NASA Scientific and Technical Information for the 1990s

GLADYS A. COTTER*

In this article, we outline our projections for NASA scientific and technical information (STI) in the 1990s. NASA STI for the 1990s will maintain a quality bibliographic and full-text database, emphasizing electronic input and products supplemented by networked access to a wide variety of sources, particularly numeric databases.

STI for the 1990s will build on the accomplishments of the 1980s. Although budgetary realities are a constraint, there is much we can accomplish by applying new technology creatively. The changes now in process will provide a springboard for further change.

CHANGING REQUIREMENTS FOR MANAGING NASA STI

NASA is by concept and by practice an advanced-technology agency. The thrust of the 1990s will be toward a more comprehensive, systematic use of computer and communications technology for all phases of NASA STI.

Computers for STI use in the 1960s and 1970s and continuing into the 1980s were tools to assist and, where possible, replace manual operations. STI managers hoped that computerization would prove cost-effective; this was not always so. However, many new capabilities were realized. NASA will strive in the 1990s to use technology to meet new demands of users in a more cost-effective manner. The reconditioned Scientific and Technical Information Modular System (STIMS) and reconditioned RECON command and access structure are expected to be completely installed and operational at the NASA STI Facility by June 1990. This will position NASA to take advantage of state-of-the-art technology for several years into the 1990s, to handle the expected volume of electronic input and output, and to network effectively.

CURRENT AND FUTURE TECHNOLOGY

As the 1980s closed, neither scientist, engineer, nor STI professional had to be convinced

*Direct all correspondence to: Gladys A. Cotter, NASA Office of Management, Code NTT, Washington, DC 20546-0001.

that menu-driven systems, common command languages, gateways, and networking were hard realities. We all use them; available hardware and software determine our methods of working. Anticipated technology influences the systems we install: a well-designed system is developed and implemented to interface with and evolve into the next generation system. Available technology controls STI use to a degree most of us never anticipated, and to an extent as yet undetermined. Most of us still think and act as though we were still in a non-computerized environment, and don't know well enough yet what we can reasonably expect from our personal computer or workstation, our local area network (LAN), our mainframe, our search and retrieval software, or our database management system. Workstation technology as pioneered for the Space Station may become the prototype for what the efficient workplace will become: more comfortable, less stressful, encouraging relaxed but alert attentiveness. STI access will be an integral part of this workstation development.

Artificial intelligence (AI), expert systems, and knowledge-based systems will be used in the development of future STI systems and to focus design and engineering of new and modified STI subsystems. These technologies are workable for narrowly defined activities. They are largely simulation routines, but they frequently try to simulate the wrong thing: manual performance of an activity or too broad-based an application. As we become more comfortable in our computerized environment, we will be better able to develop and use systems that will increase the efficiency of STI input, processing, search, and retrieval.

Electronic Output

To a large extent, new NASA STI technology has been determined and defined in the 1980s and the groundwork laid for implementation and expansion in the 1990s. Quality of the NASA STI database should be improved in both content and timeliness to receive electronic input from those whose input is now on paper. STI professionals will be working with the NASA installations to receive electronic input, first of the bibliographic entry of their publications, then the full text. While the NASA installations have indicated interest in this NASA-wide system, they will have to agree on common elements and convert to compatible hardware, software, and formats. The next step will be to obtain electronic input from NASA contractors. NASA installations and contractors already process their documents electronically; given standard formats and instructions, they will be able to transmit their documents electronically, thus moving toward a tightly-knit agency-wide STI activity.

CHANGING USER NEEDS FOR STI
SEARCH AND RETRIEVAL

As part of their daily research and development (R&D) activities, scientists and engineers at NASA installations and with NASA contractors acquire and use STI from NASA's database. Often the act of acquisition is performed by an information specialist rather than by the scientist or engineer; sometimes it is a joint effort of both. Use of the information specialist for information retrieval is frequently a chargeback service.

NASA STI professionals are themselves major users of NASA STI. They use it in order to keep up with the activities of the scientists and engineers. The traditional services they provide to the scientists and engineers are necessary but not sufficient; NASA scientists and engineers need to have access to more than one information retrieval system. To assist

these researchers in developing a comprehensive perspective, the STI professional must be familiar with and able to use many other information retrieval systems: federal and commercial, bibliographical, full-text, or numerical. The amount and type of assistance needed varies from client to client and occasion to occasion.

NETWORKING

The NASA STI professionals must be at home with different computer hardware and software and with a variety of networks. Nearly every researcher in the NASA community has his or her own personal computer or workstation and is on at least one LAN. Pointers to data provided by traditional STI tools are becoming less and less useful and effective for the NASA scientist or engineer. Documents retrieved can be as often frustrating as useful. Searches resulting in a long printout of NASA/RECON entries, or a series of entries viewed on the screen, may be baffling to the untrained user. Documents or substantial abstracts may supply facts, but the researcher's immediate need is for data that can be manipulated on the computer. Receiving a tape in the mail may be helpful, but more helpful is the ability to target and access the necessary data within minutes via a network the researcher hadn't known existed, using protocols that were previously unfamiliar.

NASA STI networking will make use of the approach already developed for scientific networks within NASA to link researchers to networks outside NASA. This methodology investigates, defines, and implements a unified approach to developing and interconnecting data systems so that users may rapidly obtain information about data of interest to them, and to enable efficient distribution of up-to-date information about data throughout the systems. In an effort coordinated by the STI Division, representatives from participating data systems will work together to:

- determine, document, and implement as fully as possible a set of guidelines or recommendations on the concepts and capabilities of an interoperable data system;
- determine, together with scientist and engineer users, requirements for interoperability;
- develop and implement interconnections so that a user may search for data sets or data systems of interest, starting with a directory, and then transfer through computer networks to the places where further information is available, and then to the data for access and manipulation;
- develop a common directory interchange format for sharing information among the data systems for input and update of directory-level information; and
- assist a user in searches among the data systems by automated transfer of information describing the user's requests.

An initial step to networking is linking NASA/RECON with the National Space Science Data Center (NSSDC) and the Space Physics Analysis Network (SPAN) to allow mutual access by users. Hardware and software interface at the NASA STI Facility will permit direct connection to the LAN at NASA Goddard Space Flight Center (GSFC). Thus users of NASA/RECON who find references to a particular database may "hotkey" to the NSSDC Master Directory and be led via the network to access that database. Similarly, a NSSDC user of a database on the SPAN network may switch to NASA/RECON and search for references to documents about that database.

Initial STI networking efforts will emphasize coordination of existing networks and clearinghouses, either within the aerospace community or related to it. The NASA Office of Space Flight (the Space Shuttle program) and the Office of Space Station operate information systems that can be accessed via links similar to the NASA/RECON-NSSDC link. Systems for accessing materials data and wind tunnel data are candidates for networking. A clearinghouse for applied and engineering data to complement NSSDC's activities for space science will be explored. Although only 2 percent of NSSDC's data are available online, it is a useful 2 percent.

INTERAGENCY AND INTERNATIONAL COOPERATION

Networking provides the basis for input to the NASA STI Facility from the NASA installations and also for information processing links with other federal agency large-scale STI operations such as the National Technical Information Service (NTIS), Defense Technical Information Center (DTIC), and the Department of Energy Office of Scientific and Technical Information (DOE/OSTI). These are represented in the interagency group of the departments of Commerce, Energy, NASA, and Defense Information (CENDI). The NASA STI Facility currently processes computer tape input from these agencies using its computer-aided indexing capability; networked input will allow direct transmission of this information, or distributed access.

The current open political climate presents a challenge to develop interoperability between U.S. government STI and the STI of the U.S.S.R. and Eastern Europe. NASA has a keen interest in this because of the active Soviet space program and existing U.S.S.R.-U.S. cooperation. The U.S.S.R.'s Institute for Scientific and Technical Information (VINITI) has indicated a willingness to share its burden of providing several hundred thousand abstracts a year of the world's scientific and technical literature. VINITI issues several dozen series of bibliographic journals. Most of these are in Russian, although some are abstracted in English. Translation is a mutual problem. VINITI's operations are already computerized, offering the possibility of networked access for searching and for inputting directly into the NASA STI database. Recent availability of desktop Russian-to-English translation software will assist in converting Russian language abstracts to English. NASA's computer-aided indexing capability can be adapted to translate the universal decimal code used by VINITI to NASA thesaurus terms.

A review of existing NASA STI commitments to the STI programs of the European Space Agency (ESA), the Advisory Group for Aerospace Research and Development (AGARD), and NATO, and the role each of these organizations might play in light of the new openness of the U.S.S.R. and Eastern Europe, will be undertaken in the 1990s.

ENTREPRENEURIAL STI AT NASA

NASA's STI services must be tailored to meet the needs of the NASA R&D activities. Instead of stating "these are the services we offer," we must ask the question "What are the services you need?" We must confirm that existing programs are needed and find innovative ways to implement new services. NASA STI managers and professionals have to play an aggressive role in working with the researchers to identify what services and information they need, and they must be flexible to implement unique services required by and paid

for by subsets of the R&D community. A big part of the cost of STI projects (as for any technical project) goes for developing software to support new approaches and to create network communications that work.

To provide STI services to researchers, NASA STI professionals must identify the services needed, determine development cost and time, and provide the appropriate program manager with the opportunity to fund the project so that the STI services they need can be developed in a timeframe that coincides with their programmatic requirements. Services developed in this manner will obviously have high usage because they will be developed to meet specific program-oriented goals. Integrating STI services into programmatic environments will ensure that STI services are an essential component of NASA R&D and that NASA receives the full benefit of being able to quickly identify relevant STI (past and present) and build that knowledge into current and planned R&D activities.

Analysis, planning, and management for such development projects must be formal, rigorous, and businesslike. Milestones must be projected for implementation and costs. Emphasis is on the bottom line: exactly what does the customer need and what is the most cost-effective strategy for meeting that need?

Program-oriented STI projects will bring NASA STI professionals in closer collaboration with NASA's R&D program managers because they will participate in the R&D process. The STI professional will become a partner in the program by devising information strategies tailored to assist programmatic success.

STI managers and professionals will continually improve their insight into the evolving needs, desires, and special characteristics of aerospace science and engineering. At the same time, the NASA scientists and engineers will become more and more attuned to what the NASA STI program can do for them. This partnership provides a foundation for accelerating the NASA R&D objectives.

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