersey: Princeton University Press, 1962.

Machlup defines knowledge as "anything that is known by somebody" and production of knowledge as "any activity by which someone learns of something he has not known before even if others have." Machlup looks at the production of knowledge as an economic activity, i.e., an industry. Chapters deal with knowledge produced through education, research and development, communication media, information machines, and information services. He quantiatively evaluates the role of knowledge-production in the national product and looks at the occupational structure of knowledge production. The book represents an attempt to put into economic terms dollar values on information, including technology.

Mansfield, Edwin. The Economics of Technological Change. New York: W. W. Norton, 1968.

Mansfield defines technological change as "the advance in knowledge relative to the industrial arts" and views it as "perhaps the most important factor responsible for economic growth." His book presents an overview and interpretation of the economics of technological change. Discussions are included on technological change. Discussions are included on technological change and productivity growth; industrial research and development; innovation and diffusion; automation, labor displacement, and adjustment problems; government expenditures on R & D; and public policy and technological change.

Menzel, Herbert. "Scientific Communications; Five Themes from Social Science Research," American Psychologist, 21 (November 1966), pp. 999-1004.

Menzel discusses five themes he identifies as emerging from studies of the behavioral aspects of scientific and technical information flow. These themes are: the view of scientific communication as a system, "... a set of interaction processes in a social system;" the frequent need for several channels of information to bring about effective information transmission; the role of informal, unplanned, person-to-person communication; the view of individuals served by science information systems as several scientific publics different from one

another in many aspects; and, finally, the multiple functions of science information systems ranging from exhaustive search and current awareness functions to the function of stimulating scientists to seek relevant developments in fields outside of their originally perceived areas of research. Research in scientific communication, Menzel states, should go beyond consideration of data gathering techniques to the analytic conceptualization and modeling of the scientific communications activities.

Mesthene, Emmanuel G. "Symposium: The Role of Technology in Society; Some General Implications of the Research of the Harvard University Program on Technology and Society," Technology and Culture, 4 (October 1969), pp. 489-536.

This article and commentary discuss the output of four years of the Harvard Program on Technology and Society. It treats technology as neither all good, all bad, nor negligible ("three unhelpful views"), but as both threat and opportunity for society. Social response to these threats and opportunities is reviewed, and technology is examined as a cause of value change. Institutional innovation is asked for (although it appears inevitable). The discussants are mainly concerned with orienting the Program more to the stream of history--past--and prospective--than it has been.

Mottur, Ellis. The Processes of Technological Innovation: A Conceptual Systems Model. Washington: The George Washington University, 1968.

This report presents a conceptual model of the processes of technological innovation set within the socioeconomic system in which these processes take place. The author states that such a model is needed in order to anticipate, assess and, to some degree, control technological changes and the consequences of such changes. The discussion, which is supplemented by an extensive bibliography on technological innovation, emphasizes the need for experimental application, assessment and refinement of the proposed model.

National Academy of Sciences. Technology: Processes of Assessment and Choice. Washington: Government Printing Office, 1969.

Technology: Processes of Assessment and Choice is the final report of the ad hoc Panel on Technology Assessment of the National Academy of Sciences. The report contains a review of problems involved in technology assessment and a design of a framework for technology assessment within the Federal government. The Panel warns against the establishment of a single assessment mechanism and calls for assessment activities throughout government and the private sector. As an overall objective of the development of technology assessment capabilities, the Panel stated that:

> . . .heightened sensitivity in technology assessment should, whenever possible, be achieved by structuring the incentives of individual decision makers so that they are induced to alter their cost-benefit calculations to encompass wider concerns than have heretofore been given consideration.

National Academy of Sciences-National Academy of Engineering. The Impact of Science and Technology on Regional Economic Development; An Assessment of National Policies Regarding Research and Development in the Context of Regional Economic Development. Washington: 1969.

This publication is a condensation of many viewpoints and judgments about national research and development goals and policies. After providing background about the national situation, regional development options related to R & D are discussed. It is recognized that regional circumstances might differ within the nation, and that mechanisms effective for the nation as a whole or a specific region might not apply in another geographic area. Broad recommendations are offered.

National Academy of Sciences-National Academy of Engineering, Committee on Scientific and Technical Communication. Scientific and Technical Communication; A Pressing National Problem and Recommendations for Its Solution. Publication 1707. Washington: 1969.

The Committee on Scientific and Technical Communication (SATCOM) was established in February 1966 at the request of NSF by

the National Academy of Sciences and the National Academy of Engineering to "make an intensive survey of the present status and future requirements of the scientific and engineering community with respect to the organization, flow, and transfer of scientific and technical information and to recommend needed policies and courses of action based on the findings." Private and governmental information-handling activities were surveyed and four ad hoc task groups and "consulting correspondents" were used. SATCOM stressed the importance of shared responsibility between government and private organizations for the effective communication of scientific and technical information in its recommendations. It proposed the creation of a Joint Commission on Scientific and Technical Information responsible to the councils of the National Academy of Sciences and National Academy of Engineering. Fifty-five recommendations are made in five areas: 1) planning, coordination, and leadership at the national level; 2) consolidation and reprocessing--services for the user; 3) classical services; 4) personal, informal communication; and 5) studies, research, and experiments. A synopsis of the report is also available (see Entry 349).

National Bureau of Economic Research. The Rate of Direction of Inventive Activity; Economic and Social Factors. Princeton, New Jersey: Princeton University Press, 1962.

Still a definitive work, this book reflects papers and comments of a 1960 conference of economists (mostly), sociologists, and political scientists. The papers are categorized by the editor among: the classical economics approach and the black box [the R & D process]; the economics of alternative or parallel approaches to R & D problem solving profits from invention; nonmarket factors and resource allocation; and invention and policy.

National Commission on Technology, Automation and Economic Progress [The Bowen Commission]. Technology and the American Economy. Report of the Commission. Washington: Government Printing Office, 1966. 6 Volumes. Appendices.

Extensive collection of source papers on technology's effects and how they occur; includes sections on applying technology to unmet needs and on impacts of technological change.

National Conference on the Administration of Research, 20th (University of Florida, October 26-28, 1966). Proceedings. Denver, Colorado: University of Denver Research Institute, 1967.

This report summarizes the proceedings of a conference focusing on the measurement of quantitative data regarding research management, with emphasis on technological innovations and the transfer process by governmental, industrial, and academic researchers.

Paisely, William J. The Flow of (Behavioral) Science Information; A Review of the Research Literature. Palo Alto, California: Stanford University, Institute for Communication Research, 1965.

This publication reviews studies conducted from 1948-1965 dealing with the information-gathering and disseminating behavior of scientists. The publication is devoted primarily to use studies with detailed summaries of Menzel's study on The Flow of Information Among Scientists: Problems, Opportunities, and Research Questions (1958) and the American Psychological Association's Project on Scientific Information Exchange in Psychology. Additionally, a few "network studies" and the literature on the flow of scientific information to the public are reviewed.

Pelz, Donald C., and Frank M. Andrews. Scientists in Organizations; Productive Climates for Research and Development. New York: John Wiley and Sons, Inc., 1966.

This book describes the kinds of working environments in which technical people were stimulated to high levels of creativity and performance. The authors relied upon interviews with over 1,300 scientists and engineers in industrial, government, and university laboratories. Among the areas explored in the book are: freedom, communication, dedication, motivations, satisfactions, creativities, age, groups, and coordination. The authors did not explore specifically how scientists and engineers acquired externally-generated scientific and technical information.

Price, Derek J. de Solla. "Is Technology Historically Independent of Science? A Study in Statistical Historiography," Technology and Culture, 6 (Fall 1965), pp. 553-568.

Price applies his model of science based on citations in journal articles to technology in order to determine the amount of interaction between science and technology. He concludes that "science has a culminating, close-knit structure" and "this property is what distinguishes science from technology." He further states that "science and technology each therefore have their own separate culminating structures." He states that only in special cases can there be a direct flow "from the research-front of science to that of technology or vice versa." But he finds a "reciprocal relation between science and technology, involving the research front of one and the accrued archive of the other" which "keeps the two in phase in their separate growths."

Quinn, James Brian. "Technology Transfer by Multinational Companies," Harvard Business Review, November-December 1969, pp. 147-161.

Quinn identifies technology as an essential element in a nation's economic growth. He examines the mechanism of multinational companies as an important way to move industrial technology from advanced countries to lesser developed ones. Examples are cited and evaluated in the article, with European experiences being predominant.

Roberts, Edward B., and Herbert A. Wainer. "Some Characteristics of Technical Entrepreneurs." Working Paper, #195-66. Cambridge, Massachusetts: M.I.T. Alfred P. Sloan School of Management, 1966.

This preliminary study looks at 69 entrepreneurs spinning off from the M.I.T. Instrumentation Laboratory and the M.I.T. Lincoln Laboratory. It was found that individual entrepreneurs had strong home influences of career orientation toward self-employment. Most were young, and the median education level was the Master of Science degree. Results are given on family background, education, and motivation.

Rogers, Everett M. Diffusion of Innovations. New York: Free Press of Glencoe, 1962.

This is an exhaustive review of studies of diffusion and adoption gathered from almost 600 different publications. The author then presents a paradigm of innovation diffusion and adoption, elements of which have been used by others investigating technological diffusion and technology transfer.

Rosenbloom, Richard S. "Business, Technology, and the Urban Crisis," Social Innovation in the City; New Enterprises for Community Development. Cambridge, Massachusetts: Harvard University Press, 1969. Pp. 51-61.

In the author's view, the need for new urban systems cannot be satisfied by traditional methods of business and technological innovation. Customers must be created for urban systems innovations. A system of regional Urban Development Corporations and related Local Development Corporations is proposed. The local corporations would be indigenous to the communities in which they function, and the regional corporations would provide access to financial resources and skills outside of the community. Establishment of these organizations would create customers for urban innovation.

Rosenbloom, Richard S. Technology Transfer--Process and Policy; An Analysis of the Utilization of Technological By-Products of Military and Space R & D and a Statement by the NPA CARMRAND Committee. Washington: National Planning Association, 1965.

This booklet represents an excellent overview of the issues surrounding the transfer of technology from Federal R & D programs. Rosenbloom discusses the potential magnitude of useful technology resulting from military and space programs and concludes that there exists an untapped reservoir of technology of great proportions. He then discusses the factors influencing technology utilization and concludes that "the fullest utilization of the technological by-products of military and space R & D will flow from a healthy and effective technical information system." He then goes into some detail in describing and discussing the NASA Technology Utilization Program with the conclusion that it is really too early to tell whether the NASA program will be effective. In the final chapter concerning policy issues, Rosenbloom

notes that an important question remains unanswered: how far should the government go, not only in making findings available, but also in collecting and tailoring reports for most effective use by private enterprise for utilizing the advanced technology? He concludes that the ultimate responsibility for transfer rests with the business firm. At the same time, he says that if the government is to develop programs facilitating technology utilization, it must learn how to enrich the available store of information to make it more useful for the average technologist in industry.

Rosenbloom, Richard S., and Francis W. Wolek. Technology, Information and Organization; Information Transfer in Industrial R & D. Boston: Harvard University, Graduate School of Business Administration, 1967. (PB 175-959)

This comprehensive study, sponsored by the National Science Foundation, is concerned with the means by which organizations and highly trained people acquire knowledge and make use of it to create new knowledge and new technology. The results are based on self-administered questionnaires obtained from 2,000 engineers and scientists in 13 establishments of four corporations, and from 12,000 members of the Institute of Electrical and Electronics Engineers. The unit of data analysis is a description of an instance in which the respondent acquired information useful to his work from a source outside his immediate circle of colleagues. The study concludes that interpersonal communication represents a substantial portion (55 percent) of the instances of information transferring. The authors found that for competence-oriented (or current awareness), as opposed to problem-oriented quests for information, sources outside the corporation are used substantially more often. The authors were also able to correlate characteristics of the task, personal characteristics, professional contacts, and organizational contacts in arriving at their conclusions. A key finding is that "engineers and scientists with a high commitment to development of professional skills...used professional journals and other published documents considerably more often, and correspondingly used local sources of information considerably less often, than was true for the average respondent."

Scientific and Technological Communication in Government; Task Force Report to the President's Special Assistant for Science and Technology. 1962. (AD 299-545)

A Task Force of six members, chaired by James H. Crawford, Jr., was established by Jerome B. Wiesner, Special Assistant to the President for Science and Technology, to make "a detailed study of STINFO [scientific and technological information] problems in connection with the conduct of the Government's R & D programs." The Task Force studied existing STINFO services within the Federal government, assessed the types of scientific, technological and resource information needed for management of the Federal R & D effort, and recommended a plan "to embody the necessary operating and coordinating functions to fill adequately management's needs." Recommendations of the Task Force included: establishment within the Executive Branch of "an organizational focal point of responsibility for the Government-wide direction and review of Federal Government programs and activities for the communication of scientific and technological information"; and establishment of a focal point of responsibility within each R & D agency of the Federal government for agency-wide direction and control of STINFO activities.

Shanks, Michael. The Innovators; The Economics of Technology. Baltimore: Penguin, 1967.

Shanks presents an insightful discussion about factors that control the innovation level within organizations and society. He offers a theory that those companies and nations that are most effective in bridging the gap between knowledge and application will enjoy enhanced economic success. Shanks draws mainly upon his experience in various capacities in Great Britain although certain comparisons with the United States are presented. National policy considerations are examined in considerable depth.

Spencer, Daniel L. Military Transfer of Technology; International Techno-economic Transfers via Military By-products and Initiative Based on Cases from Japan and Other Pacific Countries. Washington: Howard University, Department of Economics, 1967. (AD 660-537)

Spencer explores the effect of the United States military forces' transfer of technology to Japan's economy. Training, procurement, and

maintenance receive attention. Policy considerations are examined, and means to possibly better capitalize upon the potential transfer are suggested.

Spencer, Daniel L., and Alexander Woroniak (eds.). The Transfer of Technology to Developing Countries. New York: Praeger, 1967.

The role of the military as a technology transfer agent in foreign countries is emphasized in this collection of conference papers including several rather theoretical ones. Summary thoughts are presented.

Stewart, John M. "Techniques for Technology Transfer Within the Business Firm," IEEE Transactions on Engineering Management, EM-16 (August 1969), pp. 103-110.

This paper conveys a partial understanding of how technology is absorbed into and used by business firms. Stewart dwells on the importance of interaction and feedback among those involved in R & D, manufacturing, and marketing. He says, "there is a tendency to think of technology transfer as a process that starts in research and flows 'downstream' to applied research, development, production, and into the market place. It appears that successful examples of transfer invariably have another component operating in the reverse direction. In the commercial industry, this component is a keen knowledge of the market." The article is highly structured in a framework of 14 dimensions of transfer, and deals primarily with transfer or innovation within large firms. The paper does not clearly differentiate between internally developed technology and that obtained from the outside, nor does it deal with the current awareness versus problem solving natures of technological information.

Striner, Herbert E., et al. Defense Spending and the U.S. Economy. Bethesda, Maryland: Operations Research Office, 1959. 2 volumes. (AD 204-085 and AD 204-086)

The first extensive enumeration of technological advances based on defense and aerospace R & D which found applications in civilian fields. There is some discussion of other impacts of such R & D, and of means of measuring such impacts.

Sulkin, M. A., et al. Frontiers of Technology Study; Volume I Summary; Volume II Survey; Volume III Implementation. Los Angeles: North American Rockwell Corporation, 1968.

The objective of the study was to identify technologies, particularly in defense and space-oriented fields, that could contribute to development of new systems of urban transportation. Using an abridgement of the COSATI index, technology areas were matched with the generic modes of transportation (such as rail rapid transit, conveyors, electric highway vehicles) and their associated subsystems (such as suspension, propulsion, braking) to which the technology might contribute. After review and screening of the areas of possible technological contributions, requirements were developed for implementation of technological developments identified as feasible.

U. S. Arms Control and Disarmament Agency. Defense Systems Resources in the Civil Sector. Report prepared by John S. Gilmore, John J. Ryan, and William S. Gould, University of Denver Research Institute. Washington: Government Printing Office, 1967.

The systems approach largely developed in the defense sector offers a useful means for analysis, design, engineering or implementation, and management of policies, programs, and hardware systems. However, there are institutional obstacles to its easy adoption in non-defense sectors of government. Defense firms and related organizations have much of the experienced manpower for the systems approach, but they have had managerial problems in modifying and selling their capabilities outside the defense/aerospace sector.

U. S. Congress, Senate, Select Committee on Small Business, Subcommittee on Science and Technology. Policy Planning for Technology Transfer. A Report...prepared by the Science Policy Research Division, Legislative Reference Service, Library of Congress. (90th Congress, 1st Session). Washington: Government Printing Office, 1967.

Richard A. Carpenter of the Legislative Reference Service prepared this analysis of issues involved in obtaining the maximum benefits from Federal investments in scientific research and development. Carpenter identifies two critical phases in the technology transfer

process--the identification and reporting of new technology, and the identification of needs for new technology. The report describes the Federal participants in the technology transfer process and also summarizes Congressional concern over technology transfer.

U. S. Congress, Senate, Select Committee on Small Business, Subcommittee on Science and Technology. The Prospects for Technology Transfer; Report. (90th Congress, 2nd Session). Washington: Government Printing Office, 1968.

This brief report consolidates the results of hearings and studies of the Subcommittee on Science and Technology beginning in May 1966. The central focus of the subcommittee has been on the special problems of small business in acquiring and utilizing government-generated new technology. The subcommittee is generally critical of past efforts to transfer technology, and lays the blame on a variety of institutions ranging from various Federal agencies to individual business firms. The report is especially critical of the Department of Defense in the fact that it has not made any overt efforts to make the technology it generates readily available. On the other hand, it is largely complimentary of the NASA Technology Utilization Program.

U. S. Congress, Senate, Select Committee on Small Business, Subcommittee on Science and Technology. Technology Transfer; Hearings...First Session on Policy Planning for Technology Transfer. September 20, 26, 27, and October 12, 1967. (90th Congress, 1st Session). Washington: Government Printing Office, 1967.

The hearings are concerned with policy planning for technology transfer and are used as a take-off point for the Legislative Reference Service report, "Policy Planning for Technology Transfer" [see entry 516]. The hearings include testimony taken over five days with statements received from a wide variety of industrial, educational, and government officials concerned with the generation, dissemination, and use of new technology.

U. S. Department of Commerce, Panel on Invention and Innovation. Technological Innovation; Its Environment and Management. Washington: Government Printing Office, 1967.

This basic work describes how adjustments in taxation, finance, and competition might improve the environment for invention. The Panel stresses the need for promoting an understanding of the innovative process. Major application Federal policies are referenced, and specific modifications to these policies are recommended.

U. S. President, President's Science Advisory Committee. Science, Government, and Information; The Responsibilities of the Technical Community and the Government in the Transfer of Information. A Report of the President's Science Advisory Committee. Washington: Government Printing Office, 1963.

The Weinberg Report states that "Transfer of information is an inseparable part of research and development. All those concerned with research and development ... must accept responsibility for the transfer of information in the same degree and spirit that they accept responsibility for research and development itself." The report describes some attributes of the information process and of various information handling systems. Additionally, it makes recommendations to both the technical community and government agencies. Recommendations to the technical community include: 1) "The technical community must recognize that handling of technical information is a worthy and integral part of science"; 2) "The individual author must accept more responsibility for subsequent retrieval of what is published"; 3) "Techniques of handling information must be widely taught"; 4) The technical community must explore and exploit new switching methods"; and 5) "Uniformity and compatibility are desirable." Recomendations to government agencies include 1) "Each Federal agency concerned with science and technology must accept its responsibility for information activities in fields that are relevant to its mission. Each agency must devote an appreciable fraction of its talent and other resources to support of information activities"; 2) "To carry out these broad responsibilities each agency should establish a highly placed focal point of responsibility for information activities that is part of the research and development arm, not of some administrative arm, of the agency"; 3) "The entire network of government information systems should be kept under surveillance by the Federal Council for Science and Technology"; 4) "The various Government and nongovernment systems must

be articulated by means of the following information clearinghouses: Current Efforts Clearinghouse ... Report Announcement and Distribution ... Retrospective Search and Referral Service ..."; 5) "Each agency must maintain its internal system in effective working order"; and 6) "Problems of scientific information should be given continued attention by the President's Science Advisory Committee."

Webb, James E. Space Age Management; The Large-scale Approach. New York: McGraw-Hill, 1969.

From a long, varied experience in the Federal government, culminating in seven years as Administrator of NASA, the author describes a process of management technology transfer. The space program, viewed as primarily a management achievement, drew on the organization and management concepts developed earlier in such large-scale enterprises as the Tennessee Valley Authority, Manhattan Project, and Office of Price Administration. NASA carried these large-scale management concepts to a new level of refinement, in responding to the challenges of the space program. The author suggests that an adaptive organizational structure, such as NASA's, can strengthen society and set a desirable pattern for other large-scale endeavors facing the nation in coming years.

Welles, John G., et al. The Commercial Application of Missile/Space Technology; Parts 1 and 2. Denver, Colorado: University of Denver Research Institute, 1963.

The transfer of technology is more important than the direct commercial use or sale of missile/space by-products. The results of transfer include: stimulation of research, development of new or improved process and techniques, improvement of existing products, increased availability of materials and instruments, development of new products, and cost reduction. One hundred and eighty-five examples of transfer or contribution are described, and the applications process and related barriers and stimuli to transfer are discussed.

Wolek, Francis W. "The Engineer: His Work and Needs for Information." Working Paper No. 102. Philadelphia: University of Pennsylvania, Wharton School of Finance and Commerce, 1969.

The author states that "the purpose of this paper is to illustrate the way in which a knowledge of the work of a user group can be helpful in interpreting that group's needs for information." The paper is specifically concerned with the needs of engineers working on development projects (as differentiated from engineering research or design). The development engineer spends a relatively short period of time (5 to 10 percent) in system definition and 90 to 95 percent of his time in model building and testing. This division of effort, in the view of the author, emphasizes the importance of local, narrowly defined sources of information. Access to wider, more general sources of information is required for the development engineer's professional growth, to be called on only when the need arises for new ideas.

Yovits, M. C., et al. (eds.) Research Program Effectiveness; Proceedings of the Conference Sponsored by the Office of Naval Research, Washington, D.C., July 27-29, 1965. New York: Gordon and Breach, 1966.

The theme of the conference was "Contributions of Research to the Improvement of Research Planning, Evaluation, and Utilization." Twenty-four papers are presented with the main focus on research studies. Several papers on development and engineering are also included.

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APPENDIX A

APPENDIX A

STATEMENT OF LIBRARY POLICY

PROJECT FOR THE ANALYSIS OF TECHNOLOGY TRANSFER

The Project for the Analysis of Technology Transfer (PATT) includes in its scope of work the establishment and maintenance of a library. This library will act as a resource of information concerning technology transfer and related areas. Access to this facility and its materials is open to researchers on the University of Denver campus involved in related work and to others concerned with the study of technology transfer.

Within the PATT operations, the library will serve three functions:

1. Support current operations and research;
2. Maintain awareness of state-of-knowledge of technology transfer, related disciplines, and areas of study;
3. Act as a source of materials pertinent to the structuring of future research activities.

The library will seek to acquire the writings of study groups and researchers who have contributed to the existing body of knowledge concerning technology transfer, such as scientists and engineers, economists, lawyers, sociologists, librarians, data processing specialists, and information specialists.

Technology transfer is a field influenced by many disciplines. Therefore, it is important that the collection not be limited by narrow and precise subject categories. However, some key areas of concentration for library acquisitions are identifiable. The library will direct its efforts to acquiring materials in four main subject categories: the process of technology transfer, factors affecting technology transfer, substantive content of technology transfer, and related areas. Each of these subject categories is discussed in the following paragraphs.

I. Process of Technology Transfer

In general, materials will be acquired relating to the technology transfer process itself--the diffusion of scientific and technical information, cost effectiveness and evaluation of alternative systems, and

the effects of technology transfer. The library will acquire materials relating to the individual steps in the process, described in more detail below.

A. Generation of Information. The transfer process begins with the generation of information from some point. In this subject area materials will be acquired concerning the origination of information to be transferred, such as innovations and inventions, and the originators of information, such as innovators.

B. Storage of Information. Included in this subject area is material concerning information storage, abstracting, documentation, identification, retrieval, and indexing. The library will not acquire detailed information involving computer programs or library automation systems.

C. Communication of Information. For information to be utilized, it must be communicated to the user. Thus this subject area is concerned with the acquisition of information by the user. For example, it will include the channels and media used to communicate the information (both formal and informal), sources of information, the dissemination process, linkages (such as information centers or transfer agents), communication systems, and the communication network in general.

D. Application of Information. This field includes areas relating to the application of technology and scientific and technical information once the information has been acquired by the user, and the results of the application. It will include such areas as the evaluation of the information by the user, motivation to apply information, requirements for information, the level within a firm where information is applied, users and user needs, and utilization of information. The materials in this subject area and in the general area of technology transfer should yield information on cost-effectiveness and cost-benefit.

II. Factors Affecting Technology Transfer

Materials will be acquired relating to both the internal and external factors affecting technology transfer. These are the barriers and incentives to the process as dealt with in "I" above.

A. Internal Factors. This area concerns factors within an institution or individual which might influence the transfer of information. Among the identifiable factors are barriers and incentives to technology transfer such as patents and licensing procedures, education and

educational opportunities, the environment, information requirements, the nature of the information, user needs, proprietary data, security regulations and restrictions, time pressures, cost-effectiveness, and the management of research and development.

B. External Factors. External factors are defined as the barriers and incentives outside the institution or individual which might affect the transfer of technology. These include such factors as expenditures for missile/space programs or technology transfer, policies and programs for technology transfer, institutions (including, for example, universities, government, and industry), the volume of technology, legislative, judicial, and executive concerns, and user needs.

III. Substantive Content of Technology Transfer

Included in this subject area will be the substantive knowledge about a field whose technology is being transferred. It will deal with the technical information needed to understand what led to the application of an innovation or invention. For example, included here would be materials dealing with electronics technology, materials technology, or urban affairs, and other areas for potential transfer. This subject area will be restricted to materials necessary to the background information of the PATT study team.

IV. Related Areas

This category will include materials that might or might not contain information on the transfer process but which are areas of study pertinent to an understanding of technology transfer and the factors affecting it. These areas include: technological and environmental forecasting, R&D management, new product development, diversification, patents (this subject will also be considered as an internal or external factor affecting technology transfer, but because of its broad scope, is also included as a related area), history of technology, international technology transfer, the technology gap, economics, library science, and the information sciences. Material in these and other areas will be acquired as needed for study efforts.

The library will cooperate with the American Library Association policy for interlibrary loan. The library reserves the right to restrict circulation of certain materials, including those which are unsuitable for mailing or which are needed to support the current PATT work.

The materials collected in the library will not be restricted by form, but will include: journals and serials, books, symposia proceedings, reports, papers and speeches, industrial publications, directories, indexes, clippings, encyclopedias, bibliographies, catalogs, congressional hearings and reports, and other government documents.

A critical evaluation of material will be made, when possible, before it is acquired. This will be accomplished through book reviews, abstracts, newsletters, recommendations by knowledgeable people, library accession lists, book publishers catalogs, subject bibliographies, and other reliable sources.

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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