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(NASA-TM-158025) DOCUMENTATION REQUIREMENTS FOR APPLICATIONS SYSTEMS VERIFICATION AND TRANSFER PROJECTS (ASVTs) Final Report (Battelle Columbus Labs., Ohio.) 104 p HC A06/MF A01 CSCL 05A G3/85

N79-14944

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Report

FINAL REPORT

on

DOCUMENTATION REQUIREMENTS FOR APPLICATIONS SYSTEMS VERIFICATION AND TRANSFER PROJECTS (ASVTs)

by

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Sponsored by

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Office of Applications
(Contract No. NASw-2800, Task No. 18)

September 30, 1977

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PREFACE

This study of ASVT documentation requirements for technology transfer was carried out by Battelle's Columbus Laboratories under Contract NASw-2800 with the NASA Office of Applications. Richard L. Stone served as the task monitor for this activity. Dr. Alfred C. Robinson supervised the activity as Battelle Project Manager. The investigator and report author was John T. Suchy.

We wish to acknowledge with thanks the time and help in developing this report which was given by some 50 individuals who we interviewed, both in NASA and in other organizations.

EXECUTIVE SUMMARY

NASA's Application Systems Verification and Transfer Projects (ASVTs) are deliberate efforts to facilitate the transfer of applications of NASA-developed space technology to users such as federal agencies, state and local governments, regional planning groups, public service institutions, and private industry. These projects begin with demonstrations of how the technology can be used, then proceed through one or more technology transfer stages. An ASVT is completed successfully when a designated user adopts the technology in his operational activities and direct NASA participation in the transfer project ends. Both the adopting organization and NASA share responsibilities to instruct and train other users and disseminate results.

This study by Battelle's Columbus Laboratories focused on the role of documentation in facilitating technology transfer both to primary users identified during project planning and to others with similar information needs. It was understood that documentation can be used effectively when it is combined with informal (primarily verbal) communication within each user community and with other formal techniques such as organized demonstrations and training programs.

Documentation examples from eight ASVT projects and one potential project were examined to give scope to the investigation. Two of these are most clearly identified with large groups of users from many (principally) state agencies. Three are most clearly identified with the information needs of individual federal agencies. One involved a combination of state and federal users. One involves technology transfer to a federal service with ultimate private industry users. One (the only one of the group not identified with remote sensing) involves a consortium of public service users. The final one is a potential ASVT with private industry users. The study was conducted to include:

(1) Review of ASVTs to determine technology transfer problems they present and to determine the potential roles of documents (both reports and other types of documentation) in attacking those problems

(2) Selective interviews with ASVT participants (both NASA and non-NASA) to gain their insights into applications of documentation in attacking technology transfer problems which they have identified

(3) Interviews of potential users of ASVT technology, primarily in state government agencies, to determine their technology transfer documentation needs

(4) Interviews of others involved in technology transfer in a variety of situations to develop an understanding of their approaches to documentation.

In general, in the ASVTs which were examined, it was noted that documentation patterns, including the development of reports and professional articles, often exhibit a "research" rather than an "application" orientation. Often, project reports were lengthy and were made available only in the final stages of the project. More selective dissemination of information keyed to specific user needs seemed to be required. This would require the development of a system of user interest profiles. There also is a need for "predocumentation" products (informative abstracts and an indexing system) to assist librarians or information specialists in handling ASVT reports.

Both non-NASA participants in ASVT projects and potential users called for reliable cost and benefit information at the *beginning* of the technology transfer phase so that management decisions could be made. It was further suggested that there should be wider dissemination of summaries of ASVT projects, crossing both discipline and geographical lines.

From technology transfer specialists in the three NASA regional centers and in other organizations it was determined that extensive user participation in both planning and documenting the technology transfer aspects of an ASVT would considerably enhance its attractiveness. The analysis further indicated that user participants in ASVT projects need to be involved more aggressively in seeking technology transfer applications beyond their own immediate organizations.

It was apparent from both the interviews and a literature review that successful technology transfer documentation requires thorough consideration of such factors as style, format, distribution mechanisms, and content of documents at the beginning of an ASVT. In most cases these are best handled by a professional documentation specialist rather than by a project manager whose interests must encompass the entire project. While there has been much research on the subject of technology transfer, it was noted that little research exists on technology transfer documentation and that available studies relate to documentation of applications of "spin-off" technology to other areas. Therefore it is recommended that the Office of Applications conduct specific studies of documentation effectiveness within the ASVT program.

Ten documentation guidelines for ASVT technology transfer are proposed:

For Identified Users

(1) Basic information about the *established technology* to be applied in an ASVT should be disseminated to both policy-making and operational levels of an identified user organization at the begining of the project to lay the groundwork for technology transfer.

(2) Where necessary to bring users up to speed, a state of the art report, prepared by an unbiased outside source, should be made available early in the project.

(3) Mandatory documentation requirements required at the end of the first (or test) phase are reasonable for decision making -- a user-cost/benefit analysis (rather than a socio/economic benefits

study); a comprehensive methodology statement; an accuracy and reliability evaluation.

(4) Workshop documentation outputs should be concept discussions rather than formal "proceedings", should stress user participation.

For Potential Users

(5) To facilitate decision making, each document should begin with a clear statement of *its own* purpose and an executive summary.

(6) Technology transfer documents should not stress administrative or operational problems which are not germane to the purposes of an ASVT, but also should not avoid negative results.

(7) Every ASVT should have a simple, illustrated "fact sheet" brochure which should be revised frequently. This brochure should discuss the purposes and applications of the project and should present significant application results.

For All Users

(8) One individual in each ASVT project, a documentation generalist rather than a subject matter specialist, should have technology transfer documentation responsibilities for the entire project.

(9) User guides in appropriate formats facilitate technology transfer. Users should participate in preparing these guides. Format conceptualization must depend on the characteristics of each user organization. Needs of various categories of user personnel (i.e., managers, environmental analysts, image interpreters, etc.) should be considered individually.

(10) Mini-documents, or brief reports on specific ASVT topics, should be disseminated through professional journals or by direct circulation to users and potential users. The goal should be to communicate all useful information before the formal end of an ASVT so no new technology transfer information is presented in the final report.

It is essential to analyze user needs before implementing a documentation program. However, in the ASVT environment it is likely that users and potential users will simultaneously be at many different stages in their evaluation of the technology. Therefore, the relationship between document types and goals must be a broad one. An analysis of document types and their effectiveness measures confirms findings, reported elsewhere, that the wider the coverage obtained by a communication method, the less is the depth of information provided, and vice versa.

Ten document formats which received high cost effectiveness ratings are analyzed in detail. The tenth is a new reporting format which is recommended for "NASA Application Reports".

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

Page

FIGURE LISTING

TABLES

DOCUMENTATION REQUIREMENTS FOR APPLICATIONS SYSTEMS VERIFICATION AND TRANSFER PROJECTS (ASVTs)

by

John T. Suchy

1.0 INTRODUCTION

> The mere knowledge of a fact is pale; but when you come to *realize* your fact, it takes on color. It is all the difference between hearing of a man being stabbed to the heart and seeing it done. -- Mark Twain in A Connecticut Yankee in King Arthur's Court.

The Connecticut Yankee strove in vain to transfer the technology of 19th Century America to 7th Century England. He failed not because he lacked the knowledge but because his "user community" had not participated in developing the technology that he fostered. This lesson has been repeated many times and in situations ranging from efforts of the Peace Corps to improve the nutrition of South American Indians to NASA's own efforts to interest state and local governments in the capabilities of remote sensing. The literature provides many examples:

> Strong negative attitudes toward the use of data from LANDSAT-1 for regional land use planning and toward the research process seeking to evaluate the potential use of the data were experienced in one project. This appeared to be attributable to the lack of opportunity for input from decisionmakers in the preproposal planning for the research. -- Cases in the Relation of Research on Remote Sensing to Decisionmakers in a State Agency, by James W. Jondrow, NASA Earth Resources Survey Symposium, Houston, Texas, June 1975.

> At the present state of technology understanding, the business community is faced with the problem of attempting to provide an ill-defined product to an uninformed consumer to satisfy some real and some yet to be determined needs and requirements. -- Remote Sensing - The Role of the Supplier, by S. S. Viglione, LARS Symposium on Machine Processing of Remotely Sensed Data, West Lafayette, Indiana, June 1976.

> The states must have open and candid interaction with NASA, the supplier of the technology, to guide them in using the technology as a tool and in appropriately utilizing the private sector and universities to fill their needs. -- State Recommendations on Approaches to Landsat Technology Transfer, by Sally M. Bay, National Conference of State Legislators, April 1977.

This need for interaction between users and suppliers of technology comprises a powerful reason for the development of NASA's Applications Systems Verification and Transfer Projects (ASVTs). As outlined in the Operating Guidelines for ASVTs, these projects have three important objectives: (1) to demonstrate the technical capabilities necessary to accomplish specific objectives; (2) to establish the benefits of technology without having to prove the technology itself; (3) to provide functional technology transfer mechanisms, leading to operational use of the technology.

It is expected that ASVT technology transfer will be accomplished by a number of mechanisms, including principally (1) informal and primarily verbal communications within the user community (2) organized demonstrations and training programs held by NASA or by other public or private agencies and (3) dissemination of reports and other types of documentation developed either as part of a specific ASVT effort or as part of the activities of an agency or group charged with general technology transfer responsibilities.

The objective of this study has been to consider the third mechanism, and to address the question of what types of documentation and reports will be most effective in furthering the transfer. However, it must not be assumed that the *preparation* of documentation alone can be recommended to NASA as a suitable means of technology transfer. Just as the technology must be disseminated, the documentation must be disseminated, utilizing both formal and informal contacts. It is a rule of thumb in mail advertising that a 2 percent return on materials sent to a "blind" mailing list is a good return, even when the mailing list is carefully selected. Unless NASA is satisfied with such results, there must be additional personal cultivation.

Not all ASVTs have the same characteristics, and many other NASA projects, primarily in the remote sensing area, have technology transfer implications which resemble those of the ASVTs. Differing objectives are addressed, and there are different communities of potential users. Accordingly, it is to be expected that some specific reporting and documentation requirements will be different as well. However, it should be possible to establish reporting and documentation guidelines for at least the major categories of ASVTs because all ASVTs seek to facilitate the application of available technology. These guidelines (discussed in the last two chapters) should facilitate the development of ASVT work statements and reporting and documentation requirements.

Eight ASVTs which are currently active or in final negotiation stages and one potential ASVT were reviewed during the development of this report. The purpose of this review was not to focus on the history or methodology of each project but to determine technology transfer documentation methods and opportunities. In addition, we interviewed personnel of the three new Earth Resources Training Program centers (Moffett Field, Ca.; Slidell, La.; and Greenbelt, Md.) to obtain their perspective on needs and opportunities for technology transfer documentation.

To obtain a broad perspective on state technology transfer needs -- an area of considerable present interest to NASA -- we interviewed state agency personnel in Georgia, Mississippi, and California and visited the National Conference of State Legislatures offices in Denver. A telephone conference was held with members of the Pacific Northwest Land Resources Inventory Demonstration Project Task Force. Further information on state and local needs was obtained through an extensive literature review.

To obtain an industrial perspective we visited a major commercial supplier of Landsat data and further interviewed an industrial subcontractor involved with the Snowcover ASVT. University remote sensing scientists were interviewed at Purdue, Georgia Institute of Technology, and the University of California at Davis. Further interviews were conducted in Washington at the National Academy of Sciences and the National Science Foundation (particularly concerning documentation of the RANN -- Research Applied to National Needs -- Program).

For review and discussion purposes, we circulated a concept paper, "Toward Developing an ASVT Documentation Strategy for Technology Transfer".[1]

It might have been desirable during this task to interview the entire potential ASVT user community. Time and funding constraints prevented this; however, enough interviews were conducted to show a number of common interests in documentation strategies among ASVT project participants, users and potential users, and individuals charged with technology transfer responsibilities. The existence of these common interests was confirmed by the literature review.

Two of the ASVTs which we examined are most clearly identified with large groups of users from many (primarily) state agencies. These are the

Pacific Northwest Regional Commission Land Resources Inventory Demonstration Project and the Mississippi Natural Resources Inventory System Project. Three of the ASVTs are most clearly identified with the specific information system needs of individual federal agencies. These are the Wildland Vegetation Resource Inventory Project (Bureau of Land Management), the Water Management and Control Project (U.S. Army Corps of Engineers), and the Urban Area Analysis Techniques Project (Bureau of the Census, still under negotiation). One ASVT, Operational Applications of Satellite Snowcover Observations, involves a combination of state and federal agencies. One, Project Icewarn, involves NASA technology transfer to the U.S. Coast Guard, with ultimate users in the shipping industry. The Public Service Satellite Consortium, composed of some 75 member users of public service communications, is the user group designated in an ASVT designed to upgrade groundbased facilities for satellite telecommunications. A potential ASVT most clearly identified with private industry is the Forest Resource Information System (St. Regis Paper Company supported by Purdue's Laboratory for Applications of Remote Sensing).

A wide range of vehicles for technology transfer documentation of these ASVTs are available to NASA and to project participants outside NASA. To obtain an initial perspective on how these vehicles are being used, we asked participants what documents they are using or have planned specifically for technology transfer purposes. All agreed that the final report must be a technology transfer document, but there was a wide variety of concerns about using other types of documents for technology transfer purposes. Table 1 (below) shows the range of these concerns.

It is notable that although all participants viewed the final report as a technology transfer document, there was in none of the ASVTs we examined a documentation plan which referred specifically to an organized, detailed effort to enhance technology transfer by (1) defining the information needs of users and potential users and (2) presenting a documentation schedule to meet those needs.

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1. This concept paper is included in Appendix A.

TABLE 1. DOCUMENTATION PRODUCTS PLANNED SPECIFICALLY FOR TECHNOLOGY TRANSFER FOR NINE SELECTED ASVTs (EXCLUDING DOCUMENTATION PRIMARILY FOR ADMINISTRATIVE PURPOSES)

Formal Project Announcements	2	Exhibits, Displays, etc.	2
State of the Art Reports	3	Formal Instructional Materials and Videotapes	3
Popular Articles/ Press Releases	4	Interim Reports Including Accuracy and Reliability Information	6
Fact Sheets or Informative Brochures	2	Reports on Specific Sub-Projects or Phases	3
Symposium Proceedings	1	Comprehensive User Guides	3
Cost/Benefit Reports	4	Final Reports	9
Professional Articles	5		

2.0 THE TECHNOLOGY TRANSFER PROCESS

2.1 NASA's Role

The transfer of technology, and its subsequent utilization, has been termed the *second* most difficult job that NASA has. Certainly, NASA's involvement in translating the results of its research into useful innovations represents a commitment that is both important -- in terms of its annual budget -- and pioneering. In perhaps no other government or private agency has there been such a sustained effort to apply technologies learned in specific research.

The definition of technology transfer provided in the glossary of terms for ASVT projects defines this activity as, "the art of providing the user with the necessary capability to independently apply a technology or system in an operational mode". A purist might argue that certain remote-sensing ASVTs do not fit this definition because there is not a transfer of remote sensing technology, which includes the development and operation of hardware and the reception and primary processing of data gathered by space hardware. Rather, the goal is to transfer the *application* of data gathered by remote sensing techniques.

While this distinction may seem to be hair splitting, it is important because both NASA and the lay public have tended to confuse the actual transfer of space technology with its application. For example, in a popular-level account of the Large-Area Crop Inventory Experiment (LACIE) ASVT appearing in the April, 1977, TWA Ambassador magazine the role of space hardware in collecting earth resources data received more emphasis than the actual utilization of the data. William Kier of the California State Senate Research and Development Office told us that in the past NASA's promotion of earth resources technology has overemphasized its space aspects and underemphasized its usefulness in problem solving. His view was supported by that of Captain Winfred E. Berg of the National Academy of Sciences who said that it is a fallacy to "force feed" technology because it is *space* technology rather than because it has useful applications.

Actually, within the NASA context there are three types of technology transfer. Though each is supported by its own level of documentation, the three have much in common because they seek to promote the ancillary benefits of a large-scale research and development program which was *originated* for reasons of defense and national prestige. (We do not choose to argue the rationale of "spin-off" benefits which may ultimately exceed the value of the original innovation. History is full of such benefits as the development of nuclear power, the development of the modern digital computer, radar, etc.)

One type of concern is evidenced by direct "primary" transfers of technology which often are accomplished by conventional routes and processes. For example, a new, lighter form of electronic circuitry is required for a satellite application. There is a research program, and information from the program, conducted under NASA contract, is fed into satellite system design. Subsequently, a major supplier of transistors for military communication devices uses the same information to improve his products, an example of "vertical" technology transfer between government programs. Or a supplier of transistors for high fidelity phonographs uses the information to improve the products he sells, an example of "horizontal" technology transfer from government to industry.

Another type of concern which has received much emphasis is the "secondary" transfer of specific technology to new and different applications. This type of transfer activity, which might also be called "technology recycling", is often what is meant by those who define technology transfer as:

> ". . . the reuse of materials, processes, or equipment developed *with government support* for some national purpose in order to achieve new public or private ends."[1]

The application of data or information from space technology where the technology itself remains with NASA (as in the case of remote sensing) differs from these two types of concepts. Yet the three types must follow the same basic utilization steps -- beginning with trial application and evaluation by possible users, followed by preliminary acceptance. In each case, technology transfer is fully realized only when a market for a new product is created or when a problem is solved.

The glossary of terms for ASVT projects defines technology transfer as, "the art of providing the user with the necessary capability to independently apply a technology or system in an operational mode." Practitioners of the art sometimes discriminate between this activity and "information dissemination" to show potential users the existence, procedures, and results of research and development. Documentation can be viewed in either category, because even the most specific how-to-do-it information of the "cookbook" type is useless unless it is disseminated. Conversely, a popular magazine article with little technical content can perform a useful technology transfer role if it motivates potential users to try a new technology application. Therefore, we find no reason to discriminate between the two terms, except to note that technology transfer documentation must include information dissemination.

To the prospective user in government or industry the actual designation of a NASA project as an ASVT or some other project type makes little difference as long as technology or application transfer purposes are evident and legitimate. A useful rule of thumb for evaluating those purposes can be gleaned from a series of recommendations for effective technology transfer made by the Committee on Technology Transfer and Utilization of the National Academy of Engineering.[2] These recommendations see technology transfer as, basically, an entrepreneurial activity with four fundamental parts:

- The technology to be applied
- The opportunity for its application -- markets, needs, and impacts
- Organization of the participants (innovators, users, suppliers) to define the opportunity and match it with available technology
- And, finally, activities which profitably and efficiently produce benefits from the technology -- adaptive engineering, financing, marketing, purchasing, etc.

In some government research and development areas, such as health and agriculture, activities such as these are routinely undertaken to meet recognized consumer needs. Transition to the marketplace is not difficult because little adaptation is required. But in other areas, such as space, transition and technology application require extensive adaptation and relatively large investments, both in capital and in the ability to translate an idea from one discipline to another.

But this, alone, is not enough since it neglects the fact that technology application and transfer itself must be an innovative process. The proper environment for such innovation must be created. NASA is recognizing this by attempting to supply the best possible climate for transfer activities within the scope of what it is permitted to do. (The 1958 Space Act includes only a general charge to NASA to disseminate information, though it also calls for long-range studies of the peaceful and scientific uses of aeronautical and space activities.)

While there has been some discussion of the effectiveness of federal technology transfer programs, it has neither been seriously suggested that they be abandoned or basically altered. It also seems reasonable that the policies of the present federal administration will not differ from those of previous administrations with regard to technology transfer.[3] NASA has been counted among the proponents of technology transfer since it was founded. While not challenging the need for such NASA activities, some critics have challenged their effectiveness.[4]

It is particularly because recognized NASA technology transfer activities such as ASVT projects must be formulated to address specific transfer goals that strong and continuous user feedback from the earliest possible moment is necessary to their success. Documentation can have a role in stimulating this feedback. Such documentation should be viewed in the context of what users need to address their problems, not simply what NASA needs to operate a project.

2.2 Challenges and Opportunities

In its Survey of Users of Earth Resources Remote Sensing Data (March 31, 1976) for the NASA Office of Applications, Battelle found that university scientists and technologists, themselves among the most frequent users of NASA earth resources data, serve as a resource to make others in their states aware of the application potential of these data. Yet, the Survey also revealed that as of early 1976, "no state, however strong in its use of ERS data, was found to use LANDSAT data in an operationally routine manner".* In other words, there had been no effective stimulation process for state applications in general related to all types of remote sensing projects.

A part of the reason for this may well have been the acknowledged communication gap which exists between research scientists and practitioners. One feasible role of technology transfer documentation should be to help bridge this gap. Paraphrasing from an article on "Relations between Researchers and Practitioners", by James P. McNaul, James W. Jondrow of the University of Wisconsin provides several examples of the bridge which must be crossed.[5]

1. The value system of the practitioner is the *use* of knowledge. For the researcher, the value system is the *increase* of knowledge.

2. The time frame for practitioners is generally short. That for researchers is longer.

3. Practitioners communicate through technical agencies or companies. Researchers communicate through scientific journals (and meetings).

4. Practitioners want products or policies which relate uniquely to a particular problem. Researchers are most interested in the discovery of patterns that constitute theoretical principles that can be generalized (in their own language).

5. Practitioners have to assume that the knowledge on which they are going to act has some finality. Researchers think of scientific knowledge as never final.

6. Practitioners cannot manipulate their environments so they can be certain about the effects of every variable. Researchers try to build experimental designs in which some factors can be controlled so variables can be studied and measured.

Some 3000 papers have been published over the last 15 years dealing with one part or another of the technical innovation process, and more than a dozen books have appeared.[6] Many of these publications have dealt with efforts to bridge the practitioner-researcher gap and have presented

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* Page 66.

variations of a basic theoretical model with the practitioner on one side, the change agent (often supported by documentation) in the middle, and the researcher on the other side. G. R. Barker of the St. Regis Paper Company presented a useful variation of this model (see Figure 1) at the 1976 LARS Symposium held at Purdue University.[7] This model provides for joint participation in problem solving with assured feedback mechanisms. Further, it realistically separates the user community into executive management (state legislators, heads of departments) and operations management (project directors, line supervisors) functions. In discussing this model, Barker issues several warnings which must be heeded in any consideration of technology transfer documentation:

> Research and the development of technology within any discipline must be related to the operational or functional aspects of that discipline to be effective . . .
>
> Effectiveness, in turn, depends on how aware the potential user is to the implications of this technology to his operation. How much modification is necessary to render the techniques truly successful? Research efforts must be sensitive to the needs of the user by asking the questions before, not after the procedures have been developed . . .
>
> Unfortunately, technologists and other professional people have a propensity for talking to themselves and entertaining each other with displays and demonstrations. In addition, many papers and articles are written supposedly to disseminate research results, but are really prepared as peer group "show and tells", replete with all the neo-vernacular inevitably associated with such activity. The fact that the practitioner cannot relate any of this to his application does not seem to matter much, and so the communication gap is perpetuated and the gulf of credibility between the groups is widened . . .
>
> Although this may seem repugnant to a serious researcher, the fact remains, if the results are to be used, (*that*) an interface with the potential user must be established. To this end part of the research resource must be allocated . . . (emphasis inserted)
>
> The technical community also has the obligation not to oversell the product, either by direct claims or inference, and must make clear to the user just what is needed in terms of user input, and prerequisite materials and information . . .
>
> A written report is no guarantee of implementation regardless of the volume or repetitiveness of the exercise. Operational

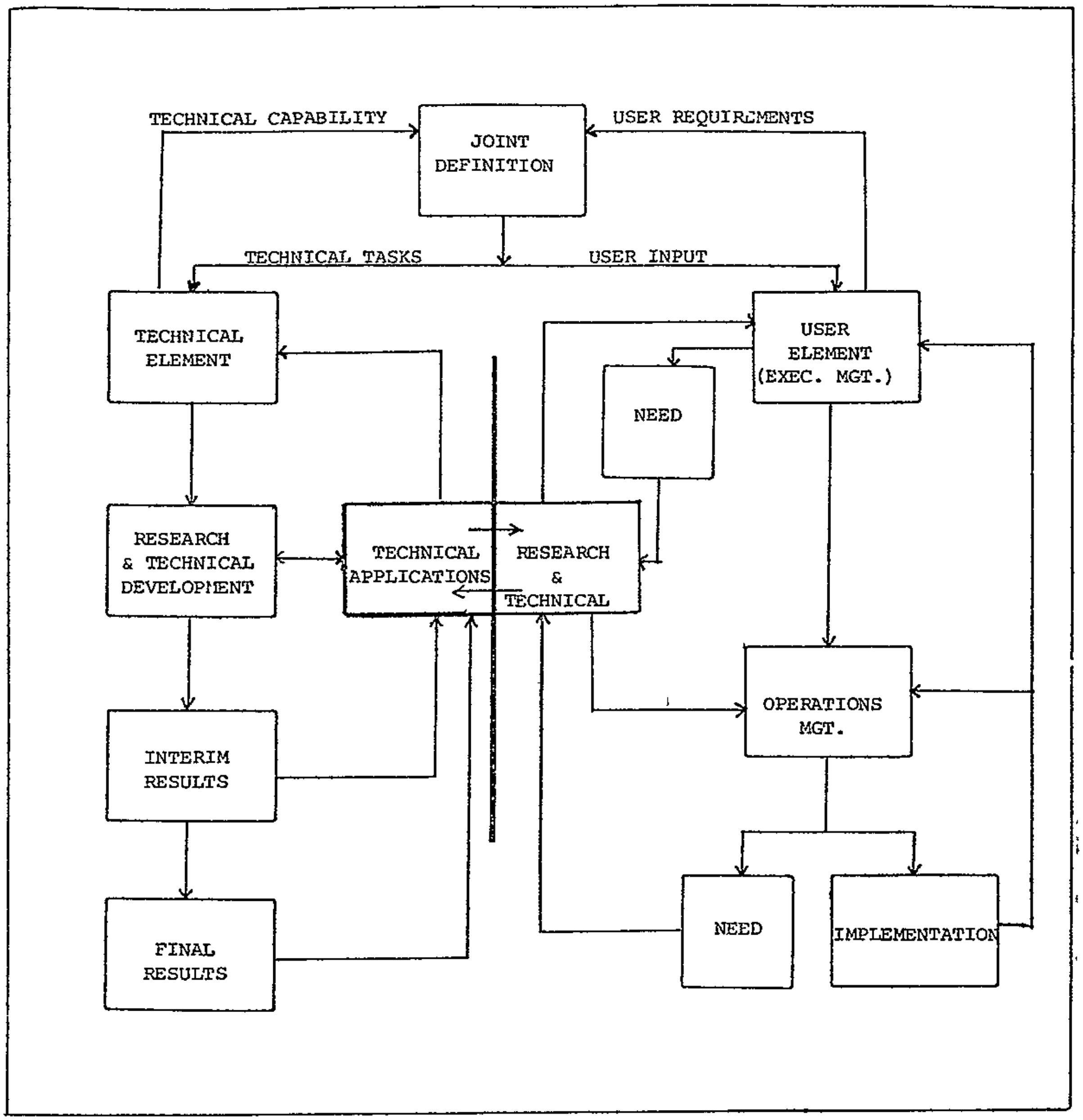

FIGURE 1. A FLOW CHART OF THE TECHNICAL/USER COMMUNITY INTERFACE IN AN IDEAL TECHNOLOGY TRANSFER SITUATION

From G. R. Barker, LARS 1976 Symposium

implementation will be assured only by hard work by a lot of people in a coordinated multi-disciplined atmosphere. Usually, neither the time nor the inclination is exhibited for such an effort. A written report often raises as many questions as it answers and, given no follow-up, does not provide the vehicle needed to apply the results.

2.3 Research on Technology Transfer Documentation

While there has been much research on the subject of technology transfer, we have looked in vain for research which relates the successes and/or failures of any specific transfer program to documentation uses which can be verified by quantitative analytical techniques. To approach this would require the detailed logging of documentation histories of a number of projects from their initiation through their conclusion. (In this respect, NASA can make a contribution through its ASVT projects by providing such a detailed logging of each project.)

NASA's Technology Utilization Program, through the University of Maryland[8] and most recently through the Denver Research Institute, has conducted analytical studies of the uses of one type of documentation product, the Tech Brief. These studies have indicated that, for technology spin-off from one technical field to another, the brief format (a short) descriptive summary with references and contact points for further information) can be a useful mechanism. Tech Briefs are disseminated widely to decision makers ("gatekeepers") who can influence the introduction of technology and to communication media. The studies have shown that Tech Briefs are most useful when followed up by personal contacts.

In a study for the National Technical Information Service (NTIS)[9], Battelle found that by suggesting applications to other fields of the technology of patents held by the Federal Government, significant interest could be generated in utilizing those patents. (Federal patents were first put through a highly selective screening process to determine potential areas of interest.) This project used documentation products ("brief" writeups followed by case-history discussions of selected patents) as means of identifying and establishing leads for further exploitation.

The Tech Brief and patents studies were concerned with the transfer of technology between disciplines, but not with furthering the original intended uses of a particular type of technology in the same discipline but within different types of organizations such as Federal agencies and state and local governments as well as private industries. The National Science Foundation Research Applied to National Needs (RANN) Program (see Section 3.2, following) is a strong example of the uses of Federal funds to transfer the intended uses of technology to state and local governments and to industry. RANN compiles case histories of its successful transfer efforts. The most recent collection of these case histories[10] covers 21 RANN projects which have been well utilized or have provided valuable insight into the technology utilization process. Although documentation products such as reports, technical articles, manuals, popular articles, and press releases are given substantial credit for enhancing technology transfer in many of these cases, in no case is there an attempt to assess the technology transfer role of documentation as a separate entity. Nor is there mention of a specific documentation plan for any of the RANN projects.

These observations, together with our searches of the literature, our interviews of ASVT participants, and our personal experiences with documentation systems have led to the conclusion that there is little information from experience and research on which to develop a systematic technology transfer documentation strategy. Documentation procedures for ASVT's as well as for other projects whose function is technology transfer generally are ad hoc procedures, developed in response to the perceived interests of the public, of a technical or management community, or of the principal investigator and his staff.

There is an exception to this picture in the work of BISRA -- the Intergroup Laboratories of the British Steel Corporation.[11] We have drawn from this work, and from our own experience with documentation programs, for the suggested guidelines for ASVT technology transfer documentation which appear in Section 6 of this Report and for a breakdown of recommended documentation purposes, types, and formats for the various stages of an ASVT project in Section 7. These recommended guidelines and procedures thus represent an approach which should be verified by further research within ASVT projects themselves.

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1. M. Frank Hersman, "Technology Utilization in the Public Sector", in Science and Technology Policies: Yesterday, Today, and Tomorrow, G. Strasser and E. M. Simons eds. (Cambridge, Mass.: Ballinger Publishing Co., 1973). p. 80.

2. Technology Transfer and Utilization, Recommendations for Redirecting the Emphasis and Correcting the Imbalance (Washington: National Academy of Engineering, 1974). p. 22.

3. President Richard M. Nixon's Message to Congress on Science and Technology, March 16, 1972, stated: "Federal research and development activities generate a great deal of new technology which could be applied in ways which go well beyond the immediate mission of the supporting agency. In such cases, I believe, the government has a responsibility to transfer the results of its research and development activities to wider use in the private sector."

4. Doctors, Samuel I., The NASA Technology Transfer Program (New York: Praeger Publishers, 1971). p. 8: "The need to establish a transfer program quickly led to a program which was based largely on expediency, not on research results concerning the transfer process".

5. Jondrow, James W., "Cases in the Relation of Research on Remote Sensing to Decisionmakers in a State Agency". Proceedings of the NASA Earth Resources Survey Symposium, Houston, Texas, June 1975 (Washington: NASA, 1976). Volume 1-C, pp. 1619-1620.

6. Draft Report, An Evaluation of SEASAT-A Candidate Ocean Industry Economic Verification Experiments (Princeton, N.J.: Econ, Inc., 1976). p. 10. An extensive discussion of "Innovation and the Technology Transfer Process" appears on pp. 10-43 of this draft.

7. Barker, G. R., "So You Think You are Ready for Remote Sensing -- Implementation Considerations of Remote Sensing Technology in a Private Industrial Environment". Purdue: LARS Symposium Proceedings, Machine Processing of Remotely Sensed Data, June 29 - July 1, 1976 (West Lafayette, Indiana: Purdue University, 1977). pp. PC-5-PC-9.

8. Reported in "Government Efforts to Facilitate Technical Transfer: the NASA Experience", by Philip Wright, in Factors in the Transfer of Technology (Cambridge: The M.I.T. Press, 1969).

9. Final Report on the Patent Technology Transfer Program to National Technical Information Service and Economic Development Administration, U.S. Department of Commerce. Battelle Columbus Laboratories, 1973.

10. RANN Utilization Experience, Final Report to the National Science Foundation. Research Triangle Institute, 1975.

11. In Quantitative Management in Research and Development, by C. J. Beattie and R. D. Reader. (London, Chapman and Hall, Ltd., 1971).

3.0 MECHANISMS FOR NASA ASVT TECHNOLOGY TRANSFER

> "Who decided that we need technology and science in the public service?" Was it the technologists and the scientists who decided that you have something to offer, or did the motivation come from state and local officials? This is a very critical question, because even if you can develop methods, processes, procedures, systems which can be useful in local and state government, you are wasting your time and talents if local and state officials have not decided they want your help. It may well be that as much talent needs to be put into creating the atmosphere in which science and technology will be accepted by public officials as you put into devising the techniques which can be useful to them." -- Gustav Heningburg, President, The Greater Newark Urban Coalition, Inc.[1]

3.1 NASA ASVT Technology Transfer Characteristics

Among NASA's greatest benefits to society is one which has gone largely unheralded which might be called "the management of technological innovation". This involves the development and application of systematic management techniques, combined with organizational capabilities, to achieve finite goals. The beneficiaries of this approach are legion, both in government and industry. For example, the concept of safety and system assurance in urban mass transportation planning is a direct descendent of the type of thinking that goes into NASA project planning, as exemplified in Project Apollo and most recently in the Space Transportation System project.

The Applications Systems Verification and Transfer projects represent an extension of NASA management philosophy into the area of technology transfer. Each project should proceed according to a plan where every phase has measurable goals and finite documentation products. Each ASVT has two major phases (which may be subdivided) separated by an opportunity for go/no-go decision making. In a draft set of ASVT guidelines prepared in 1976[2], mandatory products of the first (test) phase are listed as a documented methodology *suitable for widespread use*, a comprehensive evaluation of the system's reliability and accuracy, and a socio/economic benefits study.

Dissemination of these products in useful, understandable formats can be a valuable feature of ASVT technology transfer documentation -- even though the products themselves may have been created to assist NASA management in deciding the level and nature of support to be given a project and to provide information for use in the second project phase. This is particularly true if "creating the atmosphere" for effective technology transfer is important. (Our interviews of users and of NASA applications personnel confirm that this *is* an important aspect.)

There is considerable room for flexibility in the design and development of documentation during the second or "technology transfer" phase of an ASVT. In examining three ASVTs which are well into this phase (*Pacific Northwest, Mississippi,* and *Snowcover*) we have seen documentation products ranging from published proceedings of symposia, to user reports and handbooks, to journal articles, to exhibits and displays, to user newsletters, and to revisions of project plans and various administrative reports. Some of these reports can be improved by better defining their purposes so that a standardized approach can be employed. That is, by anticipating user needs and developing general requirements keyed to these needs a consistent documentation approach is possible. Nearly all of the documents we have seen can benefit from the application of techniques to improve their readability. In the case of administrative reports, it should be necessary to include only enough detail to ensure that each project is adequately managed at each level of performance.

Voluminous project documentation often is viewed as an odious chore by principal investigators and project managers. Often this is because the formal reporting of project results must wait until the end of a project (according to traditional views of project management in many other organizations as well as NASA). During the latter stages of a project, time and money usually are running out; moreover, project managers and participants are rightfully more interested in what lies ahead than in what has happened. This problem is well known to participants in the Earth Resources Training Program who have told us that routine reporting should be minimized. In most cases, they feel, strictly administrative reports to lead centers and the Office of Applications can be telescoped into formats of a few pages. *We did not consider administrative reporting requirements in our study. However, we feel strongly that the rationale and necessity for such reports should be studied by NASA because the production of documents for administrative purposes can detract from the time available for technology transfer documentation.*

In some cases, innovative approaches are being tried to simplify administrative reporting. (One example, developed by Armond T. Joyce to simplify routine reporting of the Mississippi ASVT, is included as Appendix C.) For final project reporting to NASA, Philip J. Cressy of Goddard Space Flight Center told us that he prefers a technology transfer document, summarizing what has been done in user oriented terms, together with a very short fiscal summary. Robert H. Rogers of Bendix Aerospace Systems utilizes a building-block approach to reporting. At each step in the development of a project, Bendix, in collaboration with a user group, prepares a written presentation or technical article. By the end of the project, only a compilation of these interim documents is required for the final report. The interim presentations and articles are given wide distribution to encourage technology transfer *before the end of the project.*

3.2 Characteristics of Other Selected Technology Transfer Programs

Bendix Aerospace Systems provides an example of how documentation by a commercial contractor can be used to encourage uses of Landsat imagery at a relatively modest expense. Copies of presentations made to technical society meetings are sent out widely, and *each is coauthored by a project user.* Simple but effective graphics are employed on the title page of each copy. Authors are identified by biographical sketches, and there always is a summary abstract. Because this distribution occurs immediately after a meeting, or while the meeting is in progress, timely information is made available without traditional publication delays. Bendix publishes a quarterly newsletter, Down to Earth Views. A film, "You and MDAS", is employed to introduce remote sensing and Bendix data processing concepts at a relatively elementary level. (This film needs to be shown by someone who is familiar with the system, according to Rogers, because it raises as many questions as it answers.) Bendix publishes the usual array of technical bulletins and reports on its products and services. An eight-page color brochure, "Resource Development and Management with Remote Sensing Systems", provides an introduction to remote sensing and describes the company's interests. A newly developed "Landsat Products Catalog" describes and illustrates every Bendix service in colorful detail and provides up-to-date price information.

According to Rogers, the *commercial* market for Landsat earth resources services is almost endless at state and regional planning levels within states. In supplying these services, Bendix seeks to capitalize on the unique qualities of its products but still feels that the biggest job is in selling remote sensing technology in general. This is significant because state agency personnel in Mississippi and California told us they would prefer to learn about both the capabilities and limitations of remote sensing from NASA, or from some other agency which like NASA *has no commercial interests*, rather than from a commercial supplier.

In a number of areas of technology, such as energy resource development and environmental impact analysis, universities have sought to play disinterested middleman roles. This has been true in remote sensing technology where university scientists have had significant roles in the first, experimental applications of the ERTS satellites. Documentation of these experiments has been accomplished through the usual avenues of professional publication. This has contributed to the development of a "remote sensing community" in university departments of geography and other academic departments. However, as illustrated by Battelle's user survey, there has been little actual technology transfer between this community and state and local governments. (We speculated on reasons for this lack in our discussion of the technology process.) In California, for example, with the exception of limited participation by the Department of Water Resources in the Snowcover ASVT, there is essentially *no* state government use of Landsat data. This is in spite of the fact that the University of California at Berkeley has been a major participant in ERTS experimentation.

There is an exception to the apparent barrier between universities and state and local governments in the state of Georgia where the Georgia Institute of Technology Engineering Experiment Station, through a non-profit corporation, the Georgia Tech Research Institute, provides a link between NASA and a wide variety of state users. The approach is based on personal contacts rather than documentation, with emphasis on "hands-on" experience at Georgia Tech and at NASA's NTSL installation at Slidell, La. Most state uses are funneled through the Office of Planning and Research of Georgia's Department of Natural Resources. This Office plays an advocacy role which is missing in other states we visited. Participants in its programs recognize the need for certain types of documentation. In his comments on user awareness Bruce Q. Rado, Senior Planner in the Office of Planning and Research, states:[3]

> There is a significant need to provide information in the form of handbooks, newsletters, brochures, films, etc., that explain in a clear manner how the satellite works, what its capabilities are, and the extent of its limitations. Further, such information must be illustrated with examples relating satellite capabilities to specific management programs in States or Federally-legislated programs that require plans from States or agencies (within States) . . .
>
> Such information must be oriented to the non-technical reader, yet provide a significant level of detail on which an interested agency may base its decision to further investigate the use of LANDSAT data. Of special interest . . . is the ability to combine various sources of information such as soils, topography, land cover, etc., into a common data base. The strengths formed by the relationship of these components exceeds their strengths individually. As Landsat is *one* potential source of such information, details should be provided on Landsat data that relate it to the merger with other data.
>
> The format of such literature should be structured in a manner so as to make it timely with the budgeting/decision cycles of potential users . . . Further such literature must be easily reproducible (e.g., looseleaf notebook).
>
> . . . It is also necessary that decision makers be briefed by (literature) means *previous* to NASA visits.

In their comments planners in Georgia alluded to the apparent fact that Federal agencies which supply geographical data engage in competition, attempting to sell one data approach over others. This leads inevitably to confusion, misinformation, and the fear of being "locked in" to a data system which is not the best. We could identify no documentation product which specifically and objectively discusses the capabilities and limitations of Landsat, LUDA (USGS), MIADS (SCS), TOPOCON (Army Map Service), etc., permitting potential users to make the best choices for their own situations. As

Robert H. Rogers of Bendix pointed out, the secret of getting the most information out of earth resources data is knowing when and how to select and combine data sources.

At Purdue University in Indiana the Laboratory for Applications of Remote Sensing (LARS) functions as a national training and research facility with special expertise in data processing rather than specifically for technology transfer within its own state. LARS makes available documentation products and produces an organized collection of educational materials. A minicourse series, "Fundamentals of Remote Sensing", consists of 19 modules which can be used in combination or individually. A series of two-page foldouts called "FOCUS" presents capsule summaries of 14 remote sensing topics. In addition, LARS has produced an educational package on the LARSYS computer software system and has developed a series of videotapes and simulation exercises.[4]

The principal documentation product of LARS is its "Information Note" series, consisting of brief project reports, which was started in 1966. LARS prefers to issue its own reports, rather than use NASA channels or channels of other federal agencies, because of publication delays which are termed "unreasonable" by LARS Director David Landgrebe. Acknowledging the need for fair public disclosure to prevent unfair private exploitation of data which are gathered at public expense, Landgrebe believes that NASA channels for putting information in the public domain through Johnson Space Center are so slow that they are inhibiting effective technology transfer. LARS's first experience with JSC documentation clearance procedures on a space applications project required three years. Landgrebe told us, "I've never had my knuckles rapped for not getting a paper out, and that's one thing that NASA really ought to do".

Landgrebe shares an opinion held by a number of those in federal agencies with technology transfer responsibilities that the National Technical Information Service (NTIS) still is an unwieldy mechanism for technology transfer documentation dissemination. For example, dissemination of documentation from the National Science Foundation Research Applied to National Needs (RANN) program is handled primarily through a commercial contractor (Capital Systems Group, Inc., Rockville, Md.) rather than through NTIS. All RANN reports, of course, are made available through NTIS, but George S. James of the NSF Communications Programs Research

Applications Directorate told us that NTIS distribution seems to be effective only for high-technology reports.

The technology transfer goals of NSF-RANN have been documented extensively.[5] In general, the objectives of RANN projects which seek to transfer technology to state and local governments are similar in nature to the objectives of ASVT projects. Robert C. Crawford, Deputy Director of the NSF Office of Intergovernmental Science and Research Utilization, emphasizes that RANN state of the art reports are based on studies to meet defined user needs. Documentation is issued at four levels: (a) an executive summary, 8-10 pages, (b) a 30-page upper management summary; (c) a middle management summary; (d) a detailed handbook.

A report on solar energy applications has received wider distribution than any other RANN report to date. James attributes this success to an editorial reference which was made to the report in Parade magazine. Another dissemination mechanism which has been effective, according to James, is the publication of abstracts of selected NSF documents in the "Resources and Technology Newsletter" of the National Association of Manufacturers. (NSF contracts with NAM for this service.)

With NASA, the National Bureau of Standards, and the Department of Transportation, NSF participates in the Model Interstate Science and Technical Information Clearing House (MISTIC) of the National Conference of State Legislatures (NCSL).

The Final Report of NCSL's Task Force on Remote Sensing[6] shows a pattern of emerging interest within state government agencies in the potential data collection capabilities of the Landsat Follow-On Program. The Task Force confirmed Battelle's findings that there is little true operational use of Landsat technology currently in state governments, stating, "Most of the applications described are experimental uses supported by outside funding so that it may be too early to estimate how much a particular agency is actually spending or willing to spend on remote sensing." NCSL developed a companion report on remote sensing technology transfer[7] which includes several specific documentation recommendations, including the increased use of information brochures, newsletters, and loose-leaf handbooks prepared in language to meet identified information needs which are interdisciplinary as well as discipline-specific. Through its Remote Sensing Project NCSL is proceeding to implement its plan to serve as an information link between NASA and state legislatures.

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1. The Application of Science to Public Programs, Papers, Recommendations, and Discussion of the Eastern Regional Conference on Science and Technology for Public Programs, Cambridge, Mass., April 2-3, 1970. (University Park, Pa.: Pennsylvania State University, 1971) p. 19.

2. "Draft Management Instructions on Guidelines for Planning, Preparation, and Approval of ASVTs", Memorandum from C. W. Mathews, March 12, 1976.

3. Communication of December 22, 1976, addressed to Sally M. Bay, National Conference of State Legislatures.

4. See Matrix of Educational and Training Materials in Remote Sensing, by John C. Lindenlaub and Bruce M. Lube, LARS Information Note 052576. (West Lafayette, Ind.: Purdue University, 1976). Also see "Systematically Disseminating Technological Information to Potential Users", by James D. Russell, NSPI Journal, Vol. 15, No. 8, October 1976, pp. 5-7.

5. For Example, see Directory of Federal Technology Transfer (Washington, D.C.: Federal Council for the Science and Technology Committee on Domestic Technology Transfer, 1975) pp. 165-170.

6. Final Report, NCSL Task Force on State Use of Satellite Remote Sensing (Denver, Col.: National Conference of State Legislatures, 1976), p. 32.

7. State Recommendations on Approaches to Landsat Technology Transfer, Final Report (Denver, Col., National Conference of State Legislatures, 1977).

4.0 TECHNOLOGY TRANSFER DOCUMENTATION AS APPLIED TO SPECIFIC ASVTs

This section briefly discusses technology transfer documentation policies which are applied to specific ASVTs covered in this study.

4.1 Pacific Northwest Regional Commission Land Resources Inventory Demonstration Project

Because this project, which aims to provide a wide variety of agencies in three states with remote sensing capabilities, is broader than any of the other ASVTs we have examined, its documentation potentialities are broader. However, only three documentation products are specifically called for in the Project Plan: (1) documentation of each element of the hardware/software system used in Phase II (Early Digital Image Analysis), (2) alternative approaches to implementing an interactive image analysis system, and (3) full description of each application to be implemented. The first and third products will be produced at the end of the ASVT; the second will be produced at the end of the current Phase IV (Landsat Products and Land Resources Information Systems). New users are becoming involved throughout the ASVT project as new interests are identified; therefore, the early analysis phase is viewed by project management as continuing *throughout* the ASVT. (Early experiments are inexpensive and help broaden user participation.)

This approach to document a phase after its conclusion (typical of ASVT documentation) might be criticized for delaying technology transfer while users are most receptive, were it not for a continuing relationship with the user community which NASA-Ames has carefully established. This is carried on through traveling exhibits, a newsletter "Pixel Facts", meetings and briefings in conjunction with the Pacific Northwest Regional Commission, and progress reports such as the two-volume Utility of Landsat Data Within the Pacific Northwest Region as well as informal reports, magazine articles, and press releases from user agencies. A brief project bibliography lists 23 articles and 8 reports.

It was *not* the intention of project management to place a heavy documentation burden on users, particularly during early phases. The philosophy, further, has been to use a low-key documentation approach and not to push Landsat technology over all other remote sensing technology. Introduction of digital data processing techniques in most cases has waited until users are confident with photographic imagery. This low-key approach has paid dividends, according to Ben Padrick, in the continued interest and support of the project by governors and members of Congress.

While the project documentation concerns are legitimate concerns, one looks in vain for signs that project users are extensively involved in *developing* data analysis techniques which address their own particular applications. The production of user guides and instructional materials, to be carried out by NASA-Ames under the Regional Applications Transfer Program, should alleviate this problem.

4.2 Mississippi Natural Resources Inventory System Project

Second only to the PNW Project in its possible extent of user involvement, this is the *oldest* ASVT and as such has had educational uses both for NASA and for its intended users in Mississippi. NASA is handling the principal documentation products, with user feedback involvement. Eight major technology transfer documentation products are being prepared. In addition, several "general reports" such as Low-Cost Data Analysis Systems for Processing Multispectral Scanner Data should be useful outside the ASVT area if they are given broad distribution. NASA's ESL facility in Slidell, La., first publishes 100 copies of each report in spiral-bound format to take care of immediate user demand. More formal publication by the Lyndon B. Johnson Space Center usually follows in a few months. To gain user feedback, a viewgraph briefing precedes the preparation of each formal report.

Technology transfer problems are evident in the Mississippi ASVT because the extent of user involvement is not as well defined in the Project Plan as in later ASVTs. Nor is there a formal documentation plan nor well established project milestones. In addition the Mississippi user environment is complex and changing, with as many as 200 possible user agencies.

(As personnel leave the agencies, retraining of new personnel is necessary.) Although the Director of Mississippi's Office of Science and Technology has provided much useful support, the project needs better awareness within the legislature and by top-level state administrators.

Georgia learned about the Mississippi ASVT through a briefing conducted by D. W. Mooneyhan. Foundations for successful technology transfer within Georgia were laid by personal contacts rather than through documentation. Georgia is well on the way to implementing the project with only limited assistance from NASA because of the interest and involvement of top-level state planners and because a university (Georgia Institute of Technology) which has high credibility within the state government chose to act as the technological middleman.

While documentation did not play an active part in the technology transfer to Georgia, good documents can assist the Regional Applications Transfer Program centers in finding users for the natural resources inventory techniques. It is unfortunate that, so far, time and resources have not been available to produce up-to-date, attractive, brief, lay language versions of these documents. (Staffing for the Regional Program should make this possible, according to Mooneyhan.)

All three of the new regional centers are in the process of developing mobile units with at least some data processing hardware for Landsat demonstration and training. These units should have sufficient technical backup to be able to select from technology representing the entire Landsat program for their demonstrations, rather than from technology representing only their own home centers. In addition, there is enough in common among the state Landsat applications to make desirable the preparation of a 16-mm Landsat earth resources film aimed at decision makers in state and local governments.

4.3 Wildland Vegetation Resource Inventory

The Bureau of Land Management Information Systems Steering Committee in 1976 developed a "Strategic Plan for Information Systems Management" which includes primarily the use of aerial photography for remote sensing but also discusses an ASVT to produce an operational system for analyzing remotely sensed data. While a significant effort in this new project will be devoted to technology transfer, the Bureau is interested only in developing its own capabilities. ("The keystone of the entire demonstration project is to develop a cadre of resource managers in the BLM who are thoroughly versed in remote sensing technology." -- p. 75, BLM Project Plan.) The joint ASVT Project Plan, dated October, 1976, mentions technology transfer to the U.S. Forest Service and to the State of Texas, the latter under the Regional Applications Program. In addition the Project Plan discusses an as yet unfunded NASA effort to promote diffusion of the technology from this project.

The NASA-funded activities in this ASVT will be performed largely by a contractor, ESL. The final project report and most information for subsequent technology transfer within the Bureau will be the responsibility of its Project Manager William J. Bonner. The BLM Project Plan reflects an appreciation of Landsat products, data analysis techniques, and potential Landsat limitations gained by Bonner in studies of LACIE and other remote sensing projects and in visits to ERL at Ames and to the Johnson Space Center.

We were limited in our study of technology transfer documentation of this project because (1) no such documentation has yet been produced and (2) the BLM Project Manager does not have a favorable impression of NASA's technology transfer efforts. Yet the project seeks to apply resource inventory techniques not unlike those used in Mississippi and the Pacific Northwest to three distinct areas (one in each project phase) in which there is wide public interest, each containing approximately 2 million acres of land: an area north of Anchorage, Alaska; the northwest corner of Arizona; and the southwest corner of Idaho. Therefore, it seems reasonable that documentation of the Bureau's efforts to incorporate the use of remotely sensed data on those areas into its information system should be of value to state, local, and regional planners as well as users of public lands.

4.4 Water Management and Control Project

While the Bureau of Land Management is active in a program to assess Landsat remote sensing potentialities, the Army Corps of Engineers has focused on learning how best to *apply* remote sensing technologies to hydrologic engineering applications. Following its assessment of remote sensing[1], the Corps Hydrologic Engineering Center at Davis, California, developed an ASVT project with NASA-Goddard which began in 1977. The Hydrologic Engineering Center (HEC) has a major corps technology transfer mission and conducts training courses, develops and modifies mathematical models, and supplies training documents, research reports, computer tapes, and training videotapes for Corps use. (Materials also are made available to consulting engineering firms at low cost.)

HEC is interested in data rather than in interactive image processing techniques, so the approach is to develop relatively unsupervised methods of acquiring data from Landsat images. Because this requires research before applications can be made, the University of California at Davis was contracted for refining and determining the feasibility of unsupervised "clustering" methods under a NASA RTOP. (These are processing techniques which apply ground-truth information to the development of computer models which then can produce useful data from Landsat images without further human involvement.) Research reports from this study are not technology transfer documents, of course. Eventually, HEC wants to incorporate remote sensing use into at least two of its generalized computer programs, STORM (Storage, Treatment, Overflow Runoff Model) and HEC-1 (Flood Hydrograph Package). HEC publishes and updates technical user manuals for all of its computer programs.

Validating Landsat data for input to STORM and HEC-1 is the pre-ASVT phase of the project. The ASVT Test Phase consists of comparing the use of remote sensing data with the use of conventional model input data on several watersheds. Under the Technology Transfer Phase the successful portions of the test effort will be used in making the data processing procedures and techniques compatible with Corps procedures and facilities. This will include training sessions at Davis. The second part of the Technology Transfer Phase will bring the methodologies, through training, documentation, and workshops, to the attention of local and regional agencies and private industry groups. While specific documentation products are not mentioned in the Project Plan, the Plan notes that there will be "complete documentation of experiences and procedures" developed in the project, including complete documentation of at least one training period for hydrologists from Corps District Offices.

This program is well programmed for technology transfer at an *operational* level. However, although Corps decision makers have evidenced their interest by supporting the ASVT, there are needs for executive-level documentation, particularly during the second part of the Technology Transfer Phase when efforts will be made to transfer the technology outside the Corps. Furthermore, "clustering" data analysis methods are relatively new and unproved even to many of those who already use Landsat imagery. If the techniques are successful, a full range of secondary dissemination media, including brochures, films, and displays as well as "cookbook" user guides should be considered.

4.5 Urban Area Analysis Techniques Project

An objective of the Intralab program at GSFC has been to facilitate user awareness and technology transfer through user *participation* in remote sensing projects. This has been particularly true of the Geography Division of the Bureau of the Census. In developing the ASVT Project, Division personnel spent hundreds of hours interacting with J. W. Christenson and other GSFC personnel. A formal project plan has not yet been approved, however. As P. J. Cressy recalls, General Electric's Space Division brought the Geography Division of the Bureau and Goddard together. The original Bureau interest was in aerial photography, but GSFC personnel introduced potential cost and time-saving advantages of Landsat imagery.

The ASVT, to determine if and how satellite imagery can be employed in assisting in the delineation of urbanized areas, is in three phases: a Test Phase covering three urbanized areas; an expanded Test Phase covering 30 additional areas duplicating and in coincidence with the 1980 Census; and a Technology Transfer Phase including actual transfer of the applications software to the Bureau's control.

This application is rather narrow in scope; however, it will introduce Landsat technology to the Census Bureau and presumably could lead to applications in other Bureau Divisions although the Geography Division plans no special dissemination activities. Applications to state and local group programs are outside the Bureau's domain. However, doubtlessly the final Project Plan will include a technology transfer phase to other agencies. Census Bureau personnel are concerned lest the application be oversold beyond the spatial resolution capabilities of Landsats 1 and 2. Such overselling might occur through inadvertent publicity such as a recent national magazine advertisement by Hughes Aircraft Company. (This advertisement, circulated in June, 1977, appeared to indicate that satellite applications already are replacing time-honored census procedures.)

4.6 Operational Applications of Satellite Snowcover Observations

When an ASVT encompasses a relatively wide area of technical applications, either a geographical area or a discipline area, there is a problem of whose methodologies should be used. This places a burden on the Project Director but is important because project documentation must have high credibility where technology transfer is attempted. In the case of this ASVT a number of California state personnel wondered why the University of California at Berkeley was not a major participant because the University's remote sensing group has extensive experience in this type of application. (We are not qualified to comment on this but present it as potential user observation.)

This ASVT was developed with a Project Plan which was designed to enhance operational-level technology transfer documentation: (1) in the Preliminary Task Phase through the Publication of a contracted Handbook of Techniques for Satellite Snow Mapping[2], (2) in the Analysis of Existing Data Phase through the dissemination to three test centers of the handbook, data packages, and technical assistance from GSFC, (3) in the Real-time Analysis and Runoff Prediction Phase (1974-75) through the publication of Workshop proceedings and other technical papers, and (4) in the current Completion of Project and Documentation Phase through the production of a revised Handbook, a cost-benefit study, the publication of proceedings of a second Workshop and other technical papers, and through the production of a final project report.

In addition, we briefly reviewed an extensive series of quarterly and annual technical progress reports which are submitted to the Project Director from the three test centers in this project.[3] These are detailed compilations of project findings together with descriptions of difficulties encountered and future work to be done. However, they do not discuss technology transfer. These reports provide NASA with progress information for administrative purposes and serve as a communication link between test centers. However, they do not stimulate technology transfer, and their sheer bulk discourages readership. Nor is there a well established dissemination mechanism for these reports.

In discussing this project with the California Remote Sensing Specialist Charles Howard and his subcontractor Jack A. Hannaford we found that there still are basic concerns over the validity of associating snow mapping with water runoff at certain seasons. (Research is still needed on determining snow depth and water content by remote methods; certain anomalies in imagery interpretation still need to be resolved.) Furthermore, uncertainties and delays in the delivery of Landsat imagery still interfere with the operational use of this technology. Howard and Hannaford felt that documentation of this ASVT in journal articles by the Project Director was excellent. However, it appeared that there are still so many technical and operational problems that it is too early to attempt to transfer this technology to decision makers in government agencies. California makes limited use of the Snowcover data in its widely circulated state water conditions reports but no longer (as of April, 1977) specifically refers to the use of NASA-supplied satellite imagery, as it did in 1976.

4.7 Project Icewarn

Icewarn was initiated by NASA-Lewis and the U.S. Coast Guard in the winter of 1974-75 (with NOAA support through the GOES satellite as a communication link) to do real-time mapping of Great Lakes ice cover, thereby providing a service to shipping. Aircraft-mounted side-looking (SLAR) radar and short-pulse S-band radar systems simultaneously determine ice cover, ice type, and ice thickness. These data are relayed to the Coast Guard Ice Navigation Center in Cleveland and disseminated to ships on the Great Lakes. Conceptual studies have been made of applying Icewarn techniques to SEASAT for use in the Far North.

Time and cost constraints prevented us from interviewing ultimate users (the shippers). Hence, our comments are based on available reports and an interview with Herman Mark (NASA-Lewis).

The usefulness of Icewarn apparently has been well demonstrated, and the problem is in transferring the technological capabilities to the Coast Guard and to the ultimate users. In an internal NASA document discussing Icewarn applications we noted, " . . . A detailed plan of transferring this activity to the U.S. Coast Guard should be developed and implemented by NASA . . . We should make sure not to get into the mode of continued working with a user on an ASVT. There is no question that the work and relationship involved in this activity are good and of benefit to NASA."

According to Mark, the major Icewarn documentation problem is that there are no funds available for user documentation beyond the project report (NASA-TM-X-71815), the supply of which has been exhausted. A NASA Tech Brief on the project was disseminated in the spring of 1976 and has resulted in about 30 inquiries, including possible application of the technology by Sweden in the Baltic Sea. Mark said the project needs hardware development from a "breadboard" to a truly operational status together with better user documentation. He believes that the Coast Guard will not be able to make Icewarn operational without some form of continued NASA support. (Even in cases where Landsat remote sensing data applications are completely transferred, NASA remains the supplier of earth resources imagery, so his argument is not without precedent.)

Documentation of this ASVT of course will depend on its future status. Already, the Coast Guard has referred to it affirmatively in a slide-tape presentation on marine safety research. User guide materials will be needed, whether they are prepared by the Coast Guard or by NASA.

4.8 Public Service Satellite Consortium (PSSC)

PSSC is a consortium of some 75 non-profit organizations formed in 1975 to carry on the type of communication activities originated during earlier ATS demonstrations in conjunction with NASA and DHEW. Membership ranges from educational associations and universities to library associations, from medical groups to state telecommunication authorities. The common thread is in seeing low-cost telecommunications services evolve through efficient use of satellite systems. Considerable delay was experienced by PSSC in getting the ASVT started due to extended funding negotiations with NASA. This has delayed documentation but is not seen as an insurmountable hurdle.

The actual ASVT is for upgrading the technical capabilities of satellite relay and coordination facilities at Denver which were developed for the earlier ATS-6 demonstrations so they can be used with ATS-6, ATS-1, ATS-3, CTS, and with a future proposed "Gapsat". The ASVT also calls for procurement of a number of receive-only satellite terminals, for operation of the Denver center for a limited time, for interface and routing services, and for technology transfer including a training manual for experimental site operators and a site operator training course. NASA is to be provided an annual report on the utilization of societal experiments involving the Denver ASVT facility.

While this ASVT differs substantially from those involving remote sensing, there is a commonality in that this also involves user *application* of a space-oriented system. Documentation should facilitate this application and make clear that NASA involvement in Denver will eventually end. NASA through its regional centers also can stimulate possible user interest in PSSC (although this presently is not a part of center activities). However, documentation of user demonstrations and experiments must be handled by PSSC and by the users themselves. This is because these demonstrations are not new applications of space technology.

4.9 Forest Resource Information System

If this project is implemented, it will be the first ASVT directly involving NASA and a private user organization (St. Regis Paper Company through Purdue's LARS). However, it resembles a smaller activity which was carried out in 1975 by Goddard's Intralab in conjunction with the Weyerhaeuser Company (Intralab Project No. 75-1)[4]. The Forest Resource Information System would demonstrate and verify the machine utilization of Landsat Multispectral Scanner (MSS) data as a significant component of a forest resource information system.

D. A. Landgrebe of LARS has outlined several technology transfer activities which could be implemented:

- General purpose remote sensing overview seminars at St. Regis sites
- Hands-on analysis and training sessions at LARS during the demonstration phase
- Analysis and advanced analysis seminars at the St. Regis site during the system transfer phase, with a direct computer link to the LARSYS program
- Preparation of case studies and training documentation (similar to other LARS documentation) including programmed texts, slide-tape programs, and detailed case studies
- Information dissemination through professional organizations such as the American Pulpwood Association.

Documentation would include quarterly progress reports, major phase reports, an executive summary (already in preparation), milestone reports, and journal articles. (In the draft Project Plan an aggressive information dissemination approach is recommended, including development of a media awareness strategy so the broadest possible visibility of the project will be afforded.)

Substantial benefits in technology-transfer documentation can be afforded both through the participation of LARS and the participation of a commercial organization with known marketing capabilities. (All documents of course will have to be in the public domain.) It might be useful also to involve the Weyerhauser Company in technology-transfer documentation, thereby avoiding duplication and providing a broader background of experience for transfer to others.

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1. An Assessment of Remote Sensing Applications in Hydrologic Engineering, Research Note No. 4, by Robert H. Burgy and V. Ralph Algazi. (Davis, Ca.: The Hydrologic Engineering Center, Corps of Engineers, U.S. Army, 1974).

2. Published December 1974 by Environmental Research and Technology, Inc., Concord, Ma. This report describes the state of the art of satellite snow mapping as of 1974. It discusses techniques, applications, and problems and includes a bibliography of some 40 items.

3. The Project Director told us that these reports are useful for informing Snowcover participants of each other's activities. However, they have no clear technology transfer role, and no external distribution.

4. Documented in Forest Land Management by Satellite: Landsat-Derived Information as Input to a Forest Inventory System, by Darrel L. Williams and Gerald F. Haver. (Greenbelt, Md.: NASA/Goddard Space Flight Center, 1976). This is the first and only major technology-transfer report of Intralab, which Philip Cressy refers to as "our unicorn project because it is now extinct." Waiting to be completed and disseminated are 5 more Intralab reports. These presumably will be disseminated during the Regional Applications Transfer Program.

5.0 CHARACTERIZATION OF ASVT DOCUMENTATION NEEDS

From the above, one can see that each ASVT project presents distinctive, individual problems and potentialities for technology transfer documentation. Yet, as we have emphasized, all ASVTs have certain common documentation needs because they seek to develop and promote the application of already established technology. In addition, it should be possible to consider ASVTs in general to show what types of documents should be most effective in reaching and serving designated user groups. These documents must be useful in answering questions such as:

- How will the application help (my state, my agency, my department, my section, me) do a better job?
- How can the technique be integrated with techniques already used?
- What will the technique cost, and how can we determine (prove) its cost effectiveness?
- Will there be continuing support or data to justify using the technique?
- How can we get people to use the new technology without feeling threatened?

5.1 Goals and Suggested Responsibilities

The goals for ASVT technology transfer documentation are twofold: (1) Helping people learn about the benefits of the new technology and (2) helping people learn how to use the new technology. For each of these goals, one can generate a logic diagram which shows general documentation needs for remote sensing ASVTs. (The Public Service Satellite Consortium ASVT has special documentation needs; yet, it shares in the common need for documentation to assist in answering questions such as those above.) The two logic diagrams are shown in Figures 2 and 3. (Note the differentiation between document purposes in these figures.) These diagrams also suggest the definite assignment of documentation responsibilities as NASA functions, user/participant functions, and joint functions.

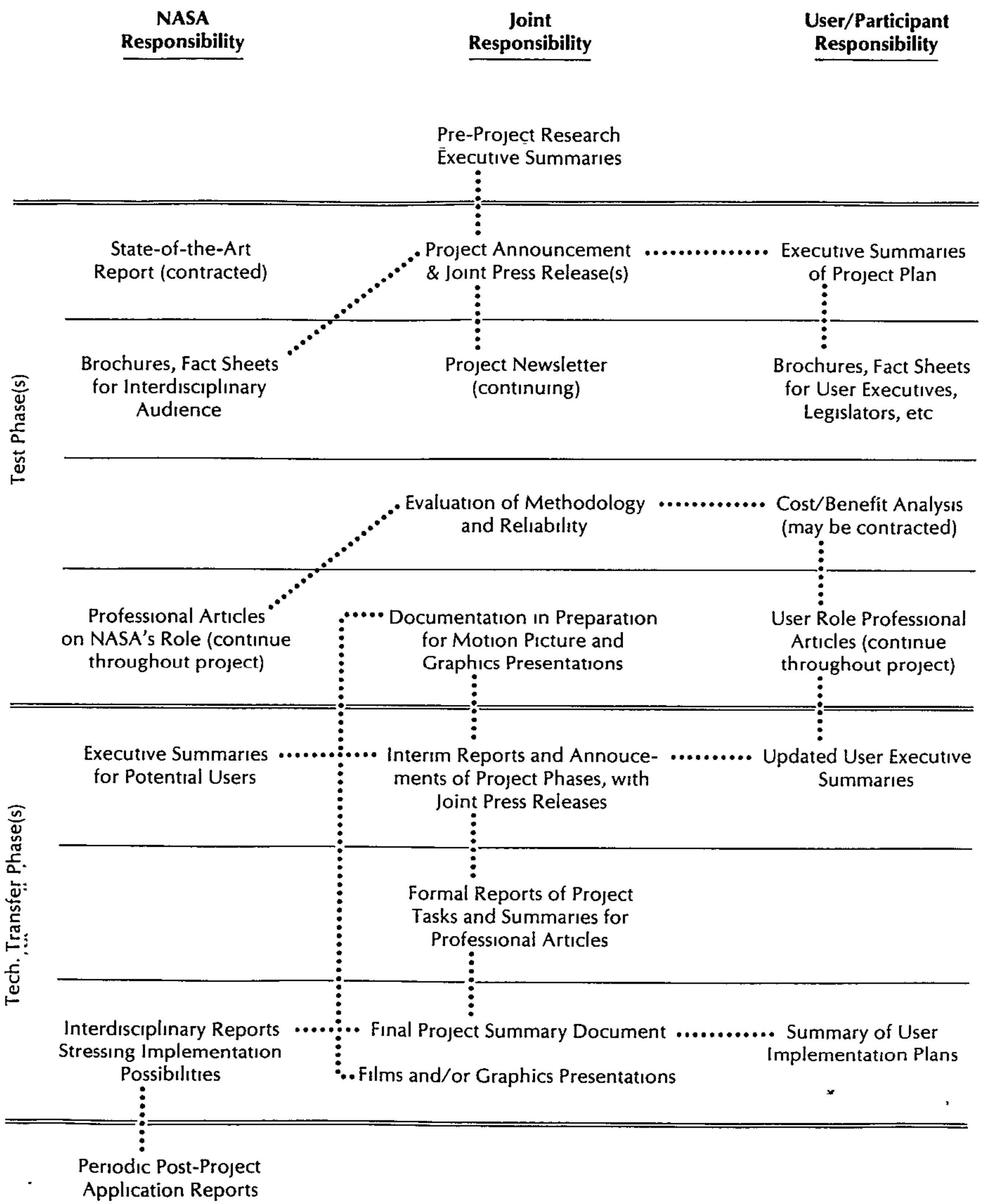

FIGURE 2. LOGIC DIAGRAM FOR THE DEVELOPMENT OF DOCUMENTATION FOR COMMUNICATING THE BENEFITS OF ASVT TECHNOLOGY TO POTENTIAL USERS. SUGGESTED RESPONSIBILITIES OF NASA AND USER/PARTICIPANTS FOR DOCUMENTATION PRODUCTS ARE SHOWN. LINKING LINES SHOW CLOSEST RELATIONSHIP BETWEEN DOCUMENT TYPES.

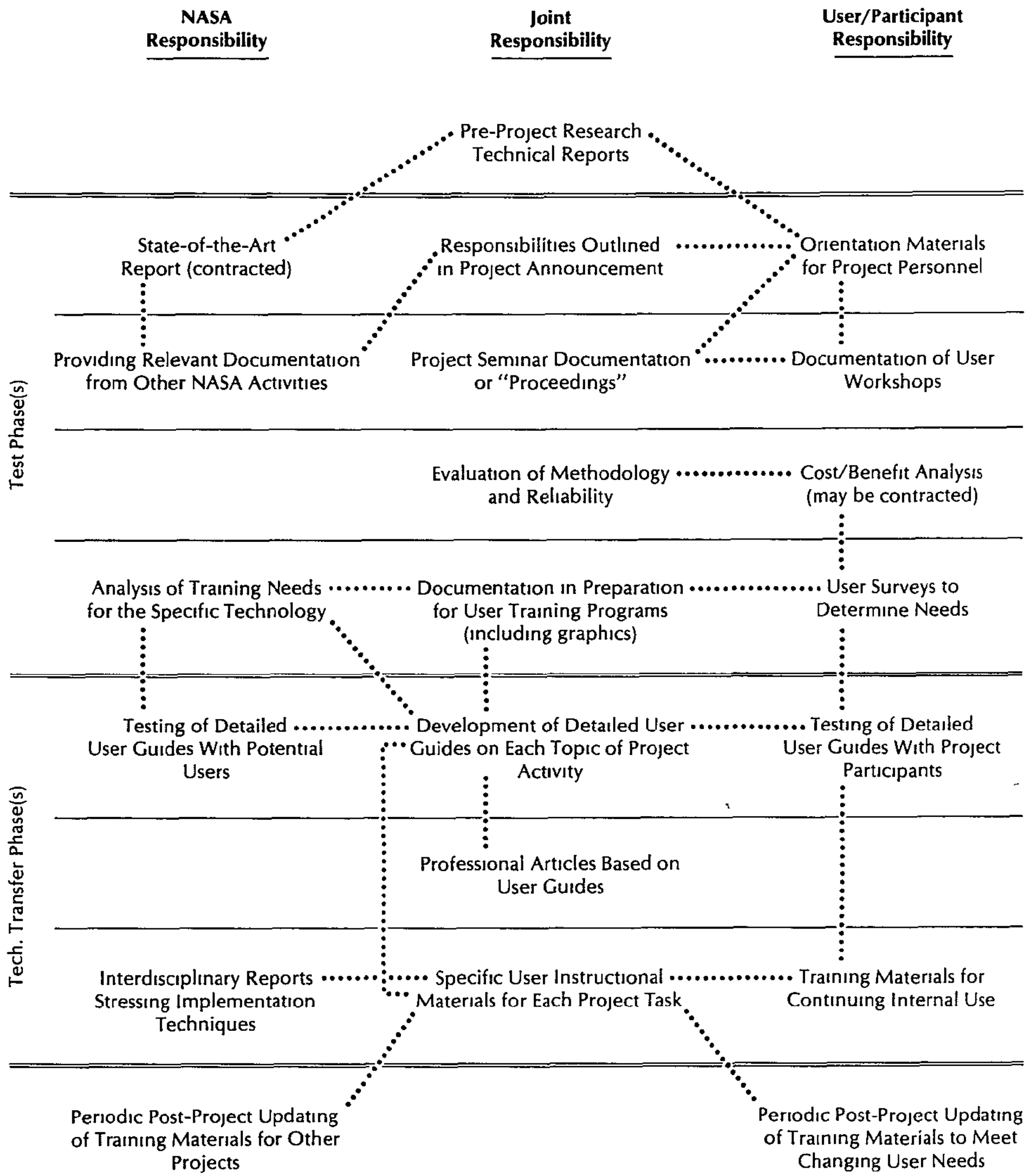

FIGURE 3. LOGIC DIAGRAM FOR THE DEVELOPMENT OF DOCUMENTATION TO PROVIDE INSTRUCTION IN USING ASVT TECHNOLOGY TO POTENTIAL USERS. SUGGESTED RESPONSIBILITIES OF NASA AND USER/PARTICIPANTS FOR DOCUMENTATION PRODUCTS ARE SHOWN. LINKING LINES SHOW CLOSEST RELATIONSHIP BETWEEN DOCUMENT TYPES.

On discussing ASVT projects with us, both participants in the projects and NASA personnel who are responsible for technology transfer emphasized the need for flexibility in project planning, particularly as it relates to documentation and other aspects of technology transfer. In fact there is reason for developing the technology transfer scenario "on the spot" rather than submitting it to rigorous review procedures within NASA headquarters and within other participating agencies. This is because people who work in the regions and in specific scientific disciplines "know the territory". They strongly believe that they are most familiar with the documentation requirements of their constituents. Beyond indicating the primary audiences for specific ASVTs we have not attempted to categorize them into "types" which should be of interest only to, say, state, federal, or local users as opposed to other users. It is natural that federal agencies which are participating in ASVT projects (Bureau of the Census, Bureau of Land Management, Army Corps of Engineers, etc.) will be most interested in technology transfer to their own constituent groups. However NASA's interests, as expressed in the Project Plans, are much wider, encompassing also state, regional, and local agencies which can use the technology in land use planning or other interdisciplinary functions. Therefore, the ultimate documentation requirements for technology transfer in, say, the Mississippi Natural Resources Inventory System Project should not differ substantially from those of the Wildland Vegetation Resource Inventory Project.

However, when documentation products are not specifically defined, there is a danger that they will be relegated to the status of project "orphans", summaries which are prepared at the end of an activity without a clear understanding of how they can be used most effectively to promote technology transfer. Typically, an ASVT Project Plan only vaguely refers to specific documentation products. Nor does it clearly define documentation responsibilities and the groups for which each document is intended. For example:

> . . . Specific products will occur at the completion of each phase to document progress, etc. These products will include contractor reports and summaries of progress that depict as accurately as possible the achievements of the preceding periods of work . . . Final products will include the complete documentation of the classification results, time and cost comparisons, the final report of the cost/benefit study, and the documentation of procedures developed in the transfer of technology/training process.[1]

We prefer wording which first explains directly how NASA or contractor personnel will work with the primary user(s) to promote the development of user expertise in applying the technology. Then the Plan should describe both NASA and user responsibilities to disseminate the technology. The current (unpublished) version of the Forest Resource Information System Technology Transfer/Information Dissemination Project Plan (see Appendix D) does this by first describing user agency responsibilities "to disseminate information such that potential users and the general public will be fully aware of the project, the methodologies developed, and the results achieved". Six specific user responsibilities are outlined. Then, four NASA responsibilities are detailed -- including making sure that the documentation, software, and reports will be made available to the public; providing liaison to several identified user groups; providing liaison with other academic and private industry organizations; and developing a possible forestry applications workshop.

We do not, however, offer a prescription for technology transfer documentation. Nor is the subject one which can be handled with the skill and assurance of NASA's "management of technological innovation" (Chapter 3.1). Technology transfer continues to be an "art" or a "soft science" because the human factors involved are not subject to rigid definition or manipulation. As, for example, the Mississippi Natural Resources Inventory System Project has shown, what works well in one state may not work well in a neighboring state with problems which, on the surface, are similar. Some organizations are chafing at the bit to apply sophisticated digital techniques to the analysis of ERTS imagery. Other organizations with similar problems must be brought up to speed on photointerpretation before even considering the application of digital techniques.

5.2 Research to Support Needs Evaluations

The Office of National R&D Assessment of the National Science Foundation in its report on Technological Innovation and Federal Government Policy[2] listed five major findings from research on public technology transfer which seeks to explore the processes by which new technology is developed, diffused, and implemented or rejected by state and local governments. On the basis of these findings, we have postulated several needs for ASVT technology transfer documentation.

First, cities and states differ widely in their needs and in conditions providing stimuli to innovation . . . In many cases, a city or state does not have the need or problem which the technology is designed to address, has solved the problem by another technique, or chooses to use its resources on needs other than the one addressed by the technology in question.

Documentation products of ASVTs thus should address needs which are perceived to be real by state and local government decision makers. An ASVT thus should not be documented as the development of a system for improving general government effectiveness but as a means of solving real-world problems which are faced by government organizations in the most effective way. Rarely if ever is it possible to employ documentation alone to convince a potential user of space technology that he has a problem.

Second, informal communication networks . . . among city and state political executives and functional agency heads . . . and among these groups and a variety of professional organizations . . . perform effectively to make state and local governments aware of innovations, but in many cases, do not function well to provide reliable knowledge about how innovations actually perform.

This supports the need in project planning of ASVTs to differentiate between user requirements to document experiences in utilizing space technology and NASA requirements to document the instructional aspects of applying the technology. It also supports NASA cooperative efforts with professional associations to make their members aware of the benefits of space technology.

Third, evidence is increasing that there are no such things as "innovative cities" or "innovative states" with respect to technological innovation generally. Federal strategies which try to identify (such cities and states) . . . and assume that the leader-follower network will diffuse the innovation to other locations are unlikely to work well.

Success in documenting the application of ASVT technology to solving the problems of its primary-user organizations will not lead automatically to applications of the technology in other organizations, even though they may seem (from the outside) to have similar problems. This does not mean that the ASVT concept of demonstrating the application of space technology to user organizations as models for user development elsewhere is a faulty concept. It does mean, however, that a space-technology application must be accompanied by documentation or by personal follow-up which goes beyond broad generalities to show a specific potential impact of the technology on a prospective user's needs.

Fourth, local government innovation processes tend to be influenced heavily by community characteristics such as population size, wealth, and urban/suburban makeup. These characteristics shape both the nature of the problems and the innovation (mechanisms). Thus, effective Federal programs for local government determination of desirable local innovation appear to be those which provide resources to local government in specific functional areas but do not require the purchase of specific technologies.

In documenting an ASVT the appropriateness of using the technology must be shown as it applies to the capabilities of user agencies and potential users in handling and making constructive use of information resulting from the application. This documentation should assist a user in making his own choices of how to obtain, process, and analyze incoming data.

Fifth, the types of (potential technology users) and the roles they play . . . vary considerably across functional or service areas . . This situation suggests that different intervention strategies are required for different types of users.

This concern is being shared in both the development and the documentation of ASVTs which address specific user groups. It is of greatest importance in projects where the concurrent needs of a wide variety of users are addressed simultaneously, such as the Pacific Northwest Natural Resources Project.

In summary, the NSF report and our own characterization of ASVT documentation needs agree on the need for both user involvement and a "selling perspective" for effective technology transfer. However, there remains a void of mechanisms for making quantitative measurements of effective technology transfer through documentation or through any other means.

5.3 The Need for Predocumentation

The first person to see a technical report in most user organizations often is a librarian or information specialist who has the responsibility of making useful information most conveniently available to staff members. Several manual and computerized information and indexing services are available to help this information professional do his or her job, and it is axiomatic that ASVT technology transfer documents should be available through these services. However, NASA's ASVT reports share with many other research reports published in the United States the difficulty that report authors and editors usually have little to do with the "predocumentation" procedures which are necessary to placing the reports in an organized system. Usually, the classification job must be accomplished through re-study of the publications by documentation specialists.

A numerical system called the Universal Decimal Code (UDC) is used widely, particularly in Europe, for searching the literature for a broad range of technical subjects. The UDC is different from the Library of Congress classification scheme in that it uses a series of numbers (like the Dewey Decimal classification system) rather than a combination of numbers and letters of the alphabet to distinguish individual documents. But more important, the UDC can be applied to any kind of report or document (even a newspaper clipping) whether or not it becomes part of the Library of Congress collection.[3]

The UDC might be considered as a candidate system for indexing ASVT documents. But whatever system is used, there are other predocumentation needs. One of these is a series of key words which describe the contents of the document and thus can be used as index terms for locating it. Another is an informative abstract which describes the nature of the document and goes on to describe its principal findings.

Uses of key words and informative abstracts in ASVT documents that we have seen have been minimal and inconsistent. In no case was a list of key words supplied by the author or his editor. While some ASVT reports had informative abstracts, there was no apparent consistency in their style or how they were handled. Often, the "Foreword", or "Introduction" of a report was in reality an informative abstract and should have been designated as an abstract.

Predocumentation of scientific and technical literature is often accomplished by a special library or specialized information service, such as Chemical Abstracts Service or the Metals and Ceramics Information Center. While these services are of course invaluable, it stands to reason that the potential readers of a report, and the information specialists who service them, will benefit most from documents which themselves bear conspicuously designated key words and an informative abstract.

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1. Final Project Plan, Water Management and Control ASVT, p. 15.

2. Technological Innovation and Federal Government Policy, Office of National R&D Assessment, National Science Foundation, 1976, pp. 31-36.

3. An abridgment of the UDC describes its relationship to the Dewey Decimal system and introduces its structure and principles. See, Universal Decimal Classification, abridged English edition, 2nd ed., British Standards Institute, London, 1957.

6.0 SUGGESTED GUIDELINES FOR ASVT TECHNOLOGY TRANSFER DOCUMENTATION

6.1 Some Important Questions and Answers

Thus far we have considered origination of ASVT documentation policies for technology transfer in the general logic of NASA systems management. We have identified the danger of burdensome administrative reporting requirements overwhelming technology transfer documentation. We have reviewed documentation policies of a number of organizations and agencies whose missions parallel those of NASA. We have considered the documentation needs and requirements of several ASVTs. Now, let us review the NASA technology transfer documentation philosophy by asking several significant questions. Consideration of these questions will help project directors establish documentation guidelines for their own ASVT projects. However, we also will include a set of guidelines for general application.

1. Is it possible to program technology transfer as part of NASA's systems management philosophy?

Precise definition of technology transfer goals and purposes in ASVT work statements should facilitate project management and should stimulate the production of useful documentation. Similarly, goal definition in the program plans for the three new NASA Earth Resources Training Centers[1] should facilitate assigning adequate resources for the documentation process. Yet, we found misgivings within the staffs of the Centers themselves. We believe that uncertainties in planning for technology transfer can stem from a lack of participation by ultimate users in defining the goals of an ASVT and the documentation products. However, there is an invisible component of technology transfer (sometimes deprecatively called "hand holding") which defies program budgets and planning strategies. Documentation can be employed to enhance the value of this component. One program leader told us that technology transfer is like pornography, "When you see it, you know it's there, but it's impossible to define".

2. How can technology transfer be accomplished through documentation?

This is at least theoretically possible providing the potential user has an understanding of the documents and also has confidence in them.

Confidence building remains an intuitive process, perhaps less subject to management by design than any other aspect of ASVT technology transfer. For example, though it may be desirable to set up priority target agencies within designated states for technology transfer activities, a technology transfer agent must be free to use his judgment to determine the best transfer approach. Documentation techniques which are effective in one state (say, Georgia) may not be effective in another state (say, Mississippi) purely for internal reasons.

3. What are the most important problems in NASA ASVT documentation content?

For maximum effectiveness, technology transfer documentation must be relevant to needs which potential users can identify. The technology must be presented so that it (1) fills a defined need, (2) can be applied economically with or without NASA assistance, (3) offers advantages over present techniques, (4) can be applied quickly enough to fill user requirements, and (5) offers sufficient precision to fill user requirements. Where the technology will not meet these criteria, an ASVT and its documentation should be continued only if future improvements in the technology system will definitely satisfy the requirements. Candor in documenting an ASVT is essential to future confidence.

4. What are the most important problems in NASA ASVT document style?

As long as documentation is viewed as the end point of a project, it will be neglected. Principal investigators should not be technology transfer documentalists for their interests are (rightfully) in solving the problems which inevitably occur when two or more agencies must be involved together in an interdisciplinary program. As a result, documents are prepared during evenings and weekends or neglected for months after project participants return home. Readability, which Webster defines as "easy to read because interesting or pleasing", is ignored.[2] (In one ASVT document intended for non-sophisticated users we found a single paragraph occupying three and one-half typewritten pages!)

5. What are the most important problems in NASA ASVT document formats?

Documents which we have reviewed are well suited for use as backup reference materials. For example, we asked several users and investigators how they use the Proceedings of the (1975) NASA Earth Resources Survey Symposium. While many had seen the Proceedings and a few had parts of the extensive collection on their shelves, few had read any of the papers. Practically every problem in applying remote sensing technology is addressed somewhere in the Proceedings. But without organization of the information to show specific applications, the sheer bulk of the collection consigns it to the reference shelf. (Calling any document collection a "Proceedings" automatically assigns it a low priority.)

NCSL, NSF-RANN, and other organizations involved in technology transfer recommend documentation in the form of targeted executive summaries and loose-leaf user guides, employing attractive presentation methods and use of graphic illustrations. These formats doubtlessly have value. However, attractive graphics and presentation techniques do not make up for poor editorial content. Seldom does even the most attractive ASVT or similar project document begin with a simple statement of its purpose; many of the content criteria mentioned above (question 3) are often ignored. There is another problem that elaborate formats may tend to be cumbersome. If a loose-leaf collection is used, procedures for updating the collection must be simple and well defined. (It may be simpler and cheaper to update an entire document in regular format than to update parts of it for a loose-leaf notebook.)

6. What are the most important problems in NASA ASVT document distribution?

Within the Office of Applications, an overall distribution strategy for ASVT documents needs to be developed. This strategy should be based on identified needs of both users who are involved in the development of ASVTs and of potential users. For remote sensing projects, the three Earth Resources Applications installations should have major inputs to this strategy formation.

Conventional document distribution strategies often are based on organization titles rather than needs of people. That is, the library of an institution and a few executives who previously might have requested reports generally are on the list. For technology transfer, which implies use of the documents by people who need them, a strategy involving "selective dissemination of information" (SDI) should be considered.[3] SDI is used widely in computerized information services developed under the _Engineering Index_ and _Chemical Abstracts_ organizations and by NASA itself for reporting technical information. The General Electric Company sells a computerized SDI system that is based on a system developed by General Electric for its internal use.

Basically, SDI is a concept which facilitates the dissemination of documents and data to those users whose "interest profiles" match the interests identified by the document source. SDI may form the basis of an elaborate, computerized system, or it may be implemented through the use of a manual system which is no more elaborate than a deck of punched "Key-Sort" cards. The most important step is a developed procedure for (1) identifying actual and potential information needs of selected individuals and (2) dispatching information (documents, data, abstracts, etc.) to match those needs on a timely basis.

An individual or office specifically charged with selective dissemination of information responsibilities could help solve the dilemma that even though ASVT participants can assist in document dissemination through (conventional) peer-group channels, the real audience of _potential_ users of the technology within an ASVT can far exceed the members of the peer group. Primary user groups for ASVTs are by necessity rather narrowly defined along disciplinary, agency, or geographical lines. Frequently, there is little concern within an ASVT project plan for users outside the primary environment. The problem is a very serious one where technology transfer might occur between state and federal agency users, between different state and/or federal departments, and between the government and private sector.

6.2 ASVT Technology Transfer Documentation Guidelines for *Identified* Users

1. Because "verification" and "transfer" of applications of established NASA technology are the goals of ASVT projects, the basic information about the *technology* to be applied should be available for dissemination at the beginning of a project. This dissemination will lay the groundwork for technology transfer by helping identify and precondition potential users. A brief project announcement specifying the purpose and goals of each ASVT should be disseminated widely as a press release jointly by NASA and the primary user(s). A detailed description, incorporating major features of the project plan, should be made available to professional journals and management newsletters and to the general public through NASA's regional centers. While early publicity of a scientific research project might lead to overselling or too great expectations, this should not be the case with an ASVT if the objectives of the particular application are indicated clearly. This is because an ASVT should be based on established research and development and should be intended to demonstrate the feasibility of utilizing established technology.

2. Where necessary to bring users up to speed, a state of the art report should be made available to users early in the first (or test) phase. To secure objectivity and conserve project management time, this report should be prepared by an outside organization. The costs of developing a state of the art report must be balanced against the costs of bringing users up to speed by some other mechanism, such as a workshop. A state of the art report may be clearly indicated where the primary user/participants in an ASVT are scattered widely in a number of different types of organizations. (Such has been the case, particularly, in the case of the ASVT related to snowmapping, which has involved three distinct and distant user agencies.) Use of an outside organization is recommended particularly to add credibility to the report and to free NASA personnel for setting up the ASVT.

3. Documentation requirements published in the draft Office of Applications Operating Guidelines for the end of the first (or test) phase are

reasonable outputs of a successful test, providing objectives are clearly stated in the project plan. These requirements are (and should be) mandatory: (1) a user-cost/benefit analysis (rather than a more broadly defined socio/economic benefits study) with at least enough information to help users make implementation decisions, (2) a comprehensive methodology suitable for widespread use (reported in style, language, and format designed for readability), (3) a comprehensive evaluation of the system's accuracy and reliability (similarly designed for readability). These are valuable technology transfer documents because they can help users achieve independence in working with the system.

4. Workshops are useful mechanisms for developing user feedback and providing information exchange. However, workshop presentations should not be viewed as opportunities for investigators to exhibit their expertise (as in some scientific meetings). Where published, workshop outputs should be presented as concept discussions, each with an executive summary, rather than as "proceedings".

6.3 ASVT Technology Transfer Documentation Guidelines for *Potential* Users

1. Technology transfer documentation must facilitate the making of decisions as well as assist in developing user technical capabilities. Each document should begin with a clear statement of its own purpose and an executive summary in non-technical language.
2. Technology transfer documents should not stress problems which are not germane to the purpose of the ASVT. However negative results including the decision not to proceed with an ASVT should receive open, frank dissemination.
3. Every ASVT should have a "fact sheet", a simple but attractive illustrated brochure which can be revised to keep pace with ASVT progress.

6.4 ASVT Technology Transfer Documentation Guidelines for *All* Users

1. Specific documentation responsibilities for the entire ASVT project lifetime should be assigned to one individual within the NASA project organization. This individual should (1) analyze administrative reporting requirements to simplify documentation at this level, (2) develop a technology transfer documentation strategy for the project plan and for revisions of the plan at the beginning of each phase, (3) interact with counterpart individuals in user organizations, (4) develop and follow through documentation distribution mechanisms, (5) prepare or have prepared the primary technology transfer documentation products, (6) guide project participants in submitting journal articles. This individual should be a documentation generalist rather than a subject matter specialist. He also may serve as project liaison with regional technology transfer personnel. Including a documentalist in an ASVT organization can improve the efficiency of the project team and may not increase total costs. However, specific provision should be made for funding the documentation effort throughout the life of the project.

2. As an ASVT shifts to the technology transfer phase(s), preparation of user guides becomes an important documentation function. Users themselves should have maximum participation in guide preparation. A format should be selected which facilitates application of the guides (That is, specific modules or summaries should be designed for specific audiences: government executives and legislators, top management, middle management, etc.).

3. Mini-documents should be prepared for dissemination through professional journals or direct dissemination. The goal should be to communicate all useful information before the formal end of an ASVT so that essentially no new technology transfer information is presented in the final report. Users should be progressively more responsible for preparing the mini-documents. Two types are suggested: (c) case histories of successes and problems of the application, and (2) profiles on each specific application based on user experience.

* * * * *

Throughout our interviews we have encountered confusion on the exact nature and purposes of the ASVT program by users, potential users, and other participants. We believe that a summary document presenting the rationale for the ASVT program and showing significant examples should be prepared in a brief, attractive, illustrated format, suitable for use by legislative decision makers. One such document of this type, which describes remote sensing applications in general but does not discuss the ASVT concept, was published in 1977 by the National Conference of State Legislatures.[4] A conventional "annual report" format is not recommended because annual reports are too long for convenient reading, no matter how attractively they are produced.

This document should be accompanied by a 15-minute general-purpose 16-mm film on the ASVT concept.[5]

We are encouraged that several of these documentation concepts already are being implemented by the regional centers and by the NCSL Satellite Remote Sensing Project. It is important that each new technology transfer product and format reflect thorough consideration of user appeal and utility before it is perpetuated.[6]

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1. For example, the June 8, 1977, draft of the Goddard Regional Applications Transfer Program Plan states on p. 1, "The goal of Goddard's regional program is, by the end of FY '82, to transfer applications of Landsat data to the management of natural resources within ten metropolitan governments and twelve states within Goddard's region of responsibility."

2. ASVT documenters would benefit from texts on readability such as How to Make Sense by Rudolf Flesh (New York: Harper Bros., 1954) and The Elements of Style by William Strunk (New York: MacMillan, 1959).

3. See "Selective Dissemination of Information: A Review of the Literature and the Issues", by J. H. Connor, Library Quarterly: 37, 373-391 (1967).

4. Landsat, Down to Earth Views from Space, 12 pp, NCSL Remote Sensing Project, Denver.

5. While costs of film reports vary according to their complexity, the use of film for information purposes does not automatically require a high investment. A 15-minute general-purpose film such as Space Transportation System (the Shuttle marketing film) can be produced for $20-25,000.

6. For example, newsletters are an important mechanism for reaching users and potential users. But newsletter formatting, editing, and distribution mechanisms should be designed to encourage user feedback and to avoid consignment of the newsletter to the waste basket. We prefer a newsletter title such as "Down to Earth Views" (Bendix Aerospace Systems) to "Pixel Facts" or "Remote Sensing".

7.0 DOCUMENT PURPOSES, TYPES, AND FORMATS

7.1 Document Purposes

There have been many studies of the innovation continuum, tracing the process of technology origination, development, and transfer. In essence, these studies have projected a five-step process, beginning with awareness of and interest in a new technology, and extending through evaluation, pilot study, and implementation stages (Figure 4). Because it is built on established technology, the ASVT concept should shorten this continuum to the last two steps for NASA and for primary participants in a project. The first three steps are at least theoretically not necessary because NASA and the primary user both have indicated their favorable initial evaluation of the concept by investing resources in the test phase.

However, if the concept is to find useful application beyond its test, the results of that test or pilot study -- which form the basic contents of much of technology transfer documentation -- must themselves pass through the entire continuum, particularly for other potential users who might implement the concept during or after the end of the ASVT. The implementation diagram becomes more complicated. (Figure 5). Documentation products thus must assume a more complex role than reporting the results of the demonstration prior to utilization.

On this diagram (in Figure 6) we have overlaid the four technology transfer documentation stages which were discussed in our concept paper on ASVT documentation strategy (Appendix A). These stages are:

- The announcement stage which establishes the ground rules of the project and provides explanations for NASA and non-NASA participants
- The development stage which provides continuing information on the project, promoting exchange of information among NASA and other participants and cultivating the interests of other potential users

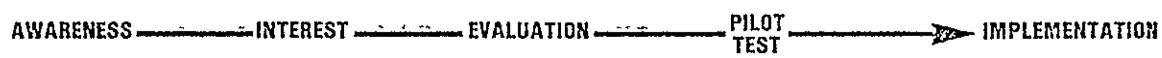

FIGURE 4. STAGES OF INNOVATION

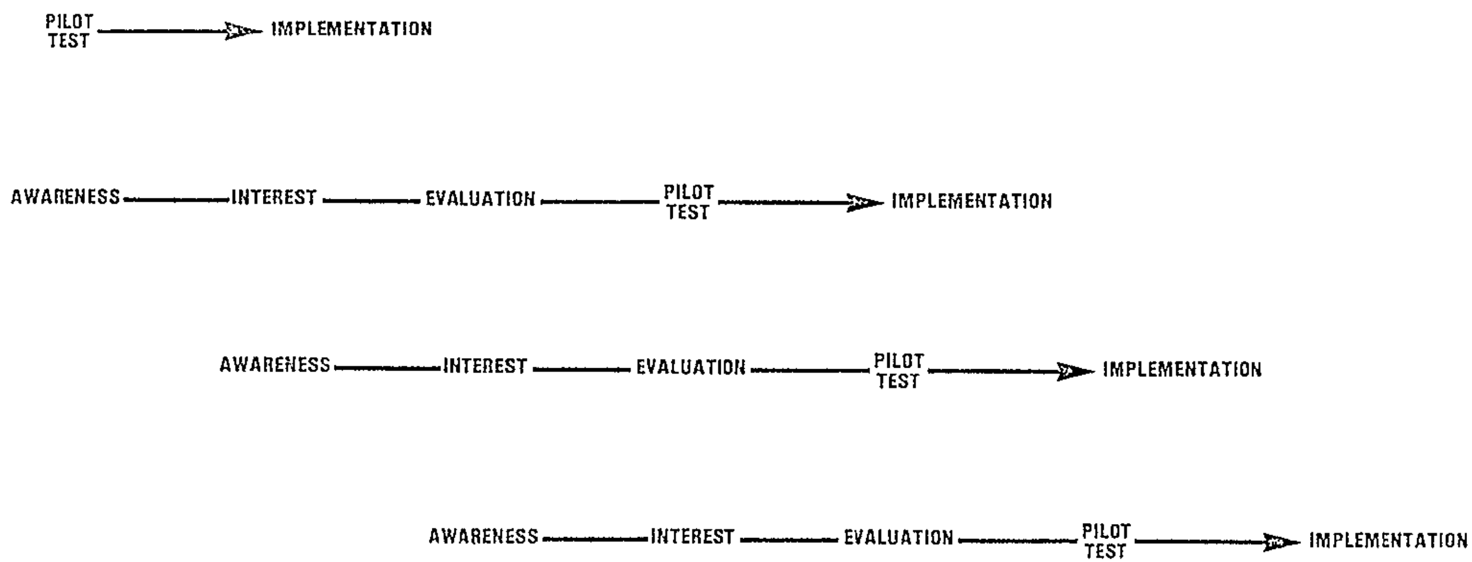

FIGURE 5. STAGES OF INNOVATION IN AN ASVT MULTI-USER ENVIRONMENT

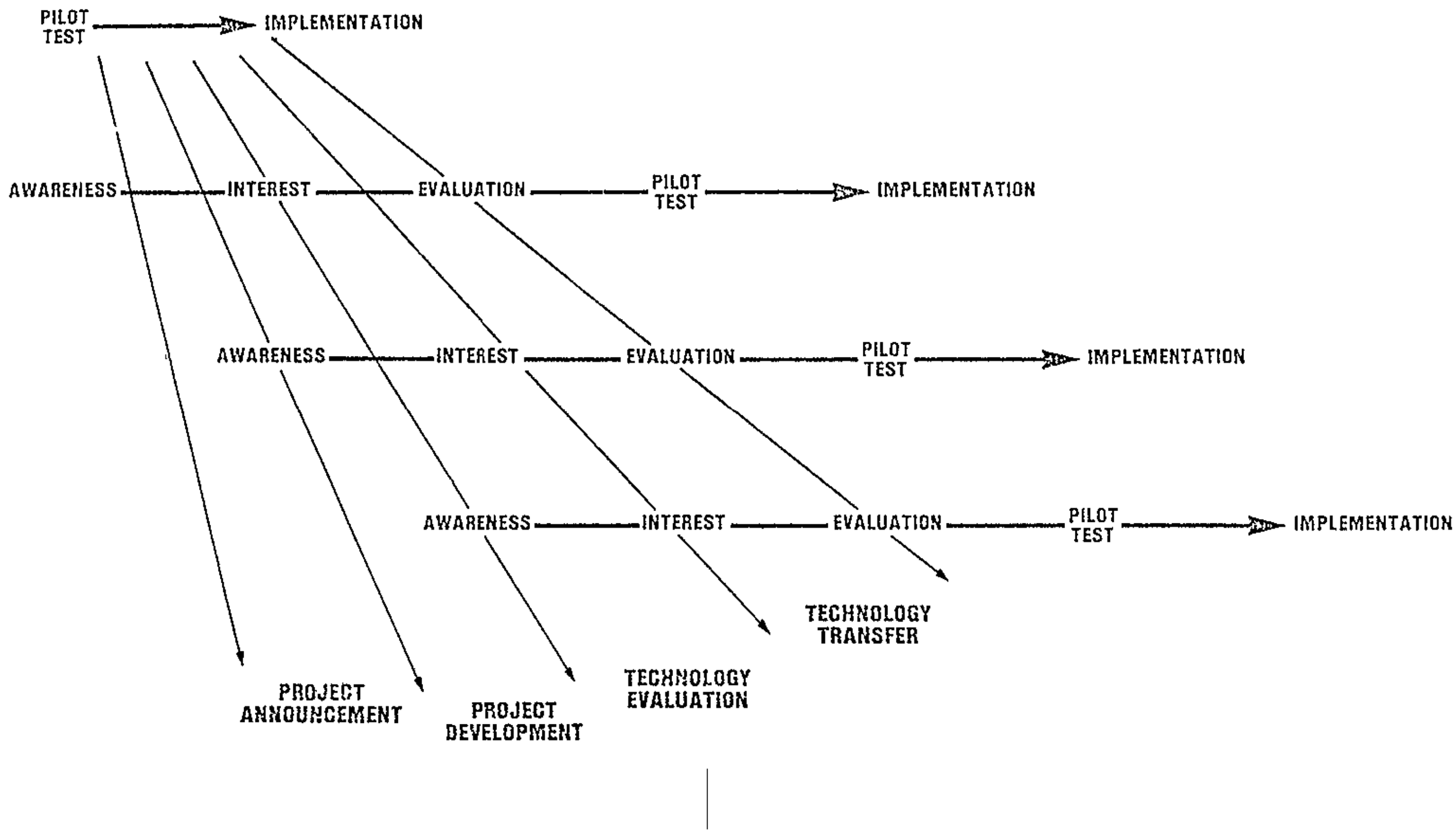

FIGURE 6. DOCUMENTATION STAGE/USER INTERFACES FOR A TYPICAL ASVT

- The technology evaluation stage which emphasizes the experiences of non-NASA participants in applying the technology to problems which they themselves have defined
- The technology transfer stage which lays the ground for practical transfer of the ASVT technology to a user community.

This overlay shows that there must be an ever-broadening relationship between document types and goals, that building awareness, confidence, and expertise in applying a space innovation is a continuous process which must be recycled. This applies both to dissemination to an ever-widening group of users and to the re-transfer of technology to a primary user organization which is necessary as the staff of that organization undergoes normal processes of development and change. As we have seen (Figures 1 and 2), certain types of documents are generally associated with the Test and Technology Transfer Phases of an ASVT. However, as the user environment changes, it will become more important to treat document goals concurrently, rather than separately. This means that a document intended primarily for established users also can help build awareness for potential users of a particular application of space technology.

7.2 Document Types

With the understanding that document purposes must overlap, it is still possible to categorize document types. A useful categorization, because it links document type with effectiveness, was prepared by the Inter-Group Laboratories of the British Steel Corporation.[1] We have adapted this classification freely for Table 2, which lists documentation methods and purposes together with several qualitative measures. Several document types which pertain particularly to ASVTs have been added to the classification scheme. Evaluations in this categorization represent a combination of the British findings and our own findings and experience.

The purpose of this classification is not to provide a ranking of the effectiveness of report types so that one will select some and

TABLE 2. COMPARISON OF AVAILABLE TYPES OF TECHNOLOGY TRANSFER DOCUMENTATION

Note: 0 = very poor; 5 = very good; 5 stars = most important

DOCUMENTATION METHOD	PURPOSE	DEPTH OF COMMUNICATION	WIDTH OF EFFECTIVE COVERAGE	COST FOR EQUIVALENT COVERAGE	EFFECTIVENESS FOR PROMOTING INNOVATION	COST/EFFECTIVENESS	IMPORTANCE
Project Announcement Stage							
Pre-ASVT Research Report	To report on development of technology to point where ASVT becomes possible	4	1	3	1	2	**
State-of-Art Summary	To bring designated and potential ASVT users up to speed	4	3	2	3	3	***
Project Announcement/ Press Release	To develop public interest and help identify additional potential users	1	5	4	2	3	****
Full Project Plan	To describe project and organization, indicate NASA and user responsibilities, and report full documentation plan	4	1	1	1	1	***
Executive Summary of Project Plan	To describe project and NASA/user interactions to decision makers	2	4	3	4	3	***
Development Stage							
Booklets, Brochures, and Fact Sheets	To give essential information or a point of view in easily digested form	1	4	3	2	2	**
Project Newsletters	To provide operating information to project participants and promote espirit	4	1	2	1	2	**
Formal Progress Reports	To provide participants and NASA with information on project progress	3	0	1	0	1	*
Progress Report Executive Summaries	To inform participant and NASA executives and other potential users	2	1	2	1	2	*

TABLE 2. COMPARISON OF AVAILABLE TYPES OF
(CONT'D) TECHNOLOGY TRANSFER DOCUMENTATION

DOCUMENTATION METHOD	PURPOSE	DEPTH OF COMMUNICATION	WIDTH OF EFFECTIVE COVERAGE	COST FOR EQUIVALENT COVERAGE	EFFECTIVENESS FOR PROMOTING INNOVATION	COST/EFFECTIVENESS	IMPORTANCE
		Note: 0 = very poor; 5 = very good 5 starts = most important					
Development Stage (cont'd)							
Seminar Reports	To provide peer-group communication in specific technical disciplines	4	1	1	1	1	*
Workshop Reports	To provide working group communicaton in ASVT subject area	3	2	2	3	2	**
Technical Articles and Copies of Talks	To provide peer-group communication	4	2	3	3	2	***
Popular Articles and Newspaper Summaries	To give selected information to a wide audience	2	5	5	1	2	***
Technology Evaluation Stage							
Evaluation of Accuracy and Reliability	To provide NASA, primary user, and potential users with evaluation of technical feasibility	4	2	2	2	2	***
Cost/Benefit Analysis	To provide NASA, primary user, and potential users with evaluation of costs vs. benefits	5	3	3	4	4	*****
Formal Task Reports	To provide specific task information to support evaluations of methodology and reliability	5	1	2	0	1	**
Task Executive Summaries	To provide management information to support cost/benefit analyses	3	3	2	2	2	**
Documented Methodology (may be incorporated in foregoing)	To show NASA extent of project development and provide basis for cultivating additional users	4[(a)]	2[(a)]	2[(a)]	0[(a)]	1[(a)]	***

(a) When considered as a separate document

TABLE 2. (CONT'D) COMPARISON OF AVAILABLE TYPES OF TECHNOLOGY TRANSFER DOCUMENTATION

DOCUMENTATION METHOD	PURPOSE	DEPTH OF COMMUNICATION	WIDTH OF EFFECTIVE COVERAGE	COST FOR EQUIVALENT COVERAGE	EFFECTIVENESS FOR PROMOTING INNOVATION	COST/EFFECTIVENESS	IMPORTANCE
		Note: 0 = very poor; 5 = very good; 5 stars = most important					
Technology Transfer Stage							
User Handbook/Guidebook	To provide instruction to user operations personnel in utilizing the technology	5	1	2	1	3	***
Methodology Executive Summary (based on handbook/guidebook)	To provide user and potential user executives with decision-related information	3	4	3	3	3	***
Formal Project Report	To provide NASA and users with archival project summary	4	0	1	0	1	**
Executive Summary of Formal Project Report	To provide NASA and user executives with information on project effectiveness; To interest additional potential users	2	4	2	3	3	***
Technical Graphics Presentation	To provide technical information for peer-group communication	3	1	1	1	1	*
Executive Graphics Presentation	To interest executive decision makers in ASVT concept	1	4	2	4	3	***
Instructional Graphics Presentation	To provide instruction in implementing concept to user and potential user operations personnel	5	2	3	2	3	***
Documentary Film	To give information or a point of view in easily digested form to a wide range of personnel	1	5	2	3	2	**
Implementation Report, Technical Details	To show potential users details of technical implementation of ASVT	5	1	1	0	2	*
Executive Report on Space Technology Application	To summarize application for executive decision makers	2	4	3	5	4	****

ignore others in developing the technology transfer documentation plan for an ASVT. The purpose is rather to provide an indication of the potential strengths and weaknesses of various documentation methods so that in planning an ASVT one can select a combination of document types which include some which impact heavily on "depth of communication", and "width of effective coverage", and provide the lowest possible "cost for equivalent coverage" (highest possible combination of number rankings), and the highest possible "effectiveness for promoting innovation". The British Steel Corporation studies extended this classification concept to non-documentation technology transfer methods and showed, as might be expected, that the wider the coverage obtained by a communication method, then the less is the depth of information provided, and vice versa. Personal contact was found to be best for communicating information to limited numbers of individuals, and the British Ministry of Technology Liaison Service (comparable to NASA's Earth Resources field centers) was identified as high in cost/effectiveness because the service (at government expense) could provide personal contacts covering a wide variety of technical applications.

Beattie and Reader, in summarizing the British findings[2], have this to say about reports and report writing:

> As a communication medium, reports have many advantages -- they are cheap, relatively easy to produce, and can have a wide coverage. In spite of this, they are not always very effective: reports present only limited information, which is not always the information required by the reader, and since they have no provision for feedback they cannot address the questions in a reader's mind. Furthermore, it is very difficult to design and write a report which will attract sufficient people to read it. Many reports are too long, badly presented, and written in jargon, and hence they are difficult to read. Plainly, many reports are written with no clear purpose in mind, and as a result are completely ineffective as an innovatory force.

7.3 Format Development

A neat-looking series of hardbound volumes which take an ASVT project from its beginning to its end, starting with a state of the art summary and ending with a formal report summarizing both the results of the demonstration of space technology and the technology transfer that has been achieved -- this might be the goal of a documentation program. But is it a realistic goal? Such a series may have archival value, but will the series actually be used? We have discussed report formats with technical information documentalists and ASVT participants and have found general agreement that document formats must represent the results of a careful analysis of the needs of those who are intended to receive the documents, what is sought to be accomplished through the documents, the nature of the information that is available, and the economies and costs of producing and distributing the documents. If a professional documentalist is part of an ASVT team, he or she should have sufficient expertise to make useful recommendations based on such an analysis.

The documentalist or report editor will need to ask several questions at the beginning of an ASVT project in developing document formats which will be implemented throughout the project, such as:

- What is the purpose or scope of the document? (It is almost axiomatic that a statement of the purpose or scope should begin any document.)
- Who will be the users and under what kind of work environment will the document be used? (Style and manner of presentation should guide the reader to useful information without burdening him with the preparation required to understand a technical glossary or an involved organization scheme.)
- What will the users of the document want to know? (What they will <u>need</u> to know is important, but any appreciation of needs must include an appreciation of <u>wants</u>.)
- What is it intended that the users of the document should do? (Only archival documents should be allowed

to omit this question. The recommended action usually should appear at both the beginning and the end of the document.)

- How long will the useful life of the document be and what provision should there be for updating the material? (Too often, published reference material becomes out of date with no provision for keeping it current; even worse, many documents omit the date of publication on their title pages -- the user has no idea whether or not he is getting current information. All documents should be updated at frequent intervals as long as they are circulated. However, loose-leaf formats (for example, as in training manuals) may be too cumbersome for convenient updating.
- In view of the present positions, knowledge, and other characteristics of intended users, how should the document be slanted? (It is axiomatic that a document should fit its intended users. Yet, the potential users of an ASVT document may far outnumber the original group for which it was intended. As shown in Figure 6, above, these potential users may be at several different levels in their own assessment of the technology at the same time.)

7.4 Recommended Formats

ASVT project personnel should assign highest priority to those document types which have the highest potential cost effectiveness for technology transfer. In Table 2, above, 10 document types received cost effectiveness ratings of 3 and above. Here we consider formats for these 10 types in more detail.

1. State of the Art Summary

Purpose and scope: To bring designated and potential users of the technology employed in an ASVT up to speed. Should provide access to a convenient list of references, annotated to show their relevance. Can provide NASA with the first opportunity to educate primary users in applications of the technology and interest potential users.

Users and user work environment: Usually multidisciplinary audience representing all potentially involved groups below top-level decision makers. Office/library work environment, though should be physically easy to refer to the summary.

User information wants and needs: To be brought to a level of awareness and understanding of the application of specific technology in an ASVT so that the project can be conducted as planned. Should also be considered as a primary tool for interesting and involving additional users at a technical level.

Intended user actions: To use the document as a common reference point in planning applications of the ASVT technology.

Slant of document: Technical discussions should be understandable to the least sophisticated anticipated user. Contents pages, summaries, and annotated references should facilitate reference use.

Anticipated life of the document: Throughout life of the ASVT project, with updating as necessary. A second state of the art summary could be issued after the conclusion of the project.

Typographical and layout considerations: Headings and subheadings should facilitate looking up useful information. Illustrations must be clearly reproduced. Report should open flat for convenient photocopying. Thumb indexing and a detailed subject index are desirable. Report should not exceed 100 pages.

Example from ASVT Program: Handbook of Techniques for Satellite Snow Mapping by James C. Barnes and Clinton J. Bowley. (Environmental Research & Technology, Inc., 1974.)

2. Project Announcement and Press Release

Purpose and scope: To develop public interest and help identify additional potential users of the ASVT technology. Should stress that the project is a test application of available technology to meet needs which can be identified with a specific state, region, locality, or type of user.

Users and user work environment: Wide range of media users. Although newspapers and TV-radio should be included, primary emphasis should be on reaching management publications and newsletters and special-interest publications with news sections. Broadest media coverage should be in ASVT user/participants' home areas.

User information wants and needs: Stress how the technology will be applied to specific problems.

Intended user actions: To disseminate the information, to seek further information from NASA and ASVT user/participants.

Slant of document: Lay language, application oriented.

Anticipated life of document: One week. Greater longevity possible only through repeated press releases and personal follow-up.

Typographical and layout considerations: Follow standard newspaper style; limit to two pages, double spaced; and include information on local contacts.

Examples: ASVT user/participants usually can supply examples of press release/announcement formats which work best in their areas.

3. Executive Summary of Project Plan

Purpose and scope: To describe project and NASA/user interactions to decision makers. Two levels of executive summary (for top and middle executives) sometimes are employed.

Users and user work environment: User/participant management and NASA management at levels and in groups other than those directly concerned with project. Staff Aides, particularly those employed by legislative and planning groups. Professional information scientists. Leaders and personnel of other ASVTs and other NASA/user applications research projects. Users lack time for extensive reading; need to know salient project details and how to get additional information by telephone.

User information wants and needs: ASVT applications otherwise may be unknown to user-organization decision makers who are not directly involved, but who may be essential for technology transfer to be completed. Summary should help executives understand how the successful completion of the project can help their organizations function better.

Intended user actions: To receive ASVT favorably as part of overall planning of user organization, to anticipate results of ASVT, and to begin seeking uses of the technology.

Slant of document: Limit to 2,000 words, stressing application to recognized needs of user organizations. Must be presented in lay language with illustrations which make a point without extensive captions.

Anticipated life of document: Short for each particular reader, though document can be circulated and updated throughout life of project. If a reader is to be contacted twice, two clearly different summaries must be employed.

Typographical and layout considerations: Avoid elaborate formats; use simple charts and graphics. Summary should not appear discouraging to reader who has only a few minutes.

Examples: We have seen no ASVT Project Plan executive summaries. For a useful example format, see the conclusion of this section.

4. Cost/Benefit Analysis

Purpose and scope: To provide NASA, primary user, and potential users with evaluation of costs vs benefits of applying a designated technology. Highly desirable at any stage of an ASVT project, an essential particularly for technology transfer to operational use in state, regional, and local agencies which have funding responsibilities.

Users and user work environment: Will be used directly by user agency planners, indirectly by user agency executives. Work environment requires projections for immediate application of the technology and for future applications using present planning procedures rather than theoretical scenarios. Political environment makes short-range benefits more useful than long-range plans.

User information wants and needs: While precise cost/benefit information is most desirable, approximations are useful, providing basis is indicated for making the approximations. Analyses made by users or by respected consulting organizations have highest credibility.

Intended user actions: To acquire capability to make own decisions about continuing in Technology Transfer phase of ASVT and to transfer technology to own organization at end of project. To discontinue any unproductive uses of the technology so as to concentrate on productive uses.

Slant of document: Comparisons of costs and benefits should be qualified to indicate degree of certainty. Terse, direct presentation is essential but in this one case an executive summary should not be attempted, to avoid any implication of manipulating the facts. Bases for cost/benefit comparisons should be supported in the appendix.

Anticipated life of document: A preliminary cost/benefit analysis at the end of the Test Phase can be supplanted by a more refined analysis at the conclusion of the project. This refined analysis should be a permanent part of the record, though it can be updated to reflect economic changes.

Typographical and layout considerations: Elaborate formats should be avoided. Typography should enhance ability of document user to make comparisons.

Example: "Remote Sensing Applications in Water Resources Management by the California Department of Water Resources", by Barry Brown, California Department of Water Resources. Paper W-19, Presented at NASA's Earth Resources Survey Symposium, Houston, Texas, June 10, 1975.

5. User Handbook/Guidebook

Purpose and scope: To provide instruction to user operations personnel in utilizing the technology. Supplanting many of the documentation products prepared throughout the entire development of an ASVT, this should be the principal operational documentation product of the project. It should be comprehensive but need not duplicate available genaric instructional materials (as in photo-interpretation, digital computer processing, etc.).

Users and work environment: Users are principally technical personnel charged with applying the technology. User environments may vary from office to field situations.

Intended user actions: To apply the technology that has been developed throughout the ASVT. Provision for user feedback is essential so that revisions reflect the actual working environment. Best mechanism for obtaining this feedback is personal contact of representative users.

Slant of document: Depends on nature of the application. If a detailed technical process is to be followed, document requires input from a professional trainer. Proper slant can be introduced by testing user-guide materials at training sessions during the Technology Transfer Phase of the ASVT.

Anticipated life of document: As long as the technology is used, with updating. While minor changes can be accomplished through loose-leaf inserts, any major revision should include republication of the entire document and withdrawal of the outdated version.

Typographical and layout considerations: Realistically, must depend on available budget. However, always should be subject-indexed and organized for convenient access. If there are large groups of users with specific, limited interests, specific guides should be considered. Another useful format is a pocket field guide with most-used information, developed from a larger reference volume.

Example: User manuals published by the Hydrologic Engineering Center of the U.S. Army Corps of Engineers, Davis, Ca., are based on instructional programs conducted at Davis to introduce Corps technical personnel to specific computer modeling applications. See for example, 'STORM' (Storage, Treatment, Overflow, Runoff Model) Users Manual, July, 1976.

6. Methodology Executive Summary

Purpose and scope: To provide user and potential user executives with decision-related information. Several levels are possible (1) to assist administrators in deciding whether or not to use an operational application of space technology; (2) to provide general information for supervisors in conducting a project; (3) to provide detailed information on steps necessary to employ techniques described in the User Handbook/Guidebook.

User and work environment: Users are primarily executives and supervisors whose reading time is limited and who may be interrupted.

Intended user actions: To make appropriate decisions regarding operational implementation of space technology applications.

Slant of document: Should be procedural rather than technical in nature, but provide enough background on project to provide executives and/or administrators with a general understanding of the scientific basis for the technology.

Anticipated life of document: Same as for User Handbook/Guide.

Typographical and layout considerations: If a single document is to accomplish all three purposes above, it should be divided into sections, each with a clearly indicated purpose. Should be organized for convenient access and should include an annotated bibliography of important project documents. Format should enhance readability. Marginal notations which give key words of important paragraphs may be desirable.

Example: This modular approach is frequently used by Public Technology, Inc. (PTI), an organization established for applying available technologies to the problems of state and local governments. PTI's Fire Station Location Package (U.S. Department of Housing and Urban Development) is one such example which also includes a User Handbook.

7. Executive Summary of Formal Project Report

Purpose and scope: Though this document has much in common with the Methodology Executive Summary, its purpose is to inform executives of the value of a technological application rather than to show how the application should be implemented. This is the only part of the formal project report which will be read widely, so it should be worded carefully to report all major findings, including how technology transfer was sought and applied.

User and work environment: Primarily for executives who might make implementation decisions, both within primary user environment and in other organizations and agencies with problems similar to those of primary users. While the reading time of an executive is limited, he may turn this summary over to an aide for further analysis. Can serve also as reference report for news media.

Intended user actions: To implement the technology in own organization, now or in the future. To bring potential applications to the attention of other executives.

Slant of document: Should be presented in lay language, avoiding technical terms and acronyms, even with a glossary. Should use illustrations and graphic techniques to clarify important points. Desirable as a technical summary with enough operational details to show how the technical information was gathered.

Anticipated life of document: Individual copies will be read, placed on a distribution list, and buried in the files over a one-month period. However, report may be distributed usefully as long as the technology is relevant to the needs of possible users.

Typographical and layout considerations: Professional layout assistance will be worth the investment. Should stress eye-appealing, fascinating aspects of the technology application. Charts should be uncluttered, easy to interpret. Use of color may be desirable. However, report must not appear gimmicky or too massive for convenient handling and insertion in interoffice mailing envelopes. Should consider use of post-card insert for requesting further information.

Example: The better corporate annual reports illustrate this report style. The trend is to reduce report bulk and increase use of graphic techniques which aid the reader. For example, Oak Ridge Associated Universities found that annual report readership and cost effectiveness was improved by drastically reducing report size and going from an 8 x 10 inch format to a unique 6 x 9 inch format on distinctive paper.[3]

8. Executive Graphics Presentation

Purpose and scope: To interest executive decision makers in ASVT concept. Besides being developed to convey maximum information on problem-solving possibilities of a space technology application, presentation should encourage user and potential user feedback.

User and work environment: Graphic techniques should be flexible enough for presentation in offices as well as auditoriums. Frequently the same presentation can most usefully be prepared with a choice of graphic display techniques (such as flip charts and 35 mm. slides). Users generally will have limited time (15 minutes or less) but will be able to devote full attention to presentation.

Intended user actions: To implement the technology in own organizations and/or endorse its implementation. To interest others in implementing the technology.

Slant of document: Can emphasize important aspects of a project more effectively than a written presentation. Research has shown that an effective graphics presentation can compress the amount of time required to understand an important concept by a factor of three. However, no attempt should be made to communicate technical details. Effectiveness is influenced by professional manner of presenter.

Anticipated life of document: As long as technology is relevant to needs of the audience. However, any graphic which is out of date outdates the entire presentation. Should be reviewed for updating before each use.

Typographical and layout considerations: Most effective to use a combination text, simple graphics, and color photographs. Most common problem is overloaded graphics, with too much on a single slide. In a 15-minute presentation, a full Carousel tray (80-100 slides) can be used effectively. Professional sound and music tracks can considerably increase slide presentation effectiveness. In some cases a documentary technical film may be even more effective.

Example: An executive briefing on the U.S. Coast Guard's RTD&E Plan for Marine Safety was produced in 1977 in slide/tape format by Battelle.[4] Although this briefing is primarily for internal use by Coast Guard executives, it illustrates the application of this technique.

9. Instructional Graphics Presentation

Purpose and scope: To provide instruction in implementing an ASVT concept to user and potential user operations personnel. Frequently useful as modules in instructional series, with each module designed to instruct user personnel in applying a specific part of the technology.

User and work environment: Most effective where users can combine attendance at a presentation with hands-on experience in using ASVT technology at their place of work or in a NASA demonstration facility. However, computer-assisted instruction, with direct user interaction with a learning terminal, should be considered.

Intended user actions: To develop confidence and skill in applying ASVT technology to real and potential applications.

Slant of document: Should first establish and define learning objectives clearly and then help user achieve those objectives through iterative techniques. Effectiveness should be confirmed through use of formative evaluation techniques before wide scale use. Instructional slant is best developed with assistance of an experienced instructional technologist. Should be accompanied by printed text or outline.

Anticipated life of document: As long as technology is relevant to user needs. Requires regular review for updating.

Typographical and layout considerations: Wide range of formats available includes -- videotape (effective if technology is demonstrated, not a good substitute for a lecturer) film strips (particularly economical if several sets are used), 35-mm. slide/audio tape (easy to edit and update), and several proprietary formats. The "Sound-page" system (marketed by 3-M) combines printed graphics with audio recordings for individualized instruction. The "Plato" system, originally developed by The University of Illinois for the Department of Defense, is a computer-aided instructional system with wide graphics possibilities. (Plato is marketed and serviced nationally by the Control Data Corporation.)

Examples: "FIFI" (Fire Information Field Investigation) system employs slide/tape presentations and printed texts at two levels of expertise. System was developed by National Fire Protection Association, Boston. Control Data is setting up nationwide network of Learning Centers for demonstrations of Plato. The Laboratory for Applications of Remote Sensing (LARS) maintains an extensive collection of mediated training materials.[5]

10. Executive Report on Space Technology Application

Purpose and scope: To summarize a specific application for executive decision makers. This is a report format which has been used in industry but has not, to our knowledge, been used in reporting the results of government-supported research, development, and technology transfer programs. Such a format is needed because, as we were told repeatedly, potential users of space technology need a kind of report which will assist them in scanning what is available so that they can follow up most promising leads. This format should be more detailed than the "Tech Brief" but less detailed than the traditional executive summary. We conclude with the following example of such a format, adapted from a British Iron and Steel Research Association report.[6]

NASA APPLICATION REPORT

A NEW REPORT STYLE FOR COMMUNICATING APPLICATIONS OF SPACE TECHNOLOGY TO EXECUTIVE DECISION MAKERS

SYNOPSIS

This report demonstrates the need for a new style of report for communicating to decision makers in state and local government and industry, outlines the content of such a report, and suggests the consequences of using it.

CONTENTS

1. THE NEED FOR A NEW REPORT STYLE

1.1 We would not normally try to communicate with a Frenchman by speaking in Arabic. Nor would we try to tell someone the time by explaining the theory of the atomic clock. As obvious as these statements are, we have been ignoring their implications for some time. We customarily write a report about technical matters in technical terms and expect anticipated users of the technology to abstract for themselves the information they require -- if indeed this information is in the report at all.

1.2 There is at present no recognized procedure within the ASVT program for writing a report in simple language containing in a nutshell just that information required by an executive about a new idea. ASVT technology reports are usually produced as progress reports for internal use, and are often both long winded and technical in nature.

1.3 As a means of communicating with executives, such reports have three main defects:

(a) They are difficult to read, as the technical nature of the material presented often leads to the use of jargon, difficult and unfamiliar concepts, and frequent references to appendices and diagrams.

(b) They are thick and demanding, and most potential readers have neither time nor the resolution to read such reports.

(c) Most importantly, they present the wrong information. Executives are not usually concerned with the techniques used by research workers. More often, a decision maker wants to know the practical results of the research, their relevance to his organization, and the likely effects of their implementation. This, however, is often the sort of information that is omitted from a conventional report.

1.4 These objections show that current research and development reports do not serve as adequate vehicles of communication to executives; a supplementary style of report is required which fills this need specifically. It is this new style that is the subject of the present report.

2. CONTENT AND STYLE

2.1 Initially, an executive needs enough information to decide whether or not to refer an idea to his technical staff for further evaluation. This information is essentially that contained in the following list, and these points form the framework for the new report, although not always in the order shown.

(a) Nature of the innovation or specific application of space technology.

(b) Problem area to which the application provides a solution. Possible uses in particular situations or extensions to related problem areas.

(c) Benefits and costs that would probably be obtained.

(d) Consequences (other than economic) of using the system, and ease of implementation.

(e) References to any practical experience that already exists with using the new technology, especially with regard to benefits and costs. For example, a very short account of successful application elsewhere.

(f) Sources of further information on the application.

2.2 This information must be presented in an appropriate style. Mathematics, jargon, technical detail or descriptive methodology should be omitted, and the report should be short, clear, and to the point. Any intelligent layman should find it easy to read and should be able to understand it all.

3. PRESENTATION

3.1 It is proposed that the report will be called, "NASA Application Report" and be produced in a distinctive format. Each report should be not more than 2000 words long and should be printed and laid out as attractively as possible. Hence, pages can be few in number and small in size, making the report easily recognizable.

3. PRACTICAL EXAMPLES

4.1 This style of presentation is not yet used extensively by the Office of Applications, although similar concepts are applied in certain effective industrial publications. In general those who were consulted heartily endorse the idea, and at least one other user of space technology is considering introducing a similar scheme.

4.2 Further research shows the difference in communication effectiveness through using such a method of written communication. There are indications that this difference is likely to be considerable.

4.3 This report is written as if it were a NASA Application Report.

5. CONSEQUENCES OF USE

5.1 Benefits

5.1.1 It is expected that after a little time most executives will readily recognize the new reports and will find them short, easy to read, and relevant. Hence they will not put them aside until time is available, but will automatically read them without delay.

5.1.2 The principal effect should be to increase the effectiveness of the communication of useful information to decision makers. This should lead to faster and wider implementation of space technology applications. The resulting benefits could be very large.

5.1.3 A supplementary benefit will be the saving of executives' time in learning about space technology innovations.

5.1.4 In addition, since the reports will be specifically concerned with the application of the technology to users and their problems, the discipline of writing the reports should give ASVT project staff a better view of the purpose of their project, and the need to give their work a practical slant.

5.2 Costs

5.2.1 Three main costs can be distinguished, although all will be small:

- *(a) The work involved in writing Application Reports.*
- *(b) The cost of printing.*
- *(c) The costs of distribution.*

The reports should be quick to write because of their brevity and predetermined framework. For similar reasons the printing costs will be low. Distribution can be handled by the existing system or by a simple modification of it, and thus will not involve large extra costs.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 This style of reporting has high potential benefit and low cost. It should, therefore, be adopted in the Office of Applications ASVT program for communication to executives.

7. FURTHER INFORMATION

7.1 Further information on this and other documentation procedures is found in the Battelle Columbus Laboratories report to the Office of Applications, "Documentation Requirements for Applications Systems Verification and Transfer Projects". This report is obtainable from:

The Chief Information Officer
NASA Office of Applications
Address
Telephone number

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1. Beattie and Reader, op cit, pp. 191-196.

2. Ibid, p. 197.

3. See, "A New Look at the Annual Report", by Richard A. Potter. Technical Communication (Journal of the Society for Technical Communication), Vol 24, No. 2, Second Quarter 1977, pp. 4-5.

4. Copy of briefing available on loan.

5. Lindenlaub and Lube, op cit.

6. "A New Report Style for Communicating to Industry Management", by C. J. Beattie. BISRA Management Brief OR/44/67. (BISRA, London, England, 1967.)

APPENDIX A

TOWARD DEVELOPING AN ASVT DOCUMENTATION STRATEGY FOR TECHNOLOGY TRANSFER
(A Concept Paper for Discussion)

Four stages can be identified in the documentation of a typical Applications Systems Verification and Transfer (ASVT) project.

The announcement stage establishes the ground rules of the project and provides explanations for NASA and non-NASA participants.

Documentation at this stage also should prepare the ground for technology transfer by alerting potential users. Examples of documentation at this stage include:

- The Memorandum of Understanding and Project Plan, distributed to project participants and to management of project agencies.
- An announcement, including important details of the Project Plan, distributed to users and potential users of the technology and to all technology transfer agents.
- Media announcements for publications read by potential users.
- Supporting documentation on project information resources and techniques, for participants, also where possible for users and potential users. (Example: "Handbook of Techniques for Satellite Snow Mapping").
- Proceedings of symposia, professional articles, etc., describing the project:
  - To the research or technology community
  - To the management (decision making) community.

In preparing documentation even at this stage, one should be able to indicate exactly how the project will meet Office of Applications guidelines as specified in the "Procedure for Planning and Approval of ASVT Projects". In as much detail as possible, the Project Plan should specify both the nature and purposes of documents which will be generated during the project. Individuals who will have principal roles in the project should be identified by name as well as by position.

Beginning in this stage, and throughout the entire documentation process, there will be questions and comments from participants, users, and other readers. The documentation strategy should encourage this feedback by providing a switching center within the ASVT organization for promoting rapid responses and encouraging exchange of information. This center function should be handled by an individual who may not be in top management but who is thoroughly familiar with the ASVT and who will remain with the project throughout its entire expected lifetime. Such an individual can be a key to effective utilization of documentation for technology transfer purposes.

The development stage provides continuing information on the project, promoting exchange of information among NASA and other participants and cultivating the interests of other potential users.

Monthly, quarterly, and/or annual reports, in detail, may be required for internal purposes. These should be as brief as possible, and each should have a section on technology transfer. Routine reports should not become burdensome, either for those who originate them or for those who are expected to read them. Elaborate appendices, particularly those containing monochrome Xerox copies of Landsat images, should be avoided. Each report should be prefaced by an information sheet containing a detailed informative abstract or executive summary (rather than a descriptive abstract) which summarizes its important points. In addition, the exact distribution of each routine report should be documented, and reference should be made to where the report is kept on file, even if it is not entered into an organized bibliographic system. For most purposes, this sheet can be used as a surrogate for the full report.

Documentation of the ASVT through professional journals, including those outside narrow disciplinary bounds (such as remote sensing), should be encouraged throughout the development stage. This documentation should be addressed to the ultimate users of ASVT technology, rather than only to those who manipulate the technology. In particular, user problems in data acquisition and handling should be addressed. If the limitations as well as the advantages of a particular application of space technology can be brought out early in the development of applications of that technology, "oversell" problems can be avoided and there will be more time to solve the problems.

As soon as a user community can be identified, vehicles for maintaining user communications and feedback, such as informal newsletters, should be considered. Often these newsletters can be piggybacked on mailings which are regularly sent to ASVT participants for management purposes. This piggybacking saves costs and helps guarantee that the newsletters will be read. The newsletters will facilitate information exchange and may be employed to bring useful supplementary documentation to the attention of the participants.

The technology evaluation stage emphasizes experiences of non-NASA participants in applying the technology to problems which they themselves have defined.

While no two ASVTs are exactly alike, this stage usually starts toward the end of the test phase of the project. There are three mandatory products:

- A documented methodology suitable for widespread use (subject to periodic changes as necessary)
- A comprehensive evaluation of the system's accuracy and reliability
- A socio/economic benefits study (usually prepared by an outside contractor).

These are important documents to the planning and justification of ASVT projects, but their focus should be outward rather than inward, toward user applications rather than only demonstrations of the technology. The documents should reflect a style of presentation and language (often called "the Scientific American approach") that is suitable for a broad, interdisciplinary readership, for one of their greatest values should be in stimulating feedback from both technical specialists and administrators. On the bases of the evaluations in these documents and the feedback, the Project Plan then can be revised to reflect the joint commitment of NASA and other participants to proceed and/or modify plans.

Evaluation of the technology from user standpoints often is obtained through one or more symposia or workshops which also facilitate transfer of the technology through the involvement, identification, and training of new users. (For example, two such workshops were developed for the ASVT on Operational Applications of Satellite Snowcover Observations.) Proceedings of these symposia are circulated, mainly, to participants. Here there is also a danger of "preaching to the choir" because workshop participants may be only those persons whose interests in space applications already have been identified.

The <u>*technology transfer*</u> *stage lays the ground for practical transfer of the ASVT technology to a user community (depending on the size and nature of the ASVT) which may be limited to non-NASA participants in the project itself (such as a single public agency) or broad enough to include all planning agencies in a designated geographic area.*

If aggressive technology transfer must wait until the end of a demonstration project, the time delay may be suicidal. Because government agency funding at all levels, and often private agency funding, requires a full year, the groundwork for planning beyond the ASVT stage must be initiated early. One way of building this groundwork is through technical publications aimed at an interdisciplinary audience. Project personnel should prepare journal articles <u>significantly before</u> the end of their involvement in the ASVT.

During the technology transfer phase the problem of getting continuing service must be addressed through the documentation if useful transfer actually is to take place. NASA's role in future technology demonstrations, particularly in the earth resources area, must be stated plainly in order to provide present and potential users with a rationale for planning decisions. Handbooks should be available which literally take the management-level user by the hand and walk him through the capabilities of the technology to address his problems. These should be augmented by operational guides to the techniques for each specific application, including documentation of existing and planned training programs, annotated guides to literature in the field, and guides to sources of equipment and services necessary to implement the technology. Detailed costing information should be included. Thus, two kinds of documentation are required for user guide purposes:

- Technical documentation to aid in involving and training those personnel who will be working directly with each particular space application
    - -- showing how to handle the data as they are received from NASA and/or other appropriate agencies, and

-- showing how to manipulate the data in order to obtain meaningful application information.

- Management documentation to show capabilities of information obtained through the space application to address problems and needs of potential users.

User guide materials, particularly at the management level, should be formatted for ease of application and impact. In planning these materials, there should be consideration of graphic techniques which add to understanding and facilitate information flow. Charts that are difficult to read or present an overload of information on a single set of coordinates should be avoided. Earth resources pictures when used in this and any context must be reproduced so clearly that prominent features are outstanding. Use of audio-visual documentation techniques should be considered. For example, the transfer of safety and system assurance planning techniques (pioneered by NASA) to urban transit administrators is being facilitated through a 20-minute film. In this case the documentation (film) was specifically developed for the direct support of a human technology transfer agent (the presenter). Whenever special graphic techniques (films, slide-tape presentations, videotapes, etc.) are employed, there should be consideration of the availability of presentation equipment to user audiences.

Several other kinds of documentation should be useful during the technology transfer stage. These might include:

- Interim reports, summarizing project experience of primary users, for circulation within the NASA and user communities (Example, "Utility of Landsat Data Within the Pacific North-west Region"). For earth resources projects, where extensive graphics are needed, color microfiche publication should be considered as a cost-saving alternative.
- Profiles on each specific successful application
    - -- Each profile a mini-report (and based on a participant or user report) but reformatted in narrative style, with illustrations, for wide distribution,

-- Each to feature the problem, the solution, and future applications.

If an ASVT is typical of other projects we have encountered, there will come a time late in the project when funds are running out and no specific appropriations are available for further documentation. A voluminous final report is written, restating the project plan and indicating the outcome. Of course such a report is necessary for archival purposes, but its use in technology transfer is questionable. We suggest that it would be much more useful to develop a series of summary reports to be used by technology transfer agents in supporting the usefulness of ASVT technology in presentations to city and state executives, company presidents and managers, department heads in government and/or industry, and research and development leaders and planners. If an ASVT is to achieve its goals, it is important that adequate funding resources be made available for such reporting.

Although it may not be possible to write a general prescription for ASVT technology transfer documentation, a specific designation of technology transfer activities which will be undertaken can be made a part of every ASVT project plan. This designation need not be cast in concrete; it can be changed each time the project plan is modified. However, the presence of identified technology transfer goals, together with a time schedule, will add impact to this important ASVT component. This statement should assign definite technology transfer documentation responsibilities to both NASA and other participating organizations and provide a schedule for carrying out these responsibilities. Specific reports, orientation packages, handbooks, films, exhibits, etc., should be described in as much detail as possible.

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APPENDIX B

LIST OF INDIVIDUALS INTERVIEWED DURING THE STUDY

APPENDIX B

LIST OF INDIVIDUALS INTERVIEWED DURING THE STUDY

Lee Aggers, USGS, Menlo Park, Ca.
V. Ralph Algazi, Professor and Department Chairman, University of California, Davis
Larry Baird, California State House of Representatives Office of Research
P. T. Bankston, Director, Mississippi Office of Science and Technology
Sally Bay, Head of Remote Sensing Project, National Conference of State Legislators
Captain Winfred E. Berg, National Academy of Sciences
Michael Bogard, Environmental Geologist, Mississippi Geological Survey
William J. Bonner, Bureau of Land Management, Supervisor of Wildland Vegetation Resource Inventory ASVT
Lou Bransford, Director of Service Development, PSSC
Barry Brown, California Energy Resources Conservation Commission
Don Card, PNW Project (NASA-Ames)
Jerrold W. Christenson, NASA-GSFC
Robert C. Crawford, National Science Foundation
Philip J. Cressy, Jr., NASA-GSFC (Intralab)
Nikolas L. Faust, Georgia Institute of Technology
Clayton Fisher, Georgia Department of Natural Resources
Stanley Fredden, NASA-GSFC
Benjamin B. Gordon, Battelle Memorial Institute
Group of state facilitators, Pacific Northwest Project
Jack A. Hannaford, Sierra Hydrotech (Consulting Engineers)
M. Chuck, Snow Surveys Branch, California Department of Water Resources
George James, National Science Foundation
Laurie Jordan, Georgia Department of Natural Resources
Dr. Armond Joyce, Principal Investigator, Mississippi ASVT
William Kier, California State Senate Office of Research
David Landgrebe, Director of LARS, Purdue University
Wasyl Law, NASA Headquarters
Dale R. Lumb, Project Director, Pacific Northwest Project (NASA-Ames)
Herman Mark, NASA Lewis Research Center
Robert W. Marx, Bureau of the Census, U.S. Department of Commerce
D. Wayne Mooneyhan, Director, ERL
William Mott, Vice President, Public Service Satellite Consortium
Ben Padrick, Head of Technology Transfer program (NASA-Ames)
Jack W. Pepper, Mississippi State Water Engineer
David Peterson, PNW Project (NASA-Ames)
Albert Rango, NASA-GSFC
Polly Rash, Director of Communications, PSSC
Donald Rogers, NASA Headquarters
Robert H. Rogers, Bendix Aerospace Systems Division
Buzz Sellman, NASA-GSFC (Intralab)
Richard L. Stone, NASA Headquarters
Minsoo Suk, University of California, Davis
Jack N. Washichek, U.S. Soil Conservation Service, Denver

Sid Whitley, Head of Training Programs at ERL
R. G. Willey, Hydrologic Engineer, Army Corps of Engineers, Davis, Ca.
Don Wilson, PNW Project (NASA-Ames)
James F. Wise, Regional Planner, Mississippi R&D Center
George Wukelic, Battelle Memorial Institute

APPENDIX C

FORMAT USED BY A. T. JOYCE, ESL, TO SIMPLIFY MONTHLY REPORTING OF MISSISSIPPI ASVT

MONTHLY EARTH RESOURCES SURVEY PROGRAM STATUS REVIEW

TITLE: Natural Resources Inventory System ASVT

FUNDING CODE: 658-10-05   CENTER: JSC/ERL   DATE: 30 Apr 76

STATUS:

PHASE I - Software/Hardware System Development
- All Phase I complete except for adaptation of Data Base Module Software

PHASE II - Demonstration Area Tests at ERL
- See matrix below for status of individual demonstrations.

Activities #1 - Ground truthing
#2 - Classification
#3 - Geographic Referencing
#4 - Evaluation of Accuracy
#5 - Data Base Building
#6 - Devel. Application algorithms
#7 - Test Application algorithms
#8 - Product Adequacy Assessment
#9 - Report

PHASE III - Software Verification on State Computer
- Training sample selection complete on 6 of 9 data sets that give statewide coverage.
- Training sample statistics produced for one data set, and training of state personnel in analysis methods has commenced.

FUNDING:		CUM FY THRU THIS MONTH	TOTAL FOR FY-
OBLIGATION	PLAN	304	364
	ACTUAL	312	XXXXXXXXXXXXXXX
COST	PLAN	281	335
	ACTUAL	301	XXXXXXXXXXXXXXX

SCHEDULE: (TRANSMITTAL TO JSC/ERPO, CODE HD, BY LAST DAY OF EACH MONTH)

APPLICATION DEMONSTRATION	Activities - (X = completed)											
	1	2	3	4	5	6	7	8	9			
Crop Production Estimation	x	x	x	x	x	x	x					
Vegetation/Salinity Regime Maps	x				NA	NA	NA					
Reforestation Needs Inventory	x	x	x		x	x						
Wildlife Habitat Assessment	x	x	x		x							
Acreage Compilation	x				NA	x						
Vegetation Documentation	x				NA	NA	NA					
Theme Inventory	x				NA							
Change Detection	x				NA							
Site Selection	x	x	x									

APPENDIX D

TECHNOLOGY TRANSFER/INFORMATION DISSEMINATION SECTION
FROM DRAFT OF FOREST RESOURCE INFORMATION SYSTEM
PROJECT PLAN

APPENDIX D

TECHNOLOGY TRANSFER/INFORMATION DISSEMINATION SECTION FROM DRAFT OF FOREST RESOURCE INFORMATION SYSTEM PROJECT PLAN

There is a need at the outset to define technology transfer as opposed to information dissemination. Both terms are used and sometimes interchangably which causes some confusion.

Technology Transfer: The definition provided in the glossary of terms for ASVT projects defines this activity as; "the art of providing the user with the necessary capability to independently apply a technology or system in an operational mode". This is an apt term fulfilling the intent as envisioned in this project.

Information Dissemination: The act of imparting to potential users the existence of, the procedures followed and the results secured from technical research and development.

TECHNOLOGY TRANSFER

By definition, it is apparent that the major technology transfer activity will be in the system transfer phase of this project; Phase III. During this period, technology will be transferred to STD through divisional personnel having direct interaction with LARS personnel. Through such programs as the visiting scientist, LARS will work with STD people to develop a competence in image interpretation, and rectification. STD systems people will work with LARS to obtain the logic and understanding of the pattern recognition approach. LARS will provide not only the instruction, but develop tutorial literature and programmed self-instructional packages which will be entered into the public domain.

General applicability of technology transfer exists up to the implementation phase. Here, the application becomes so specific that direct use by other users would be difficult, if not impossible. Users will have to contract out, or develop their own in-house implementation package. Up to this point, however, all procedures and techniques with associated documentation will be available in the public domain. "Cookbook" type instructional material, both written and on tape, will be available to the user. Of course, the main problem is, how does the user know the technology exists? He doesn't unless the information is disseminated.

INFORMATION DISSEMINATION

It will be part of Southern Timberlands responsibility to disseminate information on the Forest Resource Information project such that potential users and the general public will be fully aware of the project, the methodologies developed and the results achieved. In carrying out this responsibility, STD will endeavor to do the following:

- Publish pertinent material over and above public domain requirements. Such material might include articles and reports, tutorial brochures, or instructional primers.

- Overview seminars. To conduct for interested user groups, seminars describing the results of the project and showing comparative statistics.

- To outline the prerequisite requirements needed to implement the technique on an individual basis.

- Using the American Pulpwood Association newsletter as a vehicle, release periodic reports in an effort to bring an awareness to other users.

- Through St. Regis National advertising to make the general public aware of the fact that LANDSAT data does indeed have a viable place as a monitor of natural resources. It is the STD intention to work closely with NASA public affairs to establish a media awareness strategy so the broadest possible visibility for the project will be afforded.

- Personal participation in symposia. While STD does not consider the sponsoring or conducting of symposia as part of its function, they would be willing to participate in such symposia during and at the conclusion of the project. Southern Timberlands will also work with NASA and/or LARS in finding a suitable sponsor for such an event at the project's conclusion.

It will also be a part of NASA's responsibility to furnish guidelines in the dissemination of the technology developed for this project. NASA will:

- Insure that documentation, software developed and reports will be made available to the general public through NASA's Scientific and Technical Information Facility (STIF) and the National Technical Information Service (NTIS).

- Provide liaison to other interested users through other NASA projects (ASVT's, etc.) such as the joint NASA/Forest Service Forestry Applications Program (FAP), the NASA/BLM Project, the NASA/Pacific Northwest Regional Commission Project, etc.

- Liaison will be maintained with other academic and private industry organizations that indicate they may have a direct interest or are potential users of similar information systems.

- Separate from this ASVT and an unfunded effort, would be to develop a forestry applications workshop devoted to information systems that are considered operational for presentation to leading forest resource managers throughout the scientific, academic, professional and industrial field. The time frame would be early 1980.

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