TASK FINAL REPORT

on

OPTIONS FOR ORGANIZATION AND OPERATION OF SPACE APPLICATIONS TRANSFER CENTERS

by

A. C. Robinson and J. A. Madigan

Sponsored by

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Office of Applications
(Contract No. NASw-2800, Task No. 15)

June 14, 1976

Approved by:

A. C. Robinson, Project Manager

B. W. Davis, Section Manager
Space Systems and Applications

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

FOREWORD

This report was prepared under Task 15 of Contract Number NASw-2800, with NASA Headquarters, Office of Applications. The period of performance was from May 24 through June 14, 1976.

TABLE OF CONTENTS

Page

INTRODUCTION 1

The Space Applications Transfer Center Concept 1

Objective of the Study 1

Study Approach 2

BACKGROUND 2

Objectives of the Office of Applications in Technology Transfer 2

Characteristics of the Technology Transfer Process 3

Characteristics of Users 5

The Role of the Change Agent 7

Characteristics of Innovations 8

NASA as a Change Agent 8

Characteristics of Users of Remote Sensing Data 10

NASA Industrial Applications Centers 11

Other Related Activities 12

SATC PROGRAM CONFIGURATION OPTIONS 12

Degree of Permanence and Continuity 13

Operational Options 14

Technical Scope of SATC's 14

Geographical Scope of SATC's 15

Type of Location 15

Type of Operator 16

Degree of Identification with NASA 19

Pricing Policy 20

Types of Personnel 22

Operating Concept 23

Evaluation Techniques 29

Implementation Strategies 30

Management and Control Options 32

Funding Options 33

OTHER METHODS FOR ACCOMPLISHING TECHNOLOGY TRANSFER 33

TABLE OF CONTENTS
(Continued)

Page

LIST OF FIGURES

Figure 1. Schematic of the Process of Technological Innovation 4

Figure 2. Distribution of Adoptions During the Innovation period 6

Figure 3. Time Phasing of Charge Agent's Efforts In Adoption Period 9

OPTIONS FOR ORGANIZATION AND OPERATION OF SPACE APPLICATIONS TRANSFER CENTERS

by

A. C. Robinson and J. A. Madigan

INTRODUCTION

The Space Applications Transfer Center Concept

Among the goals of the Office of Applications is one of assuring that the technology developed in its various programs is actually used. Initiation of a new application of technology is known as technology transfer or technology diffusion. One possible mechanism for furthering this objective is a regional facility which brings information to potential users, demonstrates to them the advantages of the technology, and helps to persuade them to try it and adopt it. Such facilities have been widely used, in the past, and many are now in existence. Some have been highly successful, and others have not, but the approach is sufficiently popular that it deserves examination with respect to the contribution it might make to the Office of Applications' program.

In general terms the concept is that a facility would be established to serve a certain geographical area. Associated with the facility would be both experts in the technology in question, and personnel who can find and persuade potential users. The facility might include equipment for application or demonstration of the technology, a library, training facilities, and meeting rooms. The personnel and facilities would be utilized to inform, persuade and serve users of the technology.

Private industry uses such facilities for sales purposes. The U.S. Department of Agriculture has been supporting similar activities for over a century, in what is usually viewed as the world's most successful technology transfer operation. Other Federal agencies have either established regional technology transfer facilities or are planning such establishments.

Objective of the Study

At the present time, the Office of Applications is examining the possibility of developing facilities of this general type. There are, of course, many ways to implement and operate these regional facilities, and in order to evaluate their desirability, it is necessary to consider what form of the concept would be most applicable to the needs of the Office of Applications.

This study is devoted to a brief examination of some of the major options from the standpoints of:

(1) NASA technology transfer policy
(2) Cost
(3) Management feasibility
(4) Effectiveness in marketing Office of Applications' technology to users.

It is not the purpose of this study to make recommendations as to the course of action NASA should follow. Rather it is to suggest a number of possible courses of action and to analyze their strengths and weaknesses. For purposes of this study, the regional facilities are called Space Applications Transfer Centers (SATC's), though it may well be that further study will show a different name to be more desirable.

Study Approach

The study consists of two major parts. The first is an outline of the objectives of the Office of Applications and certain other information which is relevant to assessing the possible operational options. The second part is a review of the options themselves. A number of different aspects of SATC organization and operation are considered more or less separately. Where coupling among various issues is strong this will be indicated. However, for the most part, the various options for treating each aspect are compared directly in terms of the criteria outlined above.

BACKGROUND

Objectives of the Office of Applications in Technology Transfer

Although formal policy statements appear to be lacking, it is generally understood that the Office of Applications has a responsibility to disseminate those technologies which are developed and proven in the course of activities carried out by the Office of Applications. Similarly, there is an implied responsibility for the Office of Applications to concentrate on developing and improving those technologies for which there is practical use.

In this context, "dissemination" means not only that information relative to the technology is provided, but that the technology is actually adopted and results in benefits to those who employ the technology. This requirement for actual and beneficial application is very significant in considering the organization and implementation options.

Much of the discussion in this report is motivated by the problem of transferring remote sensing technology, and especially LANDSAT technology. At the present time, this seems to be in a stage such that a regional center could play an essential role in transfer. However, as will be discussed later, this role will be of finite duration. As time passes, other technologies under development by the Office of Applications will reach the stage at which an SATC could be useful. These could come from any of the thrust areas of the Office of Applications: Earth Resources, Weather and Climate, Environmental Observations, Earth and Ocean Dynamics, Communications and Navigation, Space Processing and Technology Applications. Some of the programs under consideration are SEASAT, MAGSAT, ROCKSAT, and NIMBUS-G.

Once established, organizations such as the SATC's tend to be rather long-lived. Accordingly, it is necessary to keep in mind considerations beyond those of LANDSAT data applications. For this reason, much of the discussion in this report deals with Technology Transfer in the abstract, rather than with the immediate concern; earth resources data.

Characteristics of the Technology Transfer Process

The process of technology transfer or diffusion of innovations has been studied extensively during the past 15 years. The majority of the study has been devoted to the field of agriculture because more technology transfer activity has taken place in this field than in any other. In the U.S. alone, for example, some $750 million a year are expended on technology transfer. However, many other studies have considered technology transfer in industrial settings. Well over a thousand papers have appeared, dealing with various aspects of technology transfer. Much of this work has been reviewed and synthesized in a remarkable book by Rogers and Shoemaker*. This book is richly deserving of study by anyone concerned with designing technology transfer mechanisms.

The general structure of the process of technology development and application is suggested in Figure 1. The link between the developer of the technology and the user is the change agent. This change agent can be defined as a process, an organization, or an individual who attempts to bring about use of the technology.

There are many kinds of change agents, depending on the type of technology being considered. The classical example is the agricultural extension agent who brings new agricultural technology to the individual farmers. In the case of a new commercial product, the change agent is the manufacturer's sales force. In other cases, an information dissemination device such as a Newsletter could be viewed as a change agent.

---

* Everett M. Rogers and F. Floyd Shoemaker, Communication of Innovations, A Cross-Cultural Approach, Second Edition, New York, The Free Press, 1971.

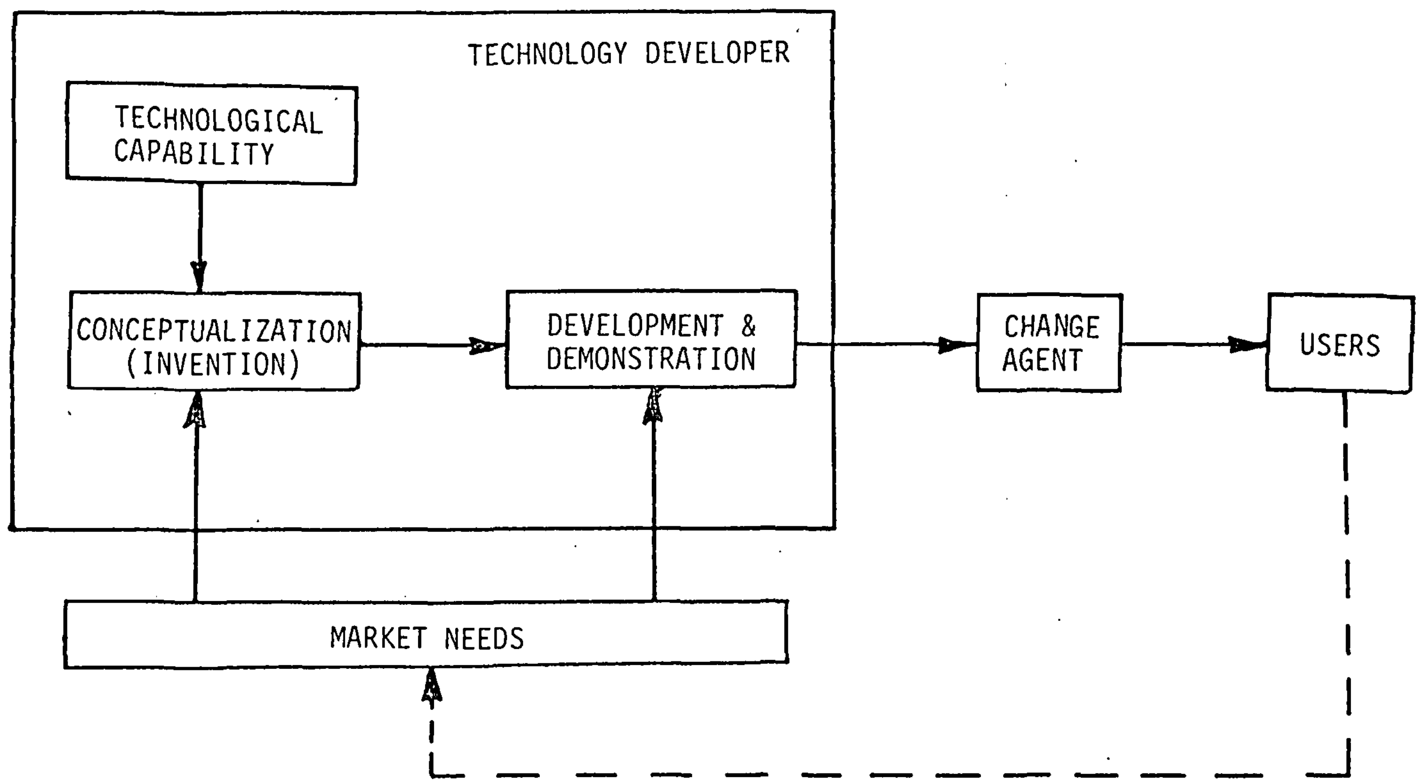

FIGURE 1. SCHEMATIC OF THE PROCESS OF TECHNOLOGICAL INNOVATION

The proposed SATC's are also change agents, and therefore the principal concern here will be the characteristics of change agents, the characteristics of users, and the interaction between the two groups. There are a number of interesting questions associated with the technology development itself and with the influence of market needs on that development. The change agent will certainly play some role in reflecting user concerns back to the technology developer, but this is not the primary interest in this study.

Characteristics of Users

In most of the cases which have been studied, there are many potential users of the technology. These could be either individuals, such as farmers, or organizations such as the group of manufacturing companies in a certain industry. In either case, the rate of adoption of a new technology follows approximately the same pattern as that suggested in Figure 2. In most cases, the number of people adopting technology per unit time follows rather closely the normal probability distribution. The first to adopt are designated innovators. These are venturesome people with an enjoyment of daring and risky behavior. They are usually able to absorb substantial losses and are not particularly highly respected by the remainder of the user community. Innovators tend to have broad interests and to be open to a variety of influences.

The early adopters (see Figure 2), on the other hand, tend to be well intergrated into the user community and to occupy positions of leadership there. They are looked up to by the other users and play a major role in motivating the rest of the community to adopt the innovation.

The laggards are usually tradition-oriented, and look primarily to the past. They adopt the innovation only when its advantages have been thoroughly demonstrated by the rest of the users and they have been subjected to persuasion, and perhaps coercion, by the majority. The early majority and late majority have been described as deliberate and skeptical, respectively.

Each of the users goes through a number of stages in the adoption process. These have been described as*:

(1) Knowledge
(2) Persuasion
(3) Decision
(4) Confirmation.

In the first stage, the individual becomes aware of the existence of the new technology and gains some understanding of it. In the second stage, the adopter forms an opinion, whether favorable or unfavorable, toward the new technology. In the decision stage, he accepts or rejects the innovation. In

* op. cit., p 100 ff.

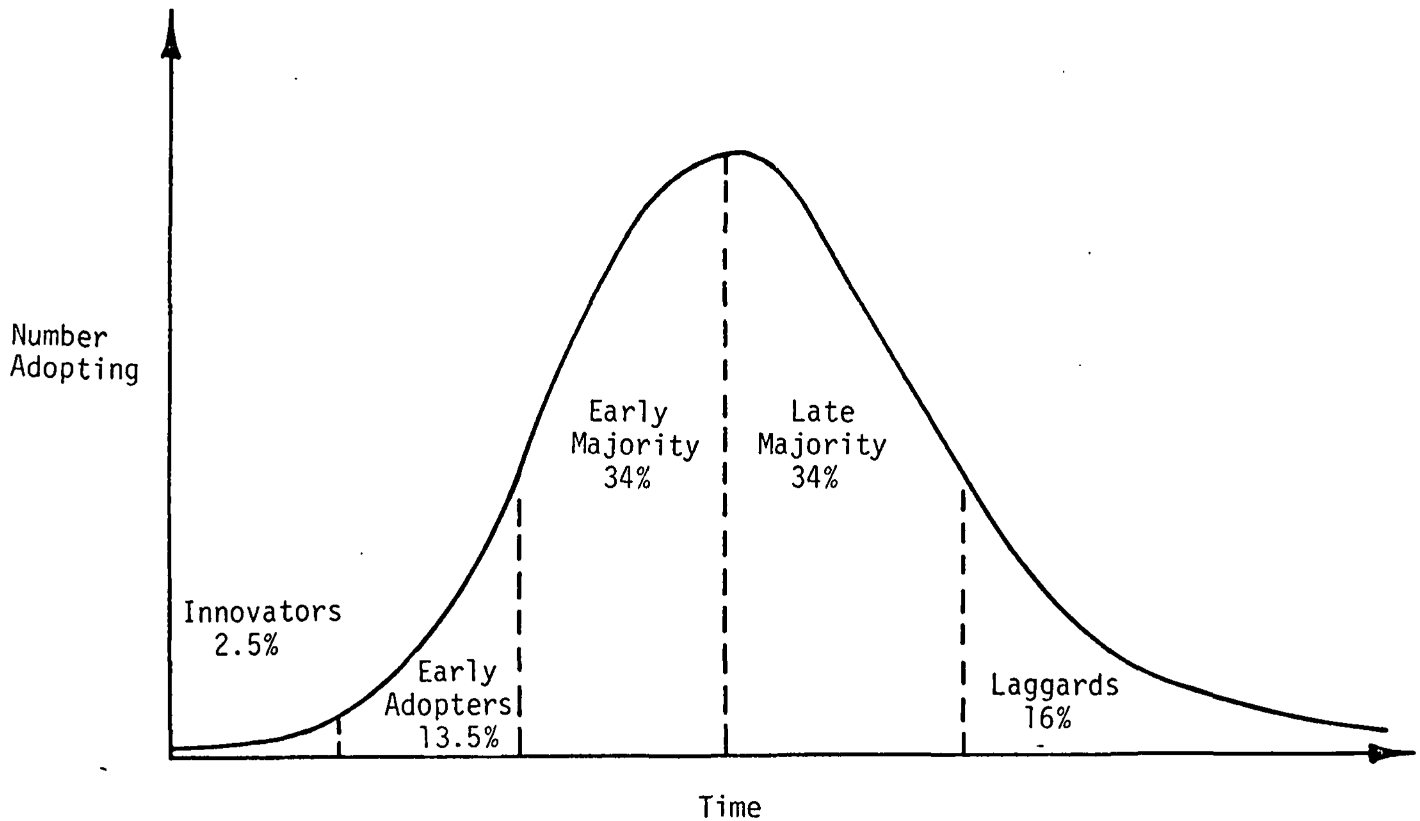

FIGURE 2. DISTRIBUTION OF ADOPTIONS DURING THE INNOVATION PERIOD

Ref: Rogers & Shoemaker, OP. CIT., p 182 the confirmation stage, he seeks evidence as to whether he made the correct decision. In the critical decision phase, it is highly desirable if the innovation can be tried on a small scale basis or can be partially adopted without incurring the risk of full commitment. Innovations which have this property are much more likely to be accepted. The amount of time that elapses between knowledge and decision depends strongly on which user group is being considered. Laggards, for example, have a period some four to eight times as long as innovators. The average period was 9 years in the case of hybrid corn in Iowa, 2.1 years for 2,4-D weed spray in Iowa, 3.8 years for fertilizer adoption by Pakistani peasants, and 2 years for language laboratories in U.S. high schools.

The total period of innovation from beginning to end can occupy periods of from 5 years to 50 years or more. The time required to develop the technology also is of the same order of magnitude, so that the period from initiation of the idea until full diffusion completion is seldom less than 10 years and can run well over a century.

In many cases of interest, the user or adopter of new technology is not a single individual but an organization. In such cases, the internal structure of the organization must be considered in the transfer process. The actual user of the new technology is typically not at the top of the organizational hierarchy. However, it may be necessary to convince several administrative levels, in addition to the using level, that the new technology should be adopted. Failure to persuade any of the echelons from the bottom to the top will inhibit or prevent adoption.

The Role of the Change Agent

The change agent can play a role in any of the four stages of adoption considered above but he is apparently most successful when he participates in all. He can inform the potential user about the new technology, he can assist that user in developing a favorable opinion about the technology and he can assist in the decision to adopt. After a decision has been made he can assist the user in confirming that he made the correct decision.

The critical phases are persuasion and decision. Success here is correlated with the credibility established by the change agent and the degree of rapport that he has with the user. The closer the change agent and the user are in terms of language, social standing, customs, and outlook, the more effective the change agent can be. This problem is, of course, compounded when a single change agent is dealing with an organization. In that case the change agent must deal with a variety of people in different levels of the hierarchy. A serious failure in any one can endanger the transfer.

Another factor in determining the change agent's effectiveness is how hard he works. This is hardly surprising, perhaps, but the relationship between hard work and effectiveness changes quite markedly through the stages of adoption. During very early stages of innovation the change agent's activities appear to be relatively ineffectual. However, once adoption takes place, a few early adopters have made a positive decision, increased activity will increase the rate of adoption until perhaps 15 to 20 percent adoption has taken place. Thereafter, adoption may continue, but the role of the change agent appears to be minimal regardless of the degree of effort he employs. Apparently the change agent is effective primarily with the early adopters. Later adoptions are motivated mainly by the early adopters and not by the change agent. The timing of the change agent's work in the diffusion period is illustrated in Figure 3.

Another factor that contributes to change agent success is a user orientation on his part. If he identifies with users, rather than with the change agency, he will have more credibility with and effect in the user community.

Characteristics of Innovations

There are several characteristics of the new technology itself which have been found to have a bearing on the rate of transfer. One of the most significant is the relative advantage; that is, the degree to which the new technology is seen as offering an improvement over existing methods. Economic profitability is a major criterion but there are several others, such as saving in labor (especially in unpleasant tasks), increases in prestige, or reduction in risk. The creation of an artificial advantage, however, as through a subsidy, frequently fails to accomplish the same effect.

Another characteristic that contributes to success is compatibility of the new technology with existing methods and infrastructures.

Complexity is a negative factor in adoption of new technology. The degree to which the innovation can be tried on a limited basis is a positive factor in adoption. Apparently, early adoptors consider this to be more significant than do later ones.

The degree to which the results of the innovation can be quantified and explained to others is a positive factor in increasing the rate of adoption.

NASA as a Change Agent

Since its organization, NASA has operated as a change agent; sometimes deliberately and sometimes without deliberate intent. As one of the nation's major developers of new technology it is reasonable to expect that NASA would be associated with technology transfer. It is perhaps fair to say (or so it appears to outsiders), that transfer has not been a primary NASA objective in the past, although emphasis on this has been increasing. Perhaps the most significant transfer of NASA technology, the development of commercial communications satellites, was accomplished with minimal effort on NASA's part. This is probably due to the fact that the relative advantage of using satellites for communications could be easily perceived by the potential users, in this case, the communications industry.

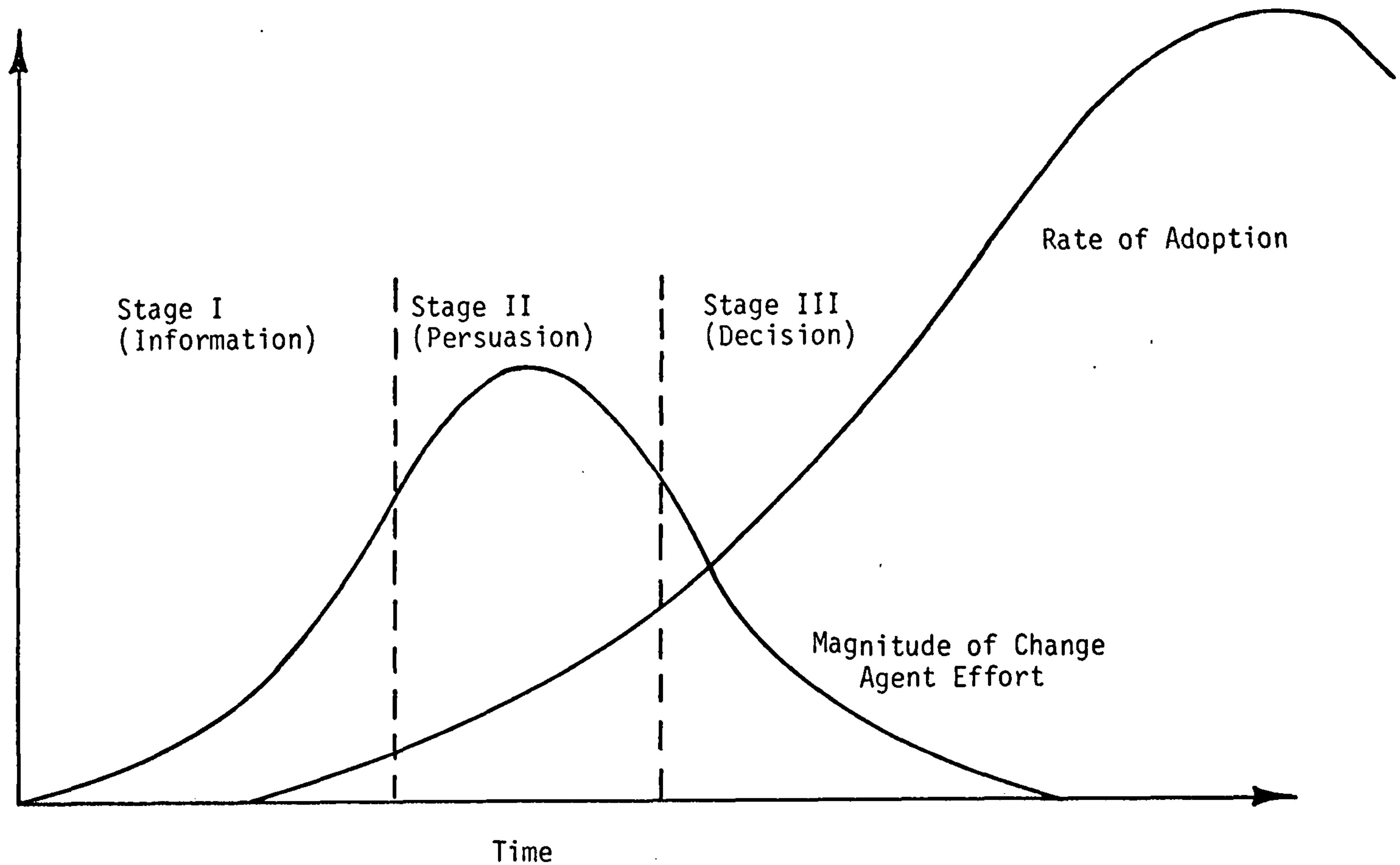

FIGURE 3. TIME PHASING OF CHANGE AGENT'S EFFORT IN ADOPTION PERIOD

Ref: Rogers & Shoemaker, OP. CIT., p 235

Among the more deliberate attempts at transfer have been the activities of the Office of Technology Utilization, which has pursued a variety of programs over the past 10 years to disseminate technology; primarily to the industrial sector.

As a change agent, NASA suffers several liabilities. For one, the technology with which NASA is primarily concerned is directed toward space activities. The benefits accruing to other sectors of the economy have been secondary to the primary mission. Furthermore, the technology is usually perceived as being very advanced and complex and this, as mentioned above, is an inhibiting factor in transfer.

Perhaps a more serious problem, however, is the lack of credibility which NASA has, especially with the industrial sector. We are not aware of any proper studies on this question but our experience suggests that NASA is widely distrusted among the non-aerospace U.S. industry. Industry feels that NASA is not concerned with their problems, does not understand their motivations, and takes unnecessarily expensive and complicated approaches to solving problems. A major exception to this is, of course, the aircraft industry, which has benefited in many ways from NASA activities and from the activities of NACA dating back to the early years of the current century.

Another difficulty is that NASA does not have a sole mandate as change agent, even in cases of purely NASA-developed technology. A case in point is the field of remote sensing. Most uses of remote sensing data require instruments and/or computers which are built and sold by industrial organizations. These organizations accordingly have a financial stake in diffusion of remote sensing technology. It is quite possible, then, that NASA's activities as change agent may conflict with or inhibit similar activities on the part of these equipment and service vendors. Thus, NASA tends to be confined to those activities which are not financially attractive to private industry. This, in turn, means that NASA is confined to those spheres of activity in which the benefits are small or substantially unknown.

Characteristics of Users of Remote Sensing Data

Battelle has recently completed a survey of the current users of remote sensing data for the Office of Applications.* Details will not be repeated here, but some of the features with the greatest relevance to the present study will be reiterated.

All user groups indicated a considerable requirement for user training and assistance. State, regional and local governmental users gave the strongest expressions of need. The most frequent users of LANDSAT data are industrial organizations, primarily in geology and geoexploration fields.

---

* G. E. Wukelic, et al., "Survey of Users of Earth Resources Remote Sensing Data", Battelle's Columbus Laboratories, May 1976, NASw-2800, Task No. 6.

The weakest user group was state, local and regional governments, and the weakest applications disciplines were water resources and environmental monitoring. LANDSAT data appear to be adequate for these purposes, but applications have not developed to any substantial degree. Agricultural, forestry and range monitoring are also not well developed, but this may be because of fundamental limitations in the data available.

Thus, it is clear that, in the remote sensing field, there are several user communities, and several different potential applications areas. The three user communities considered, and the five disciplines identified, give a total of fifteen different technology transfer problems to be considered.

The current positions of these fifteen problems are quite different. In some cases, such as geological surveys by private industry, transfer seems to be well into the early adopter stage. In several others, such as environmental monitoring, there is not yet a demonstrated capability. In selecting an operational focus for an SATC, careful analysis must be made of the specific transfer problem to be attacked.

NASA Industrial Applications Centers

Of the current NASA technology transfer activities, the one that seems most closely related to the Space Applications Transfer Center concept is that of the NASA Industrial Applications Centers (IAC). There are currently six of these centers, all contractor-operated and primarily concerned with transferring NASA technology to private industry. These centers have been in existence for about 10 years and they are generally viewed as having been rather ineffective.

The original objective for the IAC's was apparently that of information dissemination. They were literature search facilities covering both NASA literature and non-NASA technical sources. The centers carried out literature searches for clients and, in some cases, analyses of the findings. These were charged to clients primarily on the basis of cost of providing service; however, none of the centers were particularly close to being self-supporting from client fee revenues.

Five of the six centers are operated by universities and are headquartered on university campuses. The sixth is operated by a state government. One of the university-operated centers is currently being transferred to operation by a private, not-for-profit organization. The operating agency makes a contribution to the support of the center, so that there are three sources of revenues:

(1) Client fees
(2) Support by the operating agency
(3) Support by NASA.

Recently the IAC's have extended their range of services to include problem solving for the client organizations. In this they are approaching an operational concept which is analogous to that of existing contract research organizations and consultants. There have recently appeared various private organizations, in fact, which view themselves as being in competition with the centers. This augmentation in scope for the IAC's is apparently too recent to have made much change and a general evaluation of effectiveness of the modified program is not yet possible. However, the IAC's do keep records of new products and the cost savings generated by their activities, and have collected many testimonials to the value of their services.

Currently, consideration is being given to establishing several additional centers, primarily directed toward transferring technology to state and local governments and to the agricultural sector. While these additional centers have not been approved, their consideration forms part of the background against which the SATC's must be planned.

Other Related Activities

There are a number of activities of other organizations which, in various ways, parallel the activities of the proposed SATC's. The outstandingly successful activities of the Department of Agriculture have already been mentioned. In addition, the demonstration project operated by NSF to transfer technology to city governments is now more than half completed. ERDA is studying the institution of a network of regional technology transfer organizations, based on their existing major laboratories.

Of course, the regional sales offices for high-technology products also perform many of the functions which are proposed for the SATC's. They provide information to potential users and, in many cases, facilitate his trial of a new technology with minimal risks and they attempt to pursuade him to buy the technology-related equipment and thus adopt the technology itself.

SATC PROGRAM CONFIGURATION OPTIONS

Even a brief consideration of the problem indicates that there are many options available for organizing and implementing the SATC program. To facilitate consideration of these options, they are divided into somewhat independent groups. These groups can then be discussed separately. The major choices lie in four areas:

- Source(s) of funding
- Management and control
- Operation
- Degree of permanence and continuity.

There are a number of options in each area. These options can be combined in a very large number of ways, far more than can be analyzed within the scope of this study. However, it is feasible to discuss and compare the principal options within each category.

It will be convenient to take these areas in reverse of the order given above.

Degree of Permanence and Continuity

The choice here is between two major concepts. In the first, the SATC is viewed as a permanent organization with a permanent staff. It would deal successively with various Office of Applications' technologies as they mature to the point at which a regional center could be beneficial.

In the second concept, an SATC would be organized around a single technology and user group. When adoption has reached the point at which further change agent effort would be unavailing, the center (or at least NASA support of the center) would be terminated.

The first concept has the advantages that (1) it would probably be more attractive to potential operators, (2) it would facilitate recruitment of management and operational staff, and (3) it could bring to each new technology an established credibility based on prior work.

Among the disadvantages are the facts that (1) when a new technology comes along, the center may be in the wrong place, (2) it may have the wrong people, and (3) it may have the wrong management structure. Most significantly, it will have to start over with a new user community, with which there may be no existing rapport.

The second concept, in which NASA involvement with the SATC is temporary, removes most of these difficulties. A special-purpose center is created for each technology/user group combination of interest. It can be put in the right place, with the right people. Rapport with the user community could be quickly established.

The second concept raises another kind of problem, however. A potential operator is not likely to be attracted by a short-duration activity, nor are the proper personnel. There is at least one administrative device which could reduce this difficulty. Suppose, for example, that a separate corporation is created for the purpose of running the SATC. This corporation could be established by a NASA contractor. This operating corporation could receive NASA funding during the appropriate operational period, and at the proper time, it could be sold to the highest qualified bidder. During the NASA subsidy period it could be operated in such a way as to prevent serious criticism of private purveyors of analogous services. In fact, these "competitors" could be represented on the Board of Directors of the operating corporation. This type of operator will be discussed in more detail in a later section on the type of operator.

Operational Options

In this section, the third group of options is considered, the operational organization and operational concept.

Technical Scope of SATC's

The first problem in designing the SATC's is that of identifying the technologies which they should attempt to transfer. There are reasons why this scope might be less than the scope of activity of the Office of Applications and there are reasons why the scope might be greater.

In the first place, it seems almost axiomatic that only those technologies which have been adequately demonstrated and whose benefits can be perceived should be considered. NASA's credibility problems are quite large enough without dealing in unproven technologies. The SATC's might play some role in guiding the technology development programs in such a way as to meet potential user needs, but this would be a secondary function.

If this rule is to be followed, about the only candidate appears to be LANDSAT data. Several applications of these data have been demonstrated, and a few are in operational use. There has been extensive publicity concerning LANDSAT and, based on conclusions derived from the recent Battelle user survey, almost all of the potential users of these data are at least aware of their existence. Thus, the information stage of technology transfer is largely complete, for this particular technology. It is now into the second and third stages of persuasion and decision in which a change agent should be most effective.

However, considering only one technology in design of the SATC may be too restrictive. In the process of seeking out and working with users for remote sensing data, the change agents will doubtless encounter user problems which will require other types of NASA technology or, in fact, non-NASA technology. It would not be desirable to tell the potential user that the center could not help with his problem because that would involve another portion of NASA, another part of the federal government or private industry. It would, at a minimum, be highly desirable to have a referral mechanism so that the SATC could insure that the users' needs would be met when they do not fall within the sphere of remote sensing. The IAC's do not have any restrictions on the field of technology in which they operate and there would be definite liabilities if the SATC's could offer help only in a small number of technical areas.

That is not to say that the SATC's would need to offer a full spectrum of services in all technologies, but they would likely be viewed by the users as a representative of the Federal government, and it is desirable that they be prepared to fulfill this role at least to some substantial degree.

Geographical Scope of SATC's

The second question is that of the geographical coverage which a single SATC should attempt to provide. The fundamental reason for a regional center as opposed to a single national center has to do with travel, both on the part of the change agents and on the part of the potential users. The effectiveness of a change agent increases as the number of potential users with which he can interact during a given day increases. Also, if the center is providing facilities (such as computers and graphic terminals) for the user to try the technology, the center should be within a reasonable travel distance of the user. This suggests a region with a radius of perhaps 200 to 300 miles. Travel studies have shown that this is the distance at which automobile travel tends to become unattractive, and therefore a trip becomes a significant investment.

If SATC operational costs are the major consideration, then a single national center would be indicated. It would be possible to concentrate equipment and personnel at a single site and impose travel requirements on users. This minimuzes NASA's investment, but at the expense of effectiveness in carrying out the transfer.

It can be noted that, among the existing IAC's, the one in New Mexico has been designated as the center for remote sensing activities. This center has not been particularly successful in promoting utilization of remote sensing data, perhaps in part because it is remote from most of the nation's major activity centers, and the area that it covers is extremely large.

Type of Location

It is not the purpose of this study to address the question of the actual location of one or more of the SATC's, but it is possible to give some of the considerations associated with the generic type of location. Should it be at an existing NASA field center, should it be at an existing Federal complex, should it be in a major metropolitan area, etc.

Establishment of an SATC at an existing NASA facility or at a Federal complex offers substantial cost advantages, at least as costs are currently perceived. Many types of overhead are either buried or absorbed by another organization. There are, however, liabilities in terms of effectiveness in dealing with users. These liabilities are particularly heavy in the case of NASA installations. Visitors must obtain passes for themselves and for their automobiles. Parking is frequently a severe problem. The entire facility is surrounded with an aura which may be quite forbidding. Other Federal complexes share these liabilities, though to a somewhat lesser degree.

Location on a university campus has certain advantages in terms of cost also. If the facility is operated by the university, low academic overheads may result in a very attractive cost situation. However, this location also would be unattractive to many kinds of users who distrust academic institutions almost as much as they distrust NASA.

It may be helpful to observe that commercial organizations who wish to work with clients select a location as close as possible to the prospective users, with good parking and access, and bright modern surroundings and furnishings. If the facility is to be used only as a base for salesman, however, it can be located almost anywhere and need not be particularly attractive. If a major objective is to display equipment or to obtain user participation, convenience and attractiveness are major criteria. To the extent that the SATC's are designed for use by users the same considerations should apply.

Type of Operator

The principal options for operating the SATC's are:

(1) NASA itself, either headquarters or a field center
(2) A university
(3) A not-for-profit contractor
(4) A for-profit contractor
(5) A vendor of equipment related to the technology in question
(6) A special-purpose operating corporation.

Considering first the NASA option, there are several advantages. The cost would be perhaps 30 to 50 percent less than that of a contractor operation, depending on whether a NASA facility was used for the location. Also, the fact that SATC personnel could be reabsorbed into other NASA components would be an advantage if it is necessary to terminate the program. The SATC must be viewed as an experimental program, and job security for the personnel is something of a problem.

On the other hand, use of NASA personnel would rate low on the effectiveness scale. It seems unlikely that NASA could recruit and retain the types of people who could function effectively as change agents. A strong user orientation is required, and it is doubtful that NASA management would succeed in providing this based on past performance.

University management is the route that was selected by the Office of Technology Utilization. It also has cost advantages and, in the case of the IAC's, the universities have, in fact, made contributions to support. If such arrangements could be completed for the SATC's the cost might well be half that of a standard contractor operation.

Again, however, the effectiveness of the operation might well be compromised. Much depends on the concept the university chooses to follow. If they elect to use tenured faculty in management positions, turning primarily to faculty members for consultation, and employing students for much of the actual work, the rapport with user communities would be poor.

If, on the other hand, the university elected to hire personnel specifically for this task and attach them to a university-related research institute with substantial independent activity, effectiveness might be relatively high. However, the current climate in the university community seems to be one of moving away from this latter type of activity. It does not contribute strongly to the universities' main functions and there is growing distrust of activities undertaken solely or primarily for the purposes of generating revenue.

For-profit and not-for-profit contractor operations have a number of characteristics in common. Cost would run from 60 to 100 percent higher than for the NASA and university options, but in terms of effectiveness, there are several advantages. First, the location is much more flexible. The center could be located close to the users, without constraints as to locations of existing facilities. Also, the proper accessibility and surroundings can be selected. Perhaps most important is the fact that contractor operation should make it easier to obtain credibility and rapport with the user community. If a user is dealing with Contractor X, his initial impressions tend to be formed by what he knows about Contractor X, rather than what he knows about NASA, even though Contractor X is working for NASA. A contractor, especially if he is accustomed to dealing with the user group in question, will be better able to recruit (or adapt from experienced staff) and retain the type of staff which will be successful. He will be better able to understand the needs of the user community and to communicate with that community.

However, it should be noted that the user community with which the SATC deals will not always be the same one. When the transfer of a technology reaches a certain point, the SATC will decrease or eliminate its effort on that technology. It will presumably begin work on new ones. Therefore, the operator should, if possible, have ties to a number of different user communities, and be widely respected, if he is to move among different fields.

Most not-for-profit organizations will be able to establish a respect for proprietary user considerations. Many for-profit organizations can do this also, especially if they are known not to be competitors of the users. Non-manufacturing firms might be better in respect to proprietary problems than manufacturing firms. If the contractor has any manufacturing interests, even in a field unrelated to remote sensing, it could be that in the future, as other Office of Applications technologies mature, a conflict of interest could arise between the operator and some new community of users. A non-manufacturing firm should, however, have experience in dealing with manufacturing firms, or it will be difficult to establish the credibility and rapport required.

There is one type of contractor operation which deserves special consideration: operation of the SATC by the same contractor who operates an IAC. There are certainly significant cost and administrative advantages to this option. Overheads would be low, and the operators are presently contributing to IAC support. The organizations and personnel are already in place, and they have a performance record which can be evaluated. The IAC's are involved in most of the types of functions which the SATC would perform, so learning and start-up time should be minimal. Another advantage would be the fact that the IAC could provide a ready-made solution to one of the problems posed earlier: what to do with a user problem which falls outside the scope of Office of Applications technology. The IAC's already deal in a wide range of fields, including some outside NASA's purview.

The disadvantages are several. First, the IAC's have not dealt with state and local governments, which are one of the more significant groups of potential users of LANDSAT data. This disadvantage should not, however, be particularly serious.

The location of the IAC's might be undesirable, depending on the user communities selected for transfer. The university setting has already been mentioned as a negative factor. As for credibility and rapport, there seem to be mixed opinions. Certainly, for some years, the IAC's did not have outstanding credibility with industry. It may be that this is changing in recent months, but the older impression will remain in many circles for some time.

If transfer of Office of Applications technology is only one of the responsibilities of the IAC (as it is now), there might be some question as to whether it would receive the attention and priority that the Office of Applications might desire.

Next, there is the possibility of having the centers operated by vendors of remote-sensing-related hardware, or companies engaged in selling services to users.

The costs here would be about the same as for other for-profit or not-for-profit contractors, though there would be some possibility of cost-sharing on the part of the operator, especially where equipment costs are concerned. Credibility and rapport should also be good, as these vendors are already familiar with remote sensing and are experienced in dealing with users. In fact, they are already engaged in technology transfer on their own account.

The problem with this option is that selection of one such company to operate the transfer center would give him a Government-subsidized advantage over the rest. If an appropriate industry-wide association existed, dealing with that association might remove this difficulty, though there are a number of other problems here also. Even if these were overcome, there remains the factor that the next technology which becomes ready for application might have nothing to do with remote sensing, so that a different operational entity might be needed.

The final concept is that of a special-purpose corporation, created specifically for a certain technology/user group combination. From the standpoint of the users, this could be close to ideal. During the information and persuasion stages, the user would receive subsidized treatment. After decision, he could receive competitively-priced assistance from the same source. This should be satisfactory to the service-to-user industry, if certain operational doctrines are followed:

(1) The plan for the operational corporation is understood by the service-to-user industry from the outset

(2) The service-to-user industry is represented on the Board of Directors and has reasonable access to data on operational performance

(3) The service-to-user industry is informed of each "sale", i.e., adoption by a user

(4) The service-to-user industry can make inputs to the center's pricing structure for post-decision services

(5) When the corporation is to be sold, profitability data are available to qualified bidders.

This concept should also be attractive to NASA in that it is extremely flexible. NASA's commitment is limited, and there is a reasonable prospect of recouping a fraction of expenditures at the time of sale.

One disadvantage, from NASA's standpoint, might be that it would be difficult to maintain identification of the centers as NASA activities in the public mind. Eventual buyers of the corporation would rather not have a "NASA label" strongly attached. As argued below, however, this may be undesirable in any case. Another disadvantage is that this concept is somewhat lacking in precedents. There would be policy and legal problems to be overcome, and mistakes could be made.

Degree of Identification with NASA

In designing the SATC program, one key issue is the amount and type of identification that the centers have with NASA. In part, this will depend on whether the centers are funded jointly with another Federal or non-Federal agency.

In either case, there are two types of identification to be considered: (1) identification as seen by the OMB and the Congress and (2) identification as seen by users and potential users. In the first case, there seems little question that it is in NASA's interests to have OMB and the Congress fully informed about the achievements of the centers, and NASA's role in those achievements. The principal question relates to user identification.

It would appear that NASA's main concern here would be to assure center success. The question is one of whether a high NASA profile or a low profile would make a greater contribution to this end. Based on extensive contacts with industry and governmental organizations, it is our perception that centers would have a better chance if not burdened with the presently negative NASA image. The new center would have to start with a zero image, but this would be a better approach. Once the centers become successful, NASA could draw some public credit from them. Initially, however, the NASA label would be harmful.

Pricing Policy

The SATC's will be performing various kinds of services for different user groups. Presumably these services are of value, so the question arises as to what charges, if any, should be levied against users, and what should be borne by NASA.

If NASA operates the SATC's, it seems clear that both Federal and NASA policy would apply to the pricing policy. The User Charge Statute of 1951 set general guidelines for reimbursement which are so vague, however, as to offer limited guidance. Bureau of the Budget Circular A-25, dated September 23, 1959, provides some clarification of the User Charge Statute. This circular states that:

> "Where a service (or privilege) provides special benefits to an identifiable recipient above and beyond those which accrue to the public at large, a charge should be imposed to recover the full cost to the Federal Government of rendering that service."

This indicates a charge based on recovery of both direct and indirect costs, that is to say overheads should be included.

The Circular also empowers the heads of agencies to exempt certain users from charges. These users include state and local governments and certain nonprofit groups.

NASA policy on this question is exemplified by NMI 9240.1, "Reimbursement for Expendable Launch Vehicles and Other Services which are Associated with Space Flights and Provided to Non-U.S. Government Users", February 2, 1976. This Management Instruction also calls for full cost recovery, including overhead, and gives general guidelines for computing the overhead rate to be used.

NASA policy on pricing for other Federal Government users seems less definitive, but in general, it appears that reimbursement by another Federal agency is less than that implied by the full-recovery doctrine applied to non-Government users.

NASA is currently formulating a charge policy for the Space Transportation Systems. In this formulation, the same group of issues is being considered again, and it may be that additional policy statements will be forthcoming soon.

If NASA does not operate the SATC's directly, but uses a contractor, it may be that somewhat different principles could be applied. However, it is also arguable that, so long as public monies are supporting the operating deficits, Federal and NASA guidelines should be followed.

In general terms, there are four types of pricing policy which are commonly considered:

(1) Full subsidy (no fee charged)

(2) Marginal pricing (fee covers only the extra or marginal cost of providing the unit of service in question)

(3) Fully burdened, no capital recovery (marginal costs are included along with full overhead, including fee if appropriate, but no recovery of capital or R&D costs)

(4) Fully burdened, full capital recovery (all costs are recovered, including cost for developing the technology and implementing the center).

The last policy is typical of private industry, but there is little precedent for it in the pricing of publicly provided services. There is ample precedent for each of the first three, however.

Considering only the first three policies, it is clear that the choice will depend on the type of user and the type of service. Considering the service first, those activities associated with informing potential users about the technology, and persuading them to adopt it, should probably be largely free to all user groups. Precedent in both public and private sectors is strongly in this direction.

Routine services, on the other hand, and unusually expensive demonstrations, might be subject to charges. If NASA's only interest is in maximizing adoption of the technology, pricing should not be above marginal, or some potential users could be dissuaded by cost considerations.

This cannot be NASA's only interest, however. If private competition exists for the SATC's, a marginal pricing policy on NASA's part would tend to force the competiton out of the market. This would likely not be palatable to the Congress. In fact, SATC pricing much below fully burdened (including a reasonable fee) would probably draw criticism. Since the competitors' R&D costs would be well below NASA's, the difference between Options (3) and (4) for them might not be large.

In the case of users which are public organizations (state, local or regional authorities), full subsidy for all services could be defended. In view of the prevalence and acceptance of Federal cost-sharing, state and local governments might hope for no-cost service, and at least might expect marginal pricing. If NASA adopted a pricing policy in this range, and provided service quality equal to that available from the private sector, the state and local market would be taken away from the SATC's competitors. Conflict would thus be seen between the expectations of the public users and the private purveyors of technology.

Also, if NASA does eliminate private purveyors from this market, and subsequently decides to withdraw the service altogether (as by closing the SATC), even stronger objections would be forthcoming from the public users.

To add a further point of view, conventional economic theory would suggest that pricing below fully burdened plus full capital recovery would distort resource allocation and cause undesirable redistribution of income. It should be clear that there is no totally satisfactory pricing policy for the SATC's.

Types of Personnel

It seems clear that there are two principal types of personnel needed in the SATC's. For convenience, these might be labeled "sales" and "technology" personnel. The sales personnel would be responsible for making initital contacts with new users, analyzing their problems, mobilizing appropriate resources and following through the transfer process. The technical personnel would be used as required to interface with similar personnel at the user's organization, and would purvey the actual technology.

The major factor in success or failure of the SATC concept would be the sales personnel. Their characteristics have been suggested in the previous discussion of change agents. They should be able to deal with people in various levels of the user's organization. They must be able to establish credibility for the SATC and for NASA. They should have a knowledge of technology and a knowledge of business practice or government administration (depending on the type of user considered).

This is a formidable list of requirements. For the most part, people with these attributes are difficult to find at a price which would be reasonable. The ability to deal with decision-makers in user organizations would require a substantial degree of maturity. Such personnel might be found among recent retirees from Government, the Armed Forces, or industry. If they are interested in the process of technology transfer, they might be highly effective change agents, and costs might not be excessive.

Operating Concept

The two principal operating concepts which have been used in regional centers could be described as passive and proactive. The first puts the major burden on the potential user to seek out the center and use its services. The second puts the burden on the centers to seek out the users and bring them in. A department store is an example of the first, and a regional sales headquarters is an example of the second.

The passive concept is cheaper and easier to implement. It places less stringent requirements on personnel. On the other hand, it seems to be a nearly universal opinion that it is less effective in purveying technology. Virtually all companies dealing in high-technology hardware use the proactive approach, and it is what user organizations have come to expect.

If the proactive approach is selected, the salesmen or change agents would need to keep in mind that the adaptation of new technology by the industrial sector is dependent on a variety of factors, the most important of which is usually economic justification. Since the motivation for private industry involvement (profit) is different from that of the government sector (public service) and the scientific community (scientific advancement), different techniques are required for interacting with this sector. Basic to commercial involvement are fundamentals which are at times overlooked in the rush to develop the technology itself. First, an assessment of the various potential user communities and applications of the new technology within these communities must be made. This begins within a general framework, and progresses to a detailed analysis of the specific deliverables and their economic worth to a particular user. This is an important point. The user has no means whatever of assessing the value of a system unless he can approximate specific end products and their cost. This is also a primary reason that users are having difficulty considering how they might benefit from remote sensing.

The second fundamental point is that user involvement is mandatory, from the early stages of the transfer process. The specific needs and problems to be resolved should be developed with the potential user's participation so that the results are meaningful to his organization. NASA has been perceived by various industry groups as insensitive to the needs and unaware of the real variables and major problem areas of their industry. Cases of using aerospace companies to analyze the needs and problems of other industries, without ever directly involving those industries, are recurrent. The potential end user literally must be directly involved in the developing technology at as early a point as practicable, to insure his adaptation. Insuring this involvement requires a carefully considered strategy and implementation plan for each user, as discussed below.

The third point is that ongoing organizational mechanisms must be established between NASA and the potential user to respond to the potential user's information needs, encourage his participation, and identify and resolve problems in a timely manner. Industrial organizations, in many cases, are not accustomed to the methodology and bureaucracy present in dealing with government agencies, and this must be recognized as a potential problem area.

A number of industrial marketing techniques were utilized by Battelle in the Phase II development effort of new commercial users for the STS, currently a major NASA thrust (Contract No. NASA/MSFC NAS8-31621). The similarity of the technology development and transfer required in remote sensing to the STS new user development effort indicates that the general approach to involving the private sector and securing commitment for further action is applicable. Based on the STS program and similar efforts, including Battelle's own industrial market development experience, the following paragraphs outline what Battelle feels must be included in involving a commercial user in a new technology. In the referenced effort, an overall strategy was developed and refined which involved constructing profiles of the various user communities, defining specific applications of STS which fit needs of specific companies in each community, assembling an information package on STS and the application, delivering this package in a brief one-hour presentation, and then opening a discussion. The key elements of the strategy were determination of an STS application to a known need, assessment of benefits, high-level executive involvement, direct contact and discussion to determine specific areas of interest, major problems, and follow-on activities. Each specific user was considered a different case, and each user's comments were carefully considered as the basis for determining further activity with that user.

Insuring potential user involvement in the development technology requires a strategy which is oriented toward personal involvement and interaction between organizations. Such a strategy necessitates a detailed understanding of the industry, the company, specific applications of the technology to the potential user's need, benefits derived, and major problems to be overcome. Preparation for interacting with an organization prior to actual involvement includes developing at least the following background:

- User community profile
  - Structure, major organizations, agencies, trade associations and interrelationships
  - Markets and key products
  - Current level of technology employed
  - Prior involvement with space/NASA
  - Anticipated major problems and opportunities

- Specific organization profile
  - Financial, technical orientation, specific problems
  - Match of use area known needs
  - Cost/benefit of specific application
  - Identification of initial contact (location/person, etc.)
- Initial information requirements
  - The technology; description, background, capabilities, range of applications, etc.
  - Policy, cost, availability, timeliness, proprietary considerations, etc.
  - Specific user area of interest, technical overview, costs/benefits.

Once the background material has been developed and studied, initial contact is made, usually with a key executive in the user organization. Research personnel, middle managers, and so on, may be called on in order to gather information and develop internal support, but they cannot (and consequently will not) commit the organization to action. An initial meeting is set up (by telephone) by convincing the executive that what needs to be discussed is valuable to the organization and requires his level of attention. A letter to the executive restating the objective and format of the initial meeting may be in order, after the meeting date has been established by phone. The executive will determine who in his organization should attend the meeting, but in any case the group should be small. A good working group would comprise three technology representatives and six members of the potential user's organization.

The format of the meeting is one that encourages discussion. The information outlined above is presented in under one hour. Then discussion is encouraged. The objective is to determine:

- Most viable application areas for the user
- Major problems to be overcome
- Specific follow-on activities: what, when and by whom.

It is appropriate after the meeting to evaluate the contacts (were they the real decision makers?); the techniques employed; whether timing was appropriate; whether the information presented was valuable, too detailed or general; proper subjects; and information gathered in the discussion. This will allow refinement of the strategy for other organizations in the same potential user community, and will assist follow-on activities with the organization itself.

The actual development of the potential user, once the initial meeting has been held, is an activity dependent on the establishment of interaction mechanisms within both organizations.

Efforts in the early stages of developing potential users for STS showed a need for a single interface within NASA that could communicate with the entire NASA organization as required. In fact, NASA has employed a similar technique in the host concept at KSC, for example. Such a sponsor representative may be desirable. At a minimum, procedures for timely interaction with the developing user are requisite.

The potential user involvement process must be ongoing and iterative. It requires progressive direct contact and interaction between the change agent and the target organization. Techniques such as questionnaire, telephone survey, and others, may be useful in gathering background information essential to the user involvement effort, but they must be applied and evaluated in a carefully considered manner. It has been noted, for example, that the offshore oil organizations did not respond well to being asked what they would like to see in SEASAT follow-on. In fact, this was counter-productive, since they expect NASA to directly relate capabilities of SEASAT to known needs of the industry, and tell the industry what NASA can do for them.

In summary, the process of involving potential commercial users in a developing technology is not particularly difficult, but it must be strategically planned. Learn as much as possible about the user and the business environment in which the organization operates. Determine, together with the user, the specific needs of the organization, the match of capabilities to these needs, and the problem areas to be overcome. Construct the framework of interaction between the two organizations. Finally, monitor progress, remove major obstacles, and maintain a user orientation to ensure continued support of the program.

If the transfer process can be initiated with a certain user organization, there remains the question of what services the SATC's should provide in order to carry the process to conclusion. The first stage in the transfer process, that of knowledge, can be accomplished by the change agent himself, or it can even be accomplished, though less effectively, by brochures and symposia. The question is what degree and type of support should be provided for the change agent in the critical persuasion and decision stages?

It seems to be highly important to be able to show the potential user what the application of the technology involves. This is best done by hands-on demonstration using real equipment, and examining a problem of interest to the user, if possible. The same types of equipment can also provide the user with a means for low-risk trial of the new techniques. As mentioned above, this has been shown to facilitate adoption. Provision of this equipment would entail capital costs of the order of $500K. Given a reasonable scale of operations, this cost element should be less than manpower costs, but the contribution to effectiveness of the center should be quite substantial.

A major problem in operating the SATC's is the relationship with the service-to-user industry; the purveyors of goods and services related to remote sensing. Part of the problem relates to pricing policy, as discussed above, and part to the operational concept. Once a user makes a decision to adopt the new technology, he will be in the market for equipment and/or assistance in implementing the decision. If the SATC provides this, as, for example, in making computer facilities available at nominal cost, there is a possibility that the service-to-user industry will be deprived of potential revenue. The SATC, then, is in the difficult position of trying to stir up interest in the new technology, but getting out when it begins to become profitable.

One approach would be to terminate subsidy to each user when he makes the decision to adopt. So long as he is in the persuasion stage, that is to say he is forming an opinion relative to the technology, it is reasonable to provide him with services and support below cost. This is accepted practice for vendors of equipment and ideas, so that the potential user would expect this. The service-to-user industry would hardly object to NASA's activities of this type because they are not profitable.

During this persuasion stage, typical subsidized activities would include: (1) informing the potential user about experience of other similar users who have decided to adopt, (2) demonstrating application of the technology to problems of the types encountered by the potential user, and (3) demonstrating application of the technology directly to one of the potential users' own particular problems, preferably one which has been previously addressed by more conventional techniques.

At some point, the potential user makes a decision to adopt or to reject. In the case of an organizational user, there may be several echelons of decision-makers involved in the decision. In such cases, all levels would have to agree with the adoption, before it could be said that an affirmative decision has been made. So long as some relevant echelon remains unconvinced, the persuasion stage continues. If this persists for a sufficiently long period, the SATC will be forced to conclude that a de facto negative decision has been made, and the persuasion period terminates.

If a favorable decision is rendered, it may be that the SATC would then adopt a different attitude toward the user in question. The user has formed a favorable opinion of the technology and has decided to adopt it. He would now be an ideal customer for those organizations providing goods and services on a for-profit basis. The SATC could be viewed as offering competition, and possibly publicly subsidized competition, for private enterprise firms. It seems highly desirable to avoid this posture if at all possible.

There are several options for SATC policy at this point. The principal ones are:

(1) Refuse to deal with the users in any way, once a decision has been reached

(2) After decision, refuse SATC service but assure availability of an alternate source

(3) After the decision point, make further dealings with the SATC undesirable by raising the price higher than that charged by commercial firms, or by reducing the quality of service well below that of commercial firms, or both

(4) Offering price and quality similar to that of commercial firms, and letting the users make the choice.

(5) Having all SATC services (subsidized or not) provided by a service-to-user contractor from the start, and withdrawing the subsidy after the decision point; the service would appear to be the same before and after the decision, except for price.

The first option, that of severing relations with a user, once he has made a favorable decision, is almost certain to raise the ire of some users. They would feel that NASA had failed to follow through. Also, if a mistake is made by the SATC in determining whether a decision had been made, the mistake would probably be irretrievable.

The second option, which provides an alternate commercial service, would be substantially more palatable, and it is relatively easy to administer. It would be possible to furnish the name of the user to all service-to-user companies which agree to meet certain standards of service, and further relationships would not involve NASA at all. The user would, however, be faced with changing the source of service to which he had become accustomed in the persuasion period.

The third option, that of motivating the users to abandon the SATC by high price and/or poor service, would at least permit the user to continue in an accustomed pattern. It is, however, contrary to current Federal policy on reimbursable activity, at least with respect to pricing above cost.

The fourth option, offering "fair" competition to the private service-to-user firms, maximizes the choices open to the users, and would probably be the most desirable from their standpoint. However, it will be a difficult administrative problem to keep prices "equal" to those of the private firms, as their price structures will inevitably differ. Criticism from the service-to-user industry would be almost certain.

The fifth option, using a service-to-user firm to provide all SATC services, and subsidizing the pre-decision services, would also appear to be desirable from the user standpoint. The user would have continuity of service, with only a price increase once he decides to adopt. There are administrative problems here, however. Not only would it be necessary to select the service-to-user firm in open competition, and to re-compete periodically, it is almost inevitable that NASA would have to set pricing and service standards for this contractor, and to change these from time to time. This type of regulation will put a substantial workload on NASA, and will be a source of friction, both with the selected contractor, and with the remainder of the industry (the selected contractor's competitors).

In selecting among these options, NASA will be concerned with stimulating and preserving the service-to-user industry (which will provide most of the operational capability) but at the same time with protecting the users' interests. These interests include:

- An assurance of continued availability of service
- Fair pricing of the goods and services offered (minimal interference in the free market between users and vendors)
- Preservation of the user option of internalizing the technology, i.e., buying the necessary hardware, and training his own people to apply the technology (the service-to-user industry might tend to make this option more difficult).

It should also be kept in mind that SATC involvement in transferring a particular technology will be limited in duration in any case. Provision of routine services could, of course, continue. Once adoption has reached 30 percent or more, change agent activity should terminate. If users have to look elsewhere for assistance at this point, they are not so likely to feel abandoned. This should be a relatively painless way to sever relations.

Evaluation Techniques

The problem of evaluating the performance of an SATC has two aspects: (1) who should do the evaluation and (2) what characteristics should be measured for evaluation and monitoring purposes. Considering the second question first, it can be observed that the major objective of the program is to bring about adoption of the new technology. Especially in the early stages, however, even a successful program may not show many adoptions. Accordingly, monitoring the adoptions alone would be misleading.

In evaluating the early stages of a technology transfer process, it would be necessary to focus rather on the level of activity and the quality of the activity. How many contacts with potential users are being made? How many contacts are with the decision-makers? How many contacts are repeats, showing increased levels of interest? How many potential users are involved in demonstrations? How many in joint experiments? What is the standing of the interested potential users within the user community? What fraction of the total user group has been informed? What fraction has been contacted, etc.

The monitoring agency could be: (1) the SATC operator; (2) a NASA agency, either the Office of Applications or a field center; or (3) another contractor retained specifically for the purpose of evaluation. The first option is probably the least expensive and the simplest. However, self-evaluations may lack the required degree of credibility. NASA evaluation would also be relatively simple and inexpensive, but might be lacking in effectiveness because NASA personnel might not be prepared to make appropriate judgmental evaluations, especially during the early stages of the transfer. An evaluation contractor, if properly selected, could probably perform well, provided the potential problems of friction with the operating contractor can be surmounted. This approach would, of course, be substantially more expensive than the other two.

Implementation Strategies

The actual method employed in setting up the SATC's will, of course, depend on the choice made of the type of operator. In this analysis, NASA operation is not considered. The general problems for all of the contractor-operated options are rather similar, so most of the following remarks would cover all of them.

Once the general location, operational doctrine and technology scope for the SATC's have been selected by NASA, and a decision has been made for contractor operation, the general nature of the contractor relationship must be established. What duration of contract should be employed, what renewal options should be stated, what performance requirements will be laid on the contractor, etc.

As for the length of contract, it seems necessary to consider a 3-year period at a minimum, with a rather strong presumption of renewal, if performance is satisfactory. If the time span is shorter than this, the operator will have difficulty in recruiting appropriate personnel, especially the salesmen or change agents. Individuals of the type required need to have some reasonable assurance of continuity of employment. It would require from 3 to 6 months from contract initiation to get an SATC fully operational, and it would require at least 2 years of operation to permit an adequate evaluation of its effects.

An initial contract period of 5 years or more would probably be excessive, as this time is long enough for the SATC's role in transfer to be completed, and the center might be left for a time without a mission.

If more than one SATC is to be implemented, it is necessary to consider the questions of relative timing in opening the various centers, and whether the different centers should be operated in the same way. As to the timing question, there does not appear to be any strong reason for allowing time to elapse between opening successive centers unless the time difference is of the order of 4 years or more. A spacing this long would permit lessons learned in one center to be applied to the design of the next. If this spacing is felt to be too long, there is little reason, from either the cost or effectiveness standpoints, to space the initiation of centers.

There may be budgetary or administrative reasons, however, for spacings on the order of 1 year. There will certainly be substantial one-time costs associated with each opening, and it may be desirable not to have two openings in the same fiscal year. Also, the administrative workload on NASA might be unworkable if two or more centers are opened nearly simultaneosly.

As for operating doctrine, there are two major choices. They could be the same, or they could be different. If they are the same, there would still be differences in personnel and differences in geographical region which could cause differences in results. The number of centers which could reasonably be envisioned is not large, possibly of the order of a half-dozen. The first two or three would be the critical ones in determining the success of the program. With numbers this small, and with the large number of factors which could influence the outcome, it seems unlikely that a really satisfactory "experimental design" could be developed.

Still, if there is a common thread running running through the history of innovation, it is that many paths are tried, and only a few are successful. This suggests that multiple approaches should be used in the SATC program as well. When some centers succeed, and others fail, it will not always be possible to be definite about the reasons, but it seems probable that the essential causative factors can be identified with some confidence, though only after a trial of several years.

Accordingly, there appears to be merit in using different doctrines of organizations for different centers. These differences could be in the type of operator (NASA versus contractor), the type of user community being considered (industry versus government), or the disciplinary area (land use versus geology), or various combinations of these. These choices are coupled to each other and all are coupled to the location of the Center.

Management and Control Options

There are also many ways for handling the management of the SATC program. Some of these are the following:

(1) Code E alone

(2) Code E jointly with Code KT

(3) Codes E and KT jointly with another Federal organization

(4) Code E jointly with another Federal organization

(5) Code E jointly with some regional authority

(6) Code E jointly with another Federal organization and a regional authority

(7) Another NASA component, e.g., Field Center.

Other types of combinations are possible, but discussion can be confined to the merits of sole Code E management versus joining with other organizations considered singly.

The major advantage of Code E alone is, of course, that the entire effort is directed toward Office of Applications objectives, and administration is simpler. To offset this, each of the other combinations offers some type of benefit.

Joint management with Code KT would offer the advantages that: (1) internal coordination of NASA technology transfer activities would be better, (2) there would be better prospects of meeting user needs for technology outside the Office of Applications' interests, and (3) there are possible cost savings in joint management.

Joint management with another Federal organization would have to be based on a mutual interest in the particular technology or user group being emphasized. Near-term cost savings are possible, but such alliances would tend to be short-lived because of NASA's changing interests. If, however, the special-purpose corporation option is selected, joining with another Federal organization for management would be most reasonable.

Joining with an appropriate regional authority might be a good mechanism for enhancing the credibility and the user responsiveness of the center. Everything would depend, however, on finding a regional authority with a mandate and an outlook which are consistent with the technology/user group being considered.

The last option, that of turning SATC management over to a Field Center, seems to have few advantages other than administrative simplicity. In most respects, a Field Center has the same liabilities as a manager as it would have as an operator (discussed above).

Funding Options

The most probable funding combinations seem to be:

(1) Code E alone

(2) Code E jointly with Code KT

(3) Code E jointly with another Federal organization.

The advantages and disadvantages of those funding combinations are roughly parallel to those presented above for the same combinations in a management role.

OTHER METHODS FOR ACCOMPLISHING TECHNOLOGY TRANSFER

The final topic to be considered is the relationship of an SATC to other methods of technology transfer, and whether in fact there might not be some better way to accomplish the objectives for which the SATC is designed.

Considering the totality of technology transfer activity, it is clear that there are many different types of situations, with a correspondingly wide diversity of preferred methodologies. The principal variables are the characteristics of the new technology itself (and the relationship it has to existing methods) and the characteristics of the user or adopter community.

In some cases, as with communications satellites, the advantages of the new technology were so strong and so clear to the potential users that transfer took place with little or no conscious technology transfer effort. In this case, the user community was a small number of large communications companies. Even if the number of users is large, however, an overwhelming technical advantage may render transfer easy, as in the case of xerography.

On the other hand, there are instances in which the technological advantages were overwhelming, yet transfer was quite difficult, as in the case of hybrid grains, especially in lesser developed countries.

In the majority of cases, however, the new technology does not have such an overwhelming advantage, especially in the short run, when changeover costs are considered. In these cases, a deliberate program will usually be required to accomplish the transfer. This program can take many forms.

If the user community is small, as in the case of industries dominated by a few large firms, an SATC as described here would not be appropriate. The small number of contacts to be made would not place much of a travel burden on the transfer agent, regardless of where he is located. Pricing policy would be less of a factor, as would demonstration and training equipment. An SATC would make sense only in cases in which the user community has numerous members (dozens or hundreds) within a reasonable travel radius (250 miles) of the center location.

Even when this condition is met, however, a regional center is not the only possible approach. Several other techniques have been applied by NASA and others. These include dissemination of information through various media (including special mailings, technical and trade journals, news media and advertising) and regional and national symposia and/or workshops.

NASA has used all these approaches in the past, and it is generally agreed that, for whatever reason, technology transfer has not been especially effective. There are two possible reasons for this: (1) the technology itself is not attractive or (2) the transfer activities have been inappropriate. It is difficult to choose between these two reasons on any objective basis, but it can be observed that NASA has developed so much technology that it seems unlikely on its face that all of it is unsuitable for application.

If, then, it is hypothesized that the problem lies with the transfer activities, then the question is to identify what is wrong in this arena. A review of the stages of adoption suggests an answer. Of the four stages--knowledge, persuasion, decision and confirmation--past NASA activities have addressed primarily the first. Insofar as LANDSAT data are concerned, in the course of the Battelle survey we gained the impression that virtually all potential users had heard about LANDSAT, and knew, at least in a general way, what its capabilities are. This suggests that NASA's past efforts have been fairly effective in completing the first stage.

What is missing is a follow-through to the persuasion and decision phases. It is almost universally believed that this is most effectively done by face-to-face, one-on-one contact with individual users, usually with repeated contacts over a period of time. The only cases in which this approach is logically rejected are those in which the costs to the transfer agency would be higher than the benefits accruing to the transfer agency.

Virtually all expensive high-technology equipment is sold in this way. The success of this approach in the agricultural field has been spectacular, both in the United States and in other countries. A regional center is a means for carrying out this process at minimal cost, when the user community is sufficiently numerous and sufficiently dense, geographically.

This suggests, then, that a regional center is the optimum method for technology transfer when all the following conditions are met:

- There are a substantial number of potential users within a reasonable travel radius of the center
- The technology has been demonstrated to the point that its advantages to the user can be substantiated to some reasonable degree
- Adoption has not proceeded through the early adopter category
- The benefits of adoption to the transfer agency exceed the costs of operating the center through the early adoption period.

If one or more of these conditions are not met, then a different technology transfer mechanism would be indicated.