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A MODEL OF USER BEHAVIOR FOR
SCIENTIFIC AND TECHNICAL INFORMATION
(STI)

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INTRODUCTION

There are several compelling reasons why the scientific and technical information (STI) should become more user-oriented in terms of content and design of the STI, its process of dissemination and availability to potential users, and even in its pricing policies.

First, despite the vast amount and variety of STI available today, there are only a handful of scholars and researchers who use them for any scientific or personal knowledge. Although no data are really available at the micro-level of individual users, it will not be surprising to find that less than twenty percent of all potential users of STI may be using eighty to ninety percent of all STI documentation available today. There is some indirect evidence of this tremendous skewness in usage of STI from the fact that many scholarly journals are subscribed or read by only a small percentage of their total potential users. In fact, this is often the reason why STI documentations in the form of journals, books, pamphlets and monographs often incur losses and have to be subsidized by outside sources such as grant-giving agencies, foundations, professional associations and the academic institutions.

Second, even among those who regularly use the STI, it is not uncommon to find a sense of frustration and dissatisfaction with the existing STI documentations with regard to content, format and accessibility. For example, often the STI documentation is not available at the time and place which is convenient to the user which clearly indicates a dissemination - distribution problem. Furthermore, when a potential user has access to the STI documentation, he often finds that it is hard to comprehend. If he can comprehend the content of an STI documentation, it is packaged in a format which makes it difficult to use it more often. Finally, many users of STI documentation often emerge with a sigh of relief after an exhaustive search for relevant information which is often comparable to the feeling one gets when he successfully finds the needle in the haystack. It would be interesting to measure the amount of professional manyears which is wasted each year simply on the process of separating the signal from the noise in the area of STI.

Third, greater user-orientation in the design, and dissemination of STI is inevitable as the technology of STI becomes mature. As a maturing product life cycle, STI can no longer afford to remain producer-oriented. While it is perfectly acceptable and sometimes even necessary to put greater emphasis on the production side of STI in the beginning of its development, it must become more user-oriented as it gains acceptance and establishes a base among its users. Otherwise, it is likely to experience crisis of relevance and usefulness as it is already alleged by at least some of its potential users.

BENEFITS OF USER-ORIENTED STI SYSTEM

A number of benefits are obvious in a user-oriented STI system.

First and probably the most important benefit is to extend the product life cycle of STI by searching for new segments of users such as foreign scholars and researchers as well as by disseminating the information to non-technical, but educated people in the society by satisfying their epistemic needs. In fact, with small changes in the content and format of STI, it is possible to create outreach programs far beyond the boundaries of immediate users. This is already manifested by the existence and success of many magazines such as the Science Digest, Psychology Today, Scientific American and to some extent Harvard Business Review to name a few. In short, a user-oriented STI system can easily reveal at least three to four levels of interest in scientific and technical information.

Second, a user-oriented STI system is also likely to reveal the true nature of complimentary and competitive relationships among various types of STI documentations. For example, we really do not know whether Annual Reviews is perceived as substitutes or complimentary reading to many journals in psychology, sociology, and anthropology. Similarly, many fear that the journals may have become an obsolete source of receiving bibliographic information with the advent of computerized search procedures available today in many fields.

Third, a user-oriented STI system often forces it to innovate new concepts, ideas, formats, and products. Many argue that there is a serious problem in the area of scientific and technical books where the costs have gone astronomical and markets have become miniscual. It is not surprising that most of the current efforts are in the direction of cost-reduction tactics such as photocopy publishing and soft-binding, instead of a more fundamental change in the direction of producing and disseminating scientific and technical information in nonbook formats. Such a fundamental change will occur when publishers of STI understand and utilize the psychology of the users.

Fourth, any STI system which is user-oriented is likely to increase its usage. By definition, such a system is designed, produced, and disseminated in a manner which increases its likelihood of being used more often by the potential users. For example, a number of publishers of STI have realized the need for greater illustrative and pictorial materials which facilitate comprehension on the part of the reader. Similarly, some libraries arrange the publications in the open stacks in a manner which facilitate greater user. Unfortunately, these are still not very common practices, but rather exceptions.

Finally, a user-oriented STI system is likely to survive any crises of social relevance. It is not at all difficult for people to become skeptical toward scientific and technical information which remain highly abstract and portray a picture of elitist attitudes. In the long run, any STI cannot survive if the public opinion is negative toward it. We have already witnessed some examples of negative public opinion in the form of "fleece of the month" awards given by Senator William Proxmire in the U.S.

MODELING STI USER BEHAVIOR

In order to make STI system more user-oriented, we must first understand and model STI user behavior and its underlying psychological processes of user perceptions and motivations. Fortunately, there is a good deal of knowledge and research in the area of consumer behavior which seems relevant toward modeling STI user behavior (Howard and Sheth, 1969; Engel, Kollat & Blackwell, 1973; Hansen 1972; Sheth 1974; Ward and Robertson 1974).

Based on a model of individual choice behavior (Sheth, 1975), an attempt is made in this paper to model the perceptions, values and usage of STI. It is summarized in figure 1. There are two major and distinct areas of conceptualization in the model. The first part relates to perceived STI utility in the minds of potential users, and the second part relates to actual usage behavior of STI system. We will describe each part in some detail in the following pages.

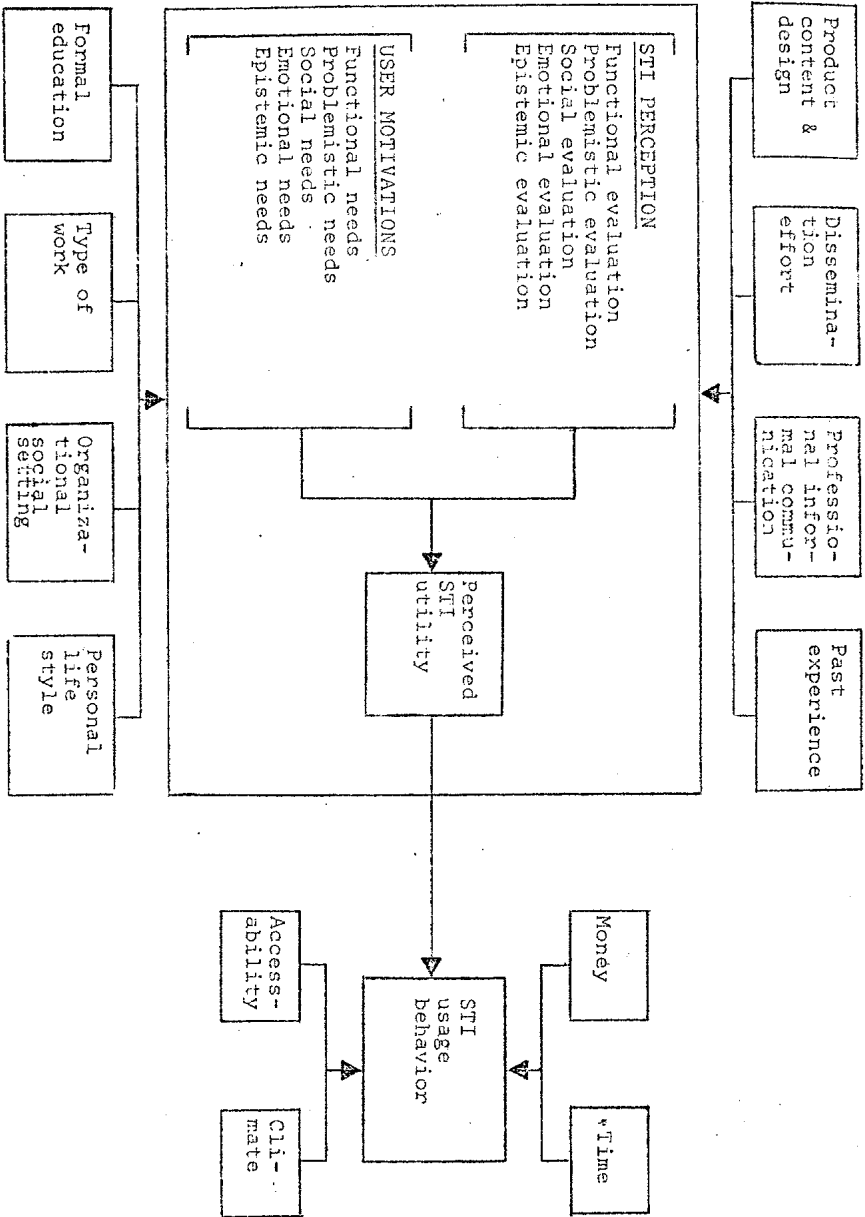


FIGURE 2.1. A MODEL OF STI USER BEHAVIOR

A. Perceived STI Utility

The utility of STI among potential users is considered to be a function of the potential user's perception of the extent to which STI satisfies a set of needs, wants and desires. In other words, each potential user has a set of evaluative beliefs about the usefulness of STI related to different types of needs. We have identified five different types of needs on which STI may be evaluated. They are functional, problematic, social, emotional and epistemic needs.

Depending upon how closely the evaluations of a particular STI system match with the expectations of the user in terms of these needs, each STI system is perceived to possess some degree of positive or negative utility which becomes the basis for its eventual usage. The greater the matching, the higher the perceived utility of a particular STI system, and vice versa. Mathematically, this can be expressed as follows:-

$$U (STI)_k = \sqrt{\sum_{j=1}^5 (E_{x_j} - E_{v_{jk}})^2}$$

The utility model presumes that a particular STI system can acquire negative utility by both offering too little or too much of a particular need satisfaction. Furthermore, it is quite possible that the perceptions of a particular STI system in the minds of potential users may not necessarily match with its objective reality due to either stereotyping or lack of full information.

We will briefly describe the five types of needs which can be satisfied by usage of STI system.

1. Functional needs are generated by task related activities. For example, a full time research scholar in the academic setting is often promoted exclusively on the basis of his record of scholarly publications and research. In the process of producing scholarly research, he needs scientific and technical information. Similarly, a professional working on applied areas also has functional needs for scientific and technical information. However, his functional needs in terms of both content and format may be very different from those of the research scholar. Therefore, a particular STI system may be perceived as more useful to one person and less useful to the other person.

2. A second type is the problematic need for STI. In this case the need for STI is not absolute but conditional upon a set of situational contingencies or antecedents. For example, the need for certain STI systems becomes manifested among graduate students when they are assigned the task of writing a research paper on a certain topic. In fact, most textbooks are often regarded as possessing only the problematic utility since they are relevant, at least in terms of student perceptions, primarily for a particular course. This goes for all the reading assignments in the course, whether they are in a periodical, book, monograph or some other form. The peak demand experienced by libraries for the assigned readings materials is a clear evidence of the problematic utility they possess from the user's viewpoint.

3. The third type of utility for a particular STI system is created not because of its intrinsic value, but because of its association with certain social roles and stereotypes. This is referred to as the social needs of STI. For example, many professionals in their offices and homes display certain books and periodicals primarily to reveal their organizational role identification. In short, many STI books and periodicals are needed for conspicuous consumption purposes. This is especially true for handbooks and professional encyclopedias.

4. A fourth type of STI utility is based upon its satisfaction of personal emotional needs. Once again, the particular STI system has less functional or intrinsic value to the individual. Instead, it acquires more of an emotional or extrinsic value because of its association to a particular discipline, author or publisher. For example, many people possess complete writings of a particular author because they pride themselves as collectors. Similarly, some people use a particular STI product such as a book or a periodical because they are emotionally attached to it by prior learning or conditioning in their earlier days as students and research assistants. This

seems to be particularly true for more technical subject areas such as statistical and mathematical books. It is even suggested that some books remain highly popular as textbooks in a discipline more due to the emotional attachment on the part of the instructor rather than their intrinsic superiority over other books for the course.

5. The last, but not the least type of need satisfied by STI is the epistemic needs of the potential users. Epistemic needs refer to the human desire to be knowledgeable, inquisitive and curious about phenomena which surround them but are not directly related to their job activities. They also represent acquisition of information now which may have some potential functional utility sometime later in life. We think that epistemic needs dominate in the determination of perceived utility of STI, and probably rank in importance only next to the functional needs.

In summary, the perceived utility of STI is presumed to be a vector of five distinct dimensions reflecting the degree to which it satisfies the functional, problemistic, social, emotional and epistemic needs of potential users of scientific and technical information.

B. Individual and Product Differences

Unfortunately, perceived STI utility is subject to both individual and product differences. In other words, it is likely that different types of scientific and technical information documentations, areas, and disciplines will have different vectors of the perceived utility among potential users. Similarly, a particular type of STI will have a distribution matrix of perceived utility among a sample of potential users since both the needs as well as perceptions are likely to vary from individual to individual users. It becomes, therefore, essential to theorize about some of the major determinants of individual and product differences. We have isolated four individual related factors and four product related factors that seem to be most relevant and useful for modeling the differences between users and between types of STI documentations.

1. Individual Factors

The individual user related factors are

- a) Prior education
- b) Type of work
- c) Organizational-social setting, and
- d) Personal life style.

It is obvious that the level and type of prior education will often determine the specific types of need satisfaction in an individual user of scientific and technical information. Prior education will determine both the attitude or value system toward STI in general as well as shape the degree of expectations with respect to the functional, social, problematic, emotional and epistemic needs. For example, an individual with less than high school education is likely to have very little involvement and interest in STI than another individual with a doctorate degree. Similarly, a doctorate in psychology will produce a different vector of expectations than a doctorate in medicine, for example. Even though prior education seems such an obvious factor in determining individual needs for STI, it is surprising that there is very little research on the topic.

A second individual related factor is type of work. Once again, it seems obvious that there should be strong differences between blue collar and white collar workers as well as between clerical and professional white collar workers with regard to the level and type of needs for STI. However, it is possible to detect even more subtle individual differences among the white collar professionals who are likely to be the prime target market for STI by examining the typology of work in terms of staff vs. line functions, academic vs. professional endeavors, and research vs. administrative responsibilities.

The third individual related factor is the organizational-social setting. It is argued that the social structure and organizational structure surrounding an individual user will also determine and influence whether he will have need for scientific and technical information and, if so whether it will be more a functional, epistemic or social need for STI. If consumer behavior is any guide in this area, one would presume that organizational-social setting will primarily generate the social (conspicuous consumption) and epistemic needs for STI. This is because certain organizations and social classes tend to acquire images or stereotypes in which it is fashionable to possess, if not use, scientific and technical information.

For example, many research laboratories affiliated to large corporations pride themselves in maintaining excellent libraries on STI which is often not relevant to the task or utilized by the research employees. Similarly, the upper socioeconomic classes in general pride in possessing, if not reading, nonfiction literature including scientific and technical information. In fact, in many upper socioeconomic classes the possession of STI documentation is conspicuously displayed for the outside world as if to indicate that mass media such as television, radio and popular magazines are definitely not welcome for satisfying their epistemic and social needs.

An individual user tends to be influenced by the organizational-social setting surrounding him in one or both ways. First, such a setting may influence whether he should or should not be a user of scientific and technical information. Second, a particular type of STI may or may not be considered as appropriate for him to use. For example, it is this type of influence which often creates the dichotomous world of trade journals and scientific journals or the trade books vs. academic books.

The last individual related factor is the personal life style of the individual user. We believe that scientific and technical information may be perceived as having or not having a useful role in the personal life style of an individual as indicated by his daily activities, interests, values and opinions. Personal life style is likely to generate the emotional and epistemic needs for STI. For example, the aspiration of a life style of intellectuals will certainly create the need for STI in the mind of an individual, but not the life style of a swinger or a family-oriented individual. It seems that there is a sufficient degree of empirical research on personal life styles (Wells, 1974) to develop a typology of potential users of STI and hypothesize the distinct roles scientific and technical information plays in the daily living patterns of people.

2. Product Factors

There are four product-related factors which produce differences in the perception of STI utility from one type of STI to another such as between books and journals, between hard sciences and social sciences and between trade and academic publications. These factors are

- a) Product content and design
- b) Dissemination efforts
- c) Prior familiarity & experience, and
- d) Professional informal communication.

The product itself in terms of its content and design is likely to be the single most factor determining differences between various STI documentation. For example, encyclopedias and handbooks tend to be useful in a different way than journals in satisfying any of the five needs discussed earlier. Similarly, abstract periodicals are perceived somewhat differently than regular journals. While it is obvious that varying content of STI documentation will certainly result in interproduct differences, we think there has been considerable less emphasis on the design aspect of the products. It includes format, writing style, medium of representation such as language vs. pictures, and packaging aspects. In this regard, STI producers can learn a great deal from advertising agencies and commercial publication houses.

Dissemination effort is the second product related factor. It includes the conscious allocation of resources in informing, communicating, and influencing the potential readers about the availability of the STI system, and in making the product as easily accessible to the potential user as possible. In marketing, this would imply allocation of resources to distribution and promotion efforts by which the time and place utility are added to the product as well as the product utility is made known to the potential users. In the STI area, the university presses and publication bureaus are generally notoriously backward in this regard as compared to the commercial publishers, for example. We think that STI can learn a great deal in the area of dissemination effort from the marketing area.

A third product related factor is the individual user's past experiences with STI system in general, and specific to a particular STI product under question. Users learn a great deal by trial and error about various STI products and their evaluations will be significantly shaped by the degree of satisfaction they experience with a particular STI product. It is not at all uncommon for many STI products to have a large percentage of transient users who use the product irregularly as well as switch around from product to product, probably in the hopes of finding one or two ideal products for their needs.

The fourth product related factor is the professional-informal communication specific to a particular STI product or system. The influence of word of mouth communication such as reviews, comments, references, citations, etc. seems enormous. Many scholars often rely upon others to screen for them good STI products from poor ones either because they cannot cope with the flow of indiscriminating dissemination of STI or because they feel a sense of risk in adapting unfamiliar STI products. In fact, in many social science disciplines, we nowadays see review periodicals which seem to cater to these people, and, in the process, are given the role of gatekeepers and opinion leaders. Contemporary psychology seems to be a good example of this type of professional informal source of communication and influence in psychology. Similarly, the popular textbooks in every area also seem to perform the same function. Finally, many individuals acting as professors, consultants and advisors to others perform a comparable function of gatekeeping and opinion leadership with regard to a particular source of scientific and technical information.

Between the individual related and product-related factors, it is possible to hypothesize that the former factors primarily shape and change the user's needs and expectations, while the latter factors shape and change the user's perceptions and evaluations of specific STI products, sources and systems. In any event, the model clearly and forcefully suggest that we need to adapt a market segmentation strategy for adequate dissemination and usage of scientific and technical information. There is no way an universal STI system can be designed with which we can satisfy all the potential users. In short, STI cannot be all things to all users.

3. STI Usage Behavior

A second part of the model of STI user behavior relates to the actual usage of STI products, sources and systems. There are at least three dimensions of STI usage behavior which need to be fully understood and analyzed.

1. The first dimension is the selectivity of specific STI products, sources and systems a particular individual user subscribes to or makes use of. By a micro-level individual user analysis, it is possible to measure the degree of selectivity of usage of a particular STI product, source or system. It should be then possible to identify which specific STI products, sources and systems are used by the same users indicating a measure of complementarity among them. Similarly, one can identify the different user segments in which different STI products, systems and sources are patronized revealing the substitution relationship among them.

2. The second dimension is the amount of usage of a particular STI product, source and system. It is argued that there will be a great deal of variability in the usage rate of a particular STI product, source and system within the user segment so that some will be heavy users and others will be light users. By analyzing the heavy half users, it is possible to measure the degree of skewness in usage and, therefore, the aforementioned 20/80 ratio: less than twenty percent of total potential users often generate more than 80 percent of total usage. We believe that the skewness is even greater in the case of many STI products, sources and systems, and, therefore, it might be worth the effort to assess the cost/benefit ratios for various STI products and services.

3. The third dimension of STI usage is related to user loyalty. Does a user acquire habit toward a particular set of STI products, sources and systems by experience and learning, and, if so, does this habit become a deterrent for the diffusion of new and innovative STI products, sources and systems? Loyalty represents continuous use over a fairly long time period and without strong interruptions for a given STI product, source or system. For example, in the case of college textbooks, it is this product loyalty which often is the basis for a virtual monopoly by a particular author. Usage loyalty is indicated by the systematic repeat choices a user makes in favor of a particular STI product, source or system even though he has the opportunity to switch to other STI products, sources and systems. For example, renewal of journal subscriptions would be one indicator of user loyalty.

4. The model presumes that the perceived STI utility of a specific product, source or system is only a necessary condition for its actual usage. There are at least four major sufficient conditions: time, money, accessibility and climate. We believe that often a good STI product, source or system with high degree of perceived utility remains underutilized by the potential users because of time, money, accessibility and climatic factors.

Increasingly, time is becoming a bigger constraint as compared to money requiring many STI products and systems to adapt different formats and packing devices to still remain viable from usage point of view under extreme time constraints. This is especially true nowadays with the advent of computerized storage and retrieval systems designed for bibliographic research, for example. However, very little systematic research is made as yet to manage the other two sufficient conditions, namely accessibility and climate. It seems that accessibility is still a serious weakness in many existing STI systems and products especially under peak pressures. One hopes that the computer technology will be also very useful in this area as it becomes increasingly applied in the distribution of scientific and technical information. For example, the current library procedures of binding journals creates a serious accessibility problem for periods as long as eight to twelve weeks which can be minimized by proper substitute methods in place of binding.

We also believe that climate will also receive increasing attention in the near future. It refers to the physical environment in which STI is to be used and thereby its influence in inhibiting or enhancing the usage behavior. For example, pleasant atmospherics are generally more conducive to product usage. The atmospherics can be related to the institutional environment, personal office environment or the laboratory environment. It is a sadly neglected area so far in the area of scientific and technical information.

LINKING USER BEHAVIOR FOR PLANNING & MARKETING OF STI

Understanding and modeling the user behavior by itself is not as relevant or useful. It must be systematically incorporated in the planning and management of STI. In this section, we have attempted to integrate the STI user psychology and behavior in the total process of planning, producing and disseminating scientific and technical information. The integration is represented in figure 2 and is based upon a similar effort in the area of planning of multinational corporations (Sheth, 1977).

We very strongly believe that the STI planning process should be based on identification and continuous monitoring of changing user needs. The monitoring itself can be done by a separate research unit which is called basic research. There should be an ongoing interaction between STI planning and basic research in view of the fact that there may be technological breakthroughs in the supply function. In other words, the role of the STI planning unit is to bridge together the fundamental supply and demand factors.

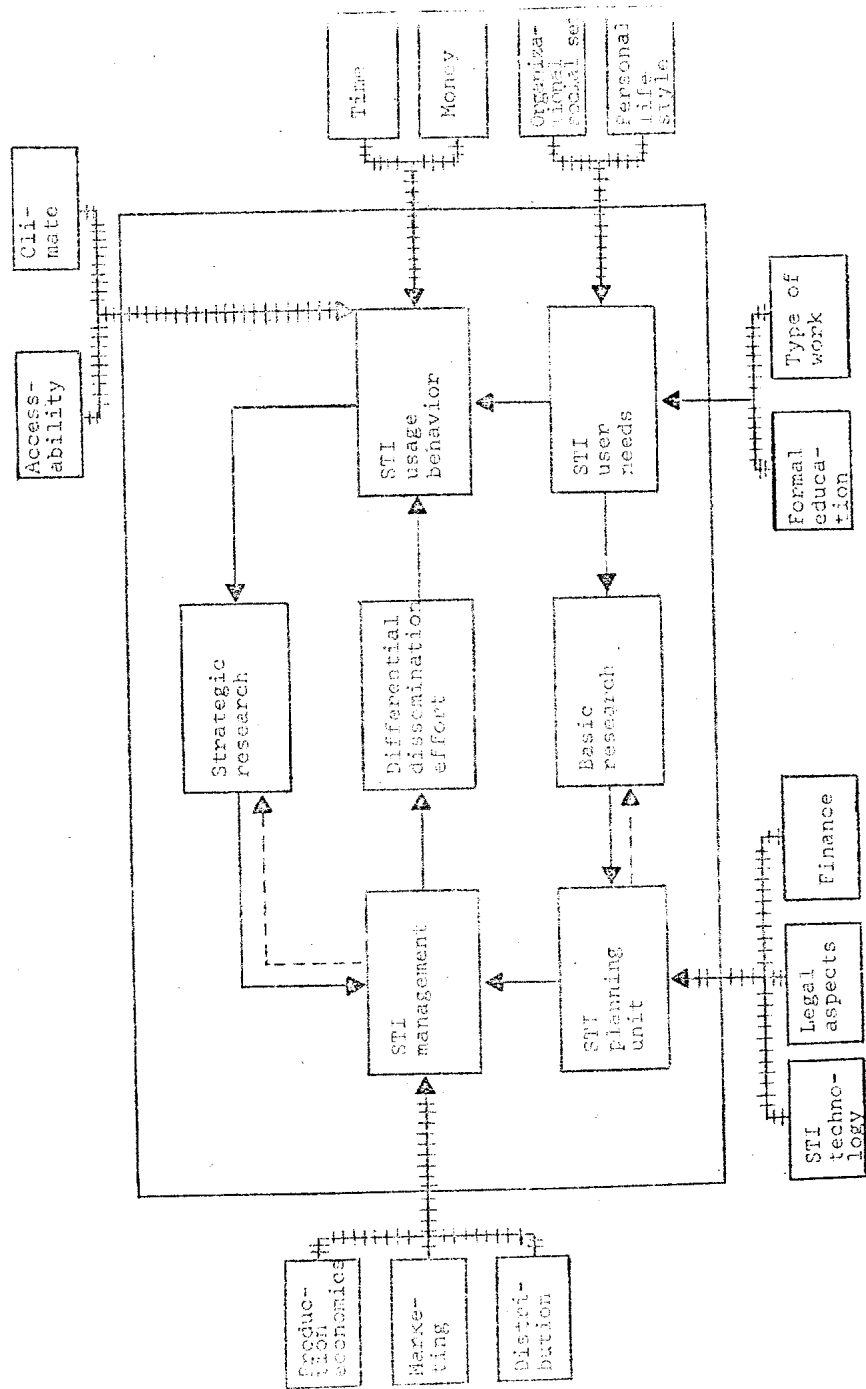


FIGURE 2.: PLANNING AND MANAGEMENT OF STI FUNCTION

The STI planning unit should be given the task of developing new concepts, products and services by blending together the user needs on the one hand, and legal, technological and financial considerations on the other hand. It is possible that some of the user needs may not be fully recognized in the development of new concepts because of technological, legal or financial considerations. However, it is the task of the STI planning unit to seek optimization between user needs and technological-financial factors.

The new concepts developed by the STI planning unit now must be brought to reality and managed which is the task of STI management. It consists of putting flesh on the skeleton, so to speak, by producing and distributing a set of STI products, systems and services. This will require integration of production economics, distribution channels and marketing efforts. The latter include the pricing and promotion aspects.

The result of STI management function will be the dissemination effort. However, we strongly argue for differential dissemination effort by properly targeting the production, marketing and distribution activities to selective user segments. As mentioned before, there are simply too many individual user differences in reality to hope for a universal product, distribution and marketing policy.

The differential dissemination effort combined together, with the user needs will result in perceived STI utility. This will in turn manifest itself in STI usage behavior depending upon the time, money, accessibility and climate conditions.

We also suggest that the usage behavior and the underlying necessary and sufficient conditions should be monitored by STI management. This type of monitoring activity is called strategic research. Hopefully, STI management will have the insights to design and implement dissemination efforts in such a way that the feedback obtained through strategic research in both pretesting and post implementation will be in the direction of desired objectives such as achieving projected levels of STI usage in various targeted segments among the potential users of scientific and technical information.

SUMMARY AND CONCLUSIONS

It is our hope that this research paper has shown the relevance of consumer behavior to the task of disseminating scientific and technical information. The basic theme of the paper has been that to produce and distribute scientific and technical information without proper inputs of the user needs and psychology is at best a wasteful and at worst a highly myopic process. As such it cannot survive too long in a society which believes in free and voluntary choice open to the users of scientific and technical information. It will at first experience crises of relevance and at last plant the seeds of self destruction by encouraging the users to produce STI themselves or to organize alternative methods of dissemination more suitable to satisfying their needs.

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