

INDUSTRIAL AND TECHNOLOGICAL INFORMATION
Who Has It and Who Needs It?
THE ROLE OF NTIS IN ACQUISITION AND DISSEMINATION

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ABSTRACT

Worldwide access to the results of research and development is critical for the effective advancement of science and its application. The U.S. National Technical Information Service (NTIS) has as its mission the collection and dissemination of scientific and technical information (STI) produced worldwide in order to increase U.S. competitiveness in the global economy. However, because of the interconnection of the world of science, NTIS also plays an important role in the world STI infrastructure.

This paper describes the general STI transfer process, discusses the generators, products and services, and users of STI, and discusses the types of programs that have evolved to facilitate this process. The technical report is highlighted as a significant information product. Finally, some future directions for NTIS are to help meet the needs of users and acquire information more effectively. In conclusion, the benefits and requirements for international cooperation and reciprocity are cited as cornerstones in building an effective worldwide STI infrastructure.

"Science is a building, but not a pile of bricks,
however valuable this pile may be . . ."¹

Wigner, Predely nauki (*The Limits of Science*)

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Introduction

During the past decades, we have witnessed significant technological enhancements which have provided us with the ability to store, manipulate and retrieve information in large quantities. However, we can barely keep pace with the burgeoning of information, particularly in science and technology (S&T). It is ironic that one of the precipitating factors creating a crisis for today's information age is that of information overload, not information scarcity. Our challenge as information managers is a problem of access to the right information at the right time, both in terms of comprehensiveness and specificity (recall and precision in information retrieval terms) rather than lack of information.

Science is an international venture. For the advancement of science, it is imperative for scientists to have open access to all vehicles of S&T communication, regardless of national origin or the source of funding--scientific information does not recognize national or geographic boundaries. Freedom and equity of access to foreign research results could yield enormous benefits. Among these benefits are accelerated pace of science and its application, prevention of duplication of effort, and reduction in increasing cost of conducting research and development. While addressing the American Society of Information Science in October of 1990, Dr. Donald Langenberg, Chancellor of the University of Illinois, who just completed a study for the U.S. National Academy of Sciences on "Information Technology and the Conduct of Research", similarly expressed the importance of open and free communication as essential for the growth of science. He stated, ". . . I share with many researchers a strong belief that much of the power of science (whether practiced by bench scientists, field engineers or clinical researchers) derives from the steadfast commitment to free and unfettered communication of information and knowledge. This principle has been part of the ethos of the global research community for centuries, and has served it and the rest of humanity well." [ED: If this is a quote please indicate source]

Figure 1 shows the overall STI transfer process from generation to the use of knowledge. Figure 2 presents a different view of the specific actions in the process regarding producers of information: (1) the types of vehicles they use to communicate, (2) some of the standard sources or references that help identify relevant publication, and (3) the user communities that access such information, nationally and internationally. What we see in looking at Figures 1 and 2 is the traditional technical communication process--one that NTIS has supported for more that 45 years.

This paper will discuss some of the aspects of this process and provide some brief thoughts about new directions for NTIS in acquiring information from those who have it and disseminating information to those who need it. The "Producers" column in Figure 2 represents the part of the transfer cycle represented by circles 2 through 9. The primary products are 2 through 6, while the secondary products begin with 6 and go through 8. Finally, the users are circles 8 through 11, with intermediaries most heavily involved in circles 8 and 9, and end users being primarily 10 and 11. This paper will look at various parts of the cycle. Figure 3 expands on the product analysis by placing them in immediacy of impact. This has implications for how NTIS delivers information. Its traditional role, as we will discuss, has been in technical reports and abstracts--more or less in the middle of the graph. We will also look at some new work in patents and seminars which attempt to increase the immediacy of product impact.

While R&D support and the vehicles reporting the results of such support are varied and many, this paper will attempt to address report literature which originates mostly from government funding--domestically and internationally. Since we are examining the role of NTIS, a U.S. perspective is presented. However, it is widely recognized that NTIS plays a vital role in the international STI infrastructure.

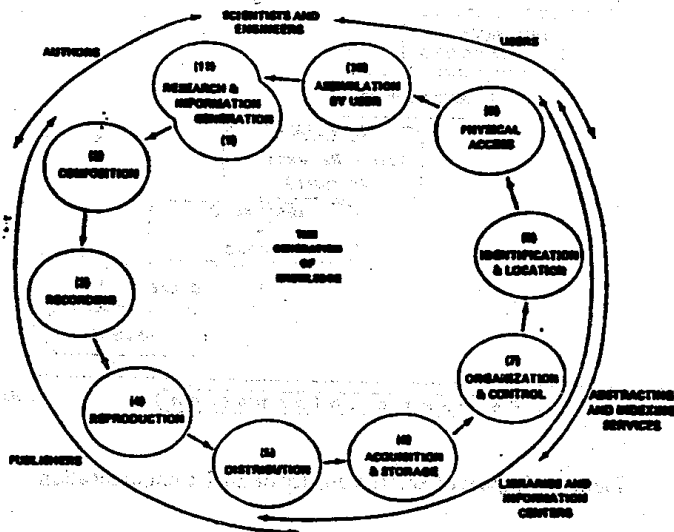


Figure 1: Scientific and Technical Information Transfer

History and mission of NTIS

Established in 1945 following World War II as the Office of Technical Service, NTIS was set up to manage the captured foreign technical reports that came into U.S. possession. In 1963, it became the Clearinghouse for Federal Scientific and Technical Information and its mission expanded to cover unclassified government research reports. Finally, in 1970, it was renamed as the National Technical Information Service. Along with the name change, its scope of coverage was expanded beyond reports and beyond the U.S. to cover tapes and data in S&T and specialized subject areas. Some of the major contributors to the database are the Department of Energy, Department of Defense and NASA (Figure 4).

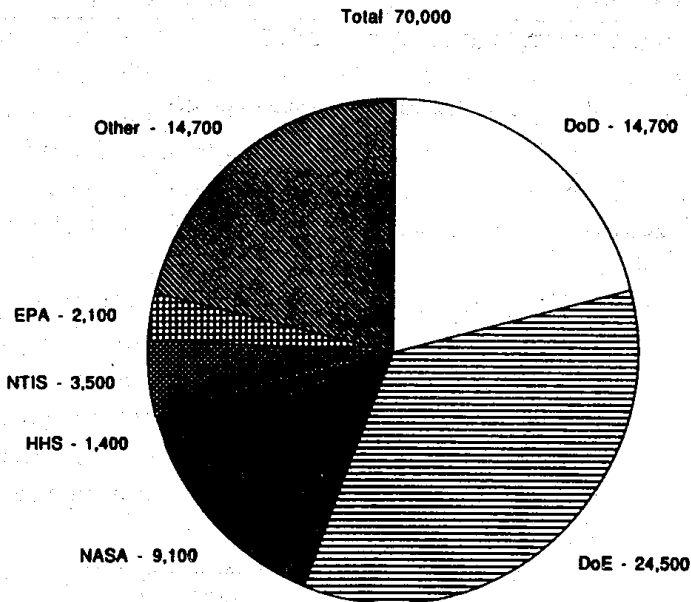


Figure 4: NTIS Acquisitions

Today, NTIS' its mission reads: *"To collect and disseminate technical information produced by governments worldwide in order to increase U.S. competitiveness in the global economy."* Its mission underscores the U.S. government's expanding role not only in allocating funds for R&D efforts, but also in recognizing the importance of collection and dissemination. New knowledge must be transferred to those who need to know and utilize it. NTIS is committed to this end with emphasis on reducing the time from

information identification to its dissemination and ultimate use in industrial production, through enhanced acquisition and through open access.

The technical report literature

Recognizing the importance and role of R&D, many nations are allocating large sums of money toward such activities as those mentioned previously. In the United States, for example, about 50 percent of the \$140 billion annual allocation for R&D effort is supported by the government. Some governments are allocating an even higher percentage.

It is important to note that the results of such government funding in the U.S. are often presented in the form of technical reports (TRs). This is particularly true for contract research. It is estimated that approximately 200,000 new technical reports are generated each year. Figure 4 shows the domestic contributors to the NTIS collection. Historically, technical reports have been referred to as "grey literature" to distinguish them from commercially published and widely available literature. Traditionally, the TRs have had a limited distribution and were not easily available for standard bibliographic control. Some distinguishing characteristics of technical reports are:

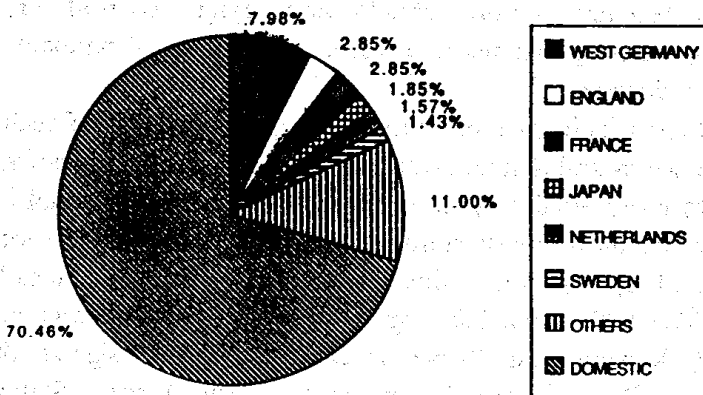
1. They are a rapid means of communication because they are not subjected to the normal external peer review process and time delays in publication.
2. TRs are used by the applied and technological communities more than by the basic research community who rely on the widely disseminated open literature.
3. They are mostly devoid of any proscriptions in format (except those required by the producing organizations) and usually include significant amounts of raw data not often displayed in traditional journals.
4. TRs primary distribution is generally at the discretion of the sponsor and/or the organization conducting the study, and usually limited to the community involved in the study.
5. They have become the primary responsibility of the federal government for bibliographic control and the secondary responsibility of on-demand distribution.

Therefore, unlike other commercially available and widely distributed forms of S&T publications, journals that enjoy multiplicity of secondary coverage, the (unclassified and unlimited distribution) report literature is mostly distributed by and is under the bibliographic control of federal agencies. In particular, NTIS is considered a major source for such S&T material with regard to public access. For many federal agencies such as DOE, DOD and NASA, NTIS is the primary source of public access.

If we accept the premise that governments (certainly the U.S. government) are funding R&D that is important for the progress of science and technology, and that the results of much of this funding are in the form of TRs, then NTIS becomes an important source of R&D information.

Acquisitions and dissemination efforts

Recognizing increasing international activity in R&D efforts, NTIS continues to acquire not only domestic but also international information. Over the years, the percentage of international input has been steadily increasing. During the past few years, overseas input has amounted to approximately 30 percent of the total input. The 1989 acquisition is presented graphically in Figure 5. Foreign input includes information acquired not only from the government sector but also from the industrial sector. For example, input from Japan included reports obtained from laboratories of such industrial giants as Hitachi, Toshiba and Toyota.



TOTAL ACQUISITION: 69,964 (Domestic: 49,246; International 20,718)

Figure 5: 1989 Contributors to NTIS database

Foreign reports In general, foreign technical reports are obtained through cooperative programs. Under the umbrella of bilateral arrangements, NTIS acquires both government and private sector information from other countries. Two examples of such arrangements are Fachinformationszentrum in Karlsruhe, West Germany, and Mitsubishi Research Institute in Tokyo, Japan. Overall, NTIS has arrangements with more than 50 countries for sharing government sponsored/funded information. Many foreign scientists are recognizing that, in providing S&T information to NTIS, they are not only sharing the results of the R&D with their international peers but are also making it readily and economically available to other scientists in their own countries. While many scientists and their nations strive for wide distribution and equity in sharing information with the U.S., many others appear to remain intentionally conservative in providing information to NTIS.

Bibliographic information once put in to the NTIS database remains accessible almost 24 hours a day through a variety of database distributors such as DIALOG and BRS. In providing such open and unrestricted access to research and development material, NTIS reflects the notion of interdependence and sharing for scientific advancement. In this spirit, NTIS seeks increased input of resource material from other nations. Widespread open access of global S&T will provide scientists in every country not only the opportunity to capitalize on each others' works, but also the opportunity to provide the challenge and impetus to be more creative and innovative than their counterparts. Additionally, equity in global access to unclassified, unlimited technical reports should also trigger spin-off products and programs, ensuring that research results, regardless of national origin, will not remain dormant.

Increasingly, as more nations accept the notions of reciprocity and equitable access and automatically deposit their technical reports, NTIS will be able to more effectively fill the role as not only a national but a *world* center for technical reports storage and retrieval--a one-stop shopping place for technical reports. International cooperation along these lines has already begun. The U.S.-Japan S&T agreement is one such example. In 1988, President Reagan and Prime Minister Takeshita signed the accord, "Agreement Between the Government of the United States and the Government of Japan on R&D in Science and Technology." Under this high-level agreement, a task force was created. This task force has four primary goals aimed toward improving STI access and NTIS' ability to serve the technical community.

The goals are as follows:

1. Improvement of awareness and understanding of organizations and systems established to improve the use of scientific and technical information.
2. Improvement of identification, collection and dissemination of technical report literature.
3. Reduction of impediments, if any, to the flow of S&T information.
4. The increase of the quantity and quality of S&T information and its translation.

Although we in the United States are fortunate that English is the major international language of science, governments of most nations are allocating increasing sums toward R&D and the reporting of results is often in languages other than English. Through cooperative programs, NTIS selectively acquires such foreign language reports.

Translation Efforts Before adding such records to the database, as a minimum the bibliographic information (along with an abstract) is prepared in English. This provides the users enough information to determine if a translation of the full text is necessary. NTIS remains active in National Translation Center activities (now a part of the Library of Congress, U.S.A.) and also in International Translation Centre activities, based in Delft, The Netherlands. Presently, NTIS is in the process of establishing a cooperative translation program with the India National Scientific Documentation Centre (INSDOC) New Delhi, India for the translation of select foreign language reports acquired by NTIS.

However, as indicated in Figure 3 and in the mission statement, NTIS does have a broader role and responsibility. While scientists benefit from knowing the results of completed research, they also benefit from identifying the various kinds of ongoing research efforts.

Ongoing research NTIS aims to alert users not only to that knowledge which has been generated as a result of completed research but also to that which is still underway or in progress. Through the Federal Research In Progress (FEDRIP) database, NTIS informs the S&T community of ongoing R&D efforts. Last year, approximately 9,000 new research projects were added to the database to make a total of more than 100,000 projects. These projects represent contributions from at least 10 key organizations which include the Department of Energy, the Department of Agriculture, National Science

Foundation, National Aeronautics and Space Administration and the National Institute of Standards and Technology.

The traditional means of addressing end-users through bibliographic control and documentation has been supplemented by NTIS with specialized and targeted educational programs. Part of these efforts were stimulated by an appreciation of the need for economic competitiveness in a global economy. NTIS now actively promotes the use of federally funded intellectual property, e.g., patents.

Patents Many government contracts are technology oriented and are targeted toward specific problems. At the end of such studies, in addition to a report, a patent may result. Patents are important in that they present an opportunity for industry to capitalize on government market factors to protect the investment made. NTIS has an active Center for Utilization of Federal Technology (CUFT). Working closely with the various federal agencies, they handle the licensing of the patents issued to these organizations. Licenses are issued on an exclusive, co-exclusive and non-exclusive basis. To date, more than 450 licenses have been issued.

Approximately 20 percent of all federal patents available for licensing through CUFT have international patent protection in selected countries. Like most private companies, NTIS has filed and obtained international patents to protect overseas marketing rights for domestic companies. Because of the close contact NTIS maintains with the corporate and academic sectors, it is in a position to immediately contact the relevant companies that could benefit from a newly issued patent. For increased awareness, NTIS issues a publication called *Catalog of Government Invention Available for Licensing*, listing more than 1,000 new inventions each year. To ascertain that new technology does not remain dormant, available inventions for licensing are announced every week through a newsletter.

To keep our industrial users cognizant of the latest acquisitions of potential patents, the CUFT is also establishing an electronic bulletin board which provides a listing of newly received patents and patent applications.

Other mechanisms of information dissemination include a series of seminars. Recognizing the notion that in-person verbal communication is the most effective vehicle of communication in terms of immediacy and early release of information, NTIS initiated a few seminar programs.

Seminars The focus of these seminars is at least threefold: (1) to learn from the user community what is important to it, (2) to share with the user

community what the NTIS plans are for future development of new products and/or services, and (3) to provide state-of-the-art, practical technical information directly related to specialized technical areas.

To date, about a dozen seminars have been conducted. Some of these seminars were conducted in conjunction with the International Trade Administration, a sister organization of the Department of Commerce. A few examples of the seminars were completed on: fiber optics, medical diagnostic imaging, and cellular radiotelephones.

The goal of such seminars is to have experts discuss in depth the results of government-funded studies that evaluate present status, and also forecast future directions in the specialized areas of R&D. These seminars are mostly geared toward managers and decision makers in the industrial area.

On an annual basis, NTIS holds a different type of seminar. This is the NTIS User Seminar. One of the main purposes of such a meeting is to inform the users of new products, services, and procedures NTIS intends to establish, and to provide the users the opportunity to question the importance or use of specific products and procedures already in place. Such meetings help NTIS remain close to the pulse of our users. Most of the attendees at these meetings are academic users.

Recognizing the importance of industry in information transfer, NTIS meets with the Industrial Technical Information Managers Group (ITIMG) on a regular basis. The group is comprised of the STI managers of the major Fortune 100 companies. These corporations are innovators in their fields. They are mostly multinational in structure, and have annual sales in the billions of dollars.

Besides the academic and industrial users, NTIS remains an active participant in the Federal Library Information Consortium Committee (FLICC). This presence assists NTIS not only in sharing experiences with other federal information centers but also in learning from their activities. NTIS exhibits its products and services at regional, national and international conferences, such as the Online Conference, American Society for Information Science (ASIS), Special Library Association (SLA), American Chemical Society and the Frankfurt Book Fair.

Special focus today has been given to means of improving technology transfer in the present competitive global market. NTIS offers opportunities in many areas for joint ventures.

Joint ventures Joint ventures are an effective means of technology transfer. They are attempts to create value-added products and/or new services for novel or enhanced end-user needs. In the recent past, NTIS has been working closely with the private sector, trade associations and academic institutions to ascertain that they too benefit from the information NTIS acquires. A variety of joint venture programs have been established. These spin-off projects range from repackaging NTIS material, to meeting specific target audiences, to reviewing NTIS reports in professional and trade publications, to producing and disseminating R&D Alerts.

NTIS is now involved in working with contractors for converting data into microcomputer diskette formats, duplicating large quantities of diskettes, pre-mastering compact discs, and mastering, replicating, labelling and packaging CD-ROMs.

As an active participant with other sister agencies, NTIS continues to play a key role in federal efforts in information acquisition and dissemination. One such cooperative program is called STRIDE.

STRIDE Like most nations, the U.S. is committed to keeping pace with R&D efforts overseas. NTIS, in cooperation with the Department of State and the National Science Foundation, brings to the U.S. community information on R&D developments abroad. This is accomplished through the STRIDE program. STRIDE stands for Scientific and Technical Reporting and Information Dissemination Enhancement. The project is a result of Presidential Order 12591, which states as its mission: "... to ensure scientific research and technology developed abroad.²" The emphasis is on delivering S&T information to the end-user quickly and pointedly. The *Foreign Technology Abstract Newsletter* was developed as a result of this program. An interesting aspect of STRIDE is that it is targeted toward R&D managers as much as bench scientists or field engineers. Managers are a group that need to see trends and have priority areas digested. STRIDE helps to fill those needs.

While continuing to work with existing programs and technologies, NTIS strives to keep pace with global advancements in information storage and retrieval. Like most information movers, it looks forward to the year 2000, and has charted its own course of direction and plans.

Future Directions

Since the industrial revolution, the pace and direction of S&T communication has remained relatively stable. Recorded scientific and technical information has, indeed, doubled about every 17 years throughout the history of mankind, and there has been a great deal of talk about "information explosion" and our inability to cope with it. However, the growth of the STI literature largely reflects the growth in expenditures and number of scientists and engineers rather than an increase in individual output. On the other hand, there are some significant implications concerning this growth of STI in the U.S. and elsewhere. Such growth means that when scientists and engineers graduate from college they are exposed to only about one-sixth of the knowledge that is created throughout their careers. They must continue to learn and take advantage of new scientific and technical knowledge. Furthermore, educational institutions should not only educate scientists and engineers concerning existing knowledge but also teach ways of learning how to continue to learn and develop skills to use STI communication tools and skills in applying new knowledge.

The best opportunities to help solve the problems of the information explosion are grounded in new technologies. Figure 6 shows graphically three concepts with regard to the direction of S&T communication: type of information, media of delivery, and retrieval support system. These are graphed generally according to time of development. The graphic is oversimplified, but makes the point that we are looking at new technologies and new ways of user interfaces. Developments, particularly in software, are leading us toward hypertext, voice analyzers and intelligent machines capable of customized information production storage and retrieval. Emphasis appears to be focused on immediacy of access for input and retrieval of targeted information for select users.

In addition to new technology interfaces, it is critical that the major institutional structures keep pace with technology for its own operations.

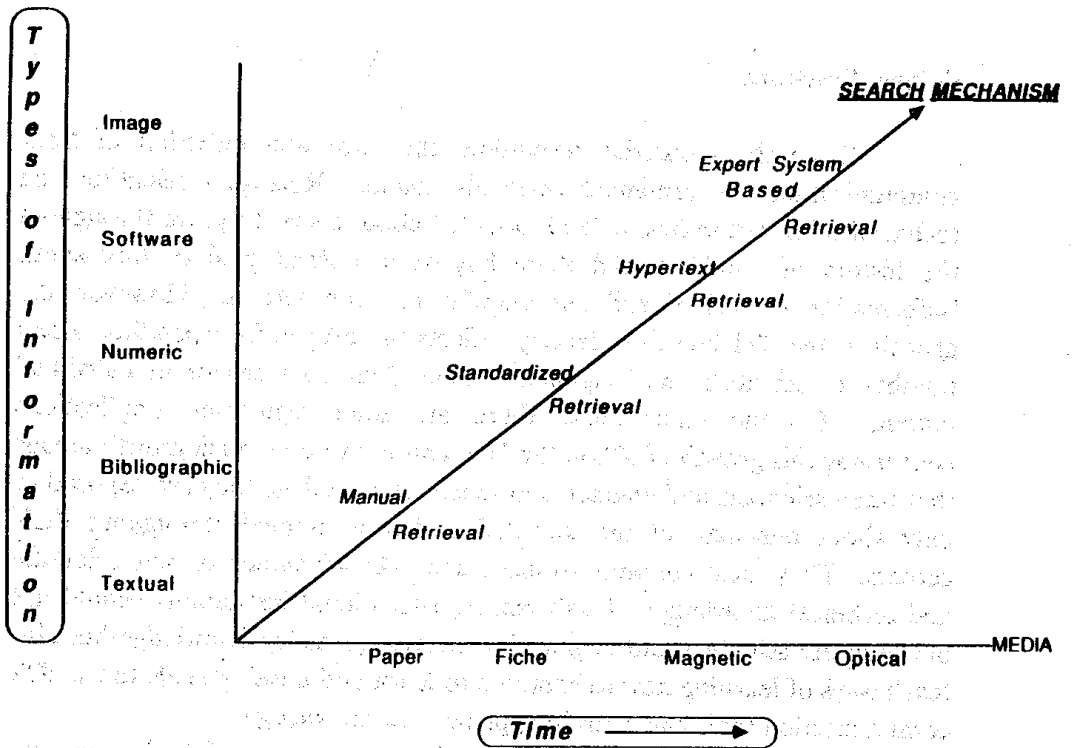


Figure 6: Media & Types of Information

Modernization Program

With the changing technologies, NTIS has embarked on a major modernization program to capitalize on the latest available hardware and software to move information from producers to users. In 1991 NTIS intends to use approximately \$500,000 to fund modernization efforts.

The modernization plan includes the following:

- The design and installation of a new integrated financial management system
- Increase of internal access to information
- Implementation of a new input processing system
- Operation of a bulletin board for users of NTIS
- Increase of office automation capabilities (presently more than 60 percent of the technical staff has desktop computers)

- Development of computer-assisted indexing
- Acquisition of bar coding equipment
- Upgrading of the Selected Research in Microfiche (SRIM) system

The plan includes an optical disk order processing system. This system will provide for full text storage of reports in electronic form and an on-demand printing system. It is expected to eliminate not only manual location, pulling and filing time but also to reduce costs. This should reduce the turnaround time by three to five days by making customers' orders available for fulfillment sooner than the present system.

With direct emphasis on quality and service, NTIS management is aiming to provide the discerning customers the information they need in the format they like and at a price they can afford.

In an effort to increase the U.S. competitive edge in a global economy, NTIS continues to remain active in identifying and acquiring industrial and technical information from those who produce it and disseminate it to those who need it. The various vehicles through which such information is presented are important because the potential impact of these vehicles of communication appears to be different (Figure 3).

Issues and Opportunities

For information provision units, one of the main challenges is to ascertain that specific information, regardless of national origin and whether it is in the preferred format, is available and disseminated in a timely fashion. To this end, it is imperative that all relevant information, regardless of national origin, be acquired regularly, input properly and transmitted appropriately. To accomplish this, it implies:

1. Knowledge of all sources of information origin for cooperation in acquisitions
2. Application of appropriate technologies for efficient input, manipulation and delivery of such information
3. Identification of the user community for development of marketing programs for diffusion of information
4. Understanding of the searching pattern for development of user friendly software, and more importantly

5. Cognizance of the use behavior for effective transmission to scientists, engineers and decision makers

Opportunities exist today, given the present state of technologies, to address the issues identified here. However, the question is: are we ready to make the most of it? As Louis Pasteur implied, opportunities favor prepared minds. As today's information producers, users, and movers, we can play a significant role through joint concerted efforts in shaping the direction of tomorrow's information producers, users, and movers. Additionally, since the ultimate producers and the users of information will remain humans, customer satisfaction--not only in terms of content but also in terms of quality and customer service--will continue to remain a key ingredient in meeting the changing needs of the S&T community.

The following are some recommendations that will assist NTIS in maintaining the user responsiveness it provides today to its users:

- Increased cooperation in timely input from the international community
- Adherence to standardized TR indexing practices
- Joint programs in development in automatic indexing
- Provision of information, preferably in machine readable (magnetic or optical) media from primary and secondary input sources
- For foreign language reports, submission of English language bibliographic information and abstract
- Submission of the full text of document preferably in magnetic or optical form
- Joint programs in machine aided translations
- Joint programs in enhancing information (text, numeric, image and graphic) storage and retrieval techniques
- Efforts toward understanding information seeking behavior of scientists and engineers nationally and internationally.

Joint programs are emphasized with the international community because NTIS is a unique organization. It is self supporting. Additionally, joint programs with organizations having similar objectives breed increased synergy in accomplishing set objectives.

Conclusion

NTIS was one of the first government S&T databases to be accessible on-line. It has successfully survived the test of time and technological changes. It remains sensitive to meeting the changing needs of the end users. Through NTIS, many scientists, globally, have disseminated and acquired information.

Global equity in exchange and access to comparable S&T information should lead toward true cooperation and advancement of science at large. International cooperation towards this end will provide the necessary impetus for each nation to be increasingly creative and innovative. Unrestricted access to global literature will prevent duplication of research efforts, and assist in reallocation of resources toward other important objectives.

Such reciprocity should also provide other benefits. For example, from a scientists' perspective, it will provide the appreciation and recognition of their works and rightfully call for the protection of their intellectual property. From a political perspective, increased scientific cooperation could lead to increased political cooperation.

Today, with direct emphasis on quality and service, NTIS management is aiming to provide discerning customers the information they need, in the format they like, in the time they prefer, at a price they can afford.

NOTES

1. E. Wigner. "Predely naudi" (The limits of science). In: *Etudy o simmetrii*. Edited by E. Wigner. Moscow, Mir, 1971. pp.171-172.
2. STRIDE, *Facilitating Access to Science and Technology* (April 10, 1987)