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Modernization of the NASA Scientific and Technical Information Program

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NASA
STI PROGRAM
SCIENTIFIC &
TECHNICAL
INFORMATION

ABSTRACT

The NASA Scientific and Technical Information Program utilizes a technology infrastructure assembled in the mid 1960s to late 1970s to process and disseminate its information products. When this infrastructure was developed it placed NASA as a leader in processing STI. The retrieval engine for the STI database was the first of its kind and was used as the basis for developing commercial, other U.S., and foreign government agency retrieval systems. Due to the combination of changes in user requirements and the tremendous increase in technological capabilities readily available in the marketplace, this infrastructure is no longer the most cost-effective or efficient methodology available. Consequently, the NASA STI Program is pursuing a modernization effort that applies new technology to current processes to provide near-term benefits to the user. In conjunction with this activity, we are developing a long-term modernization strategy designed to transition the Program to a multimedia, global "library without walls." Critical pieces of the long-term strategy include streamlining access to sources of STI by using advances in computer networking and graphical user interfaces; creating and disseminating technical information in various electronic media including optical disks, video, and full text; and establishing a Technology Focus Group to maintain a current awareness of emerging technology and to plan for the future.

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INTRODUCTION

The NASA Scientific and Technical Information (STI) Program is a combination of systems, functions, products, services, and information professionals that share the common mission of providing for the "widest practicable and appropriate dissemination" of information concerning NASA activities and research results[1]. The Program is geographically and organizationally dispersed across NASA Headquarters, each of the 13 NASA Research and Flight Centers, and service centers such as the Center for AeroSpace Information (CASI). The Program provides interfaces to and from other U.S. government agencies engaged in the collection and dissemination of scientific and technical information and to and from international aerospace agencies such as the European Space Agency (ESA).

The Program's user community includes NASA scientists, engineers, and managers; NASA contractors; other U.S. government agencies and their contractors; U.S. industry and the academic community; and the international aerospace community. In total, over 7,000 entities are registered with the Program but since many of these are actually registered at the intermediary and organizational level, the number of end users reached by the Program is much greater. For example, the number of registered international users in January 1992 was 700 although the potential end user population derived from these registrations could be as high as 40,000 [2].

A central inventory of all information products acquired by the Program is maintained at the CASI in the STI Database. Included are roughly three million NASA research reports and technical memoranda, conference proceedings, and journal articles within NASA's scope of interest. The STI Database is used to generate hard copy and online products such as the <u>Scientific and Technical Aerospace Reports</u> (STAR) announcement series and the NASA REsearch CONnection (RECON) online database.7

When developed in the 1960s, RECON positioned NASA as a leader in online dissemination of STI; the RECON retrieval engine became the basis for other commercial and government agency online systems. In the intervening years, however, the NASA version of the system was only upgraded in minor ways. Today RECON remains a command-driven bibliographic retrieval system. Users state that in addition to these capabilities, they need online access to the full text of published and other STI, improved ways to search this information, and capabilities for integrating the results across diverse formats and sources. In addition, the highly distributed and diversified nature of the NASA user community requires that we begin to take advantage of advances in computer systems networking in order to deliver STI directly to individual end users at the desktop. Several NASA user surveys conducted since 1990 validate these requirements [3].

At the same time, the reality of continually shrinking U.S. government budgets requires us to develop a strategy for streamlining our information products and delivering them more cost effectively. We need to focus, for example, on replacing selected hard copy documents with electronic media in order to reduce production and user costs. And, we need to enhance product accuracy, completeness, and the timeliness of delivery to avoid the high cost of research duplication and missed research opportunities.

BACKGROUND

Beginning in late 1990, the Program adopted and applied business system planning methodologies to develop and refine a Strategic Plan [4]. Among the many objectives defined in the Plan, four are key to Program modernization:

1. Enhance the quality of our products and services through a focus on the customer

2. Enhance and improve access to STI resources for the user community

3. Increase the scope of and access to foreign source materials

4. Improve current operations

In line with the first objective, the Program reoriented its focus to the Total Quality Management (TQM) philosophy of providing customers with products of value that meet their needs through continuous improvement of the production process. The Program was reorganized internally to support a proactive user outreach function. A board of senior NASA scientists and managers, the STI Council, was formed to provide advice on user requirements and monitor Program progress.

In the Spring of 1992, the Program established a STI Technology Focus Group composed of representatives from across the STI Program. This group is responsible for maintaining a current awareness of emerging technologies and developing recommendations on the application of the technologies to Program modernization.

User inputs and technology surveys are being synthesized continually to identify and refine modernization strategies for each of the critical Program objectives. A summary of current objectives and modernization strategies is presented in Table 1 on the following page.

Table 1
NASA STI Program Objectives and Modernization Strategies

OBJECTIVE	MODERNIZATION STRATEGIES
Provide for quality enhancement through a focus on the customer	• Develop user outreach function • Establish formal mechanisms for user input and feedback
Enhance and improve access to STI resources	• Utilize Graphical User Interfaces (GUIs) • Provide applications and communications gateway interfaces • Develop value-added search tools • Implement full text search • Expand coverage of multimedia products • Strengthen intra-government exchange agreements
Increase scope and access to foreign source materials	• Expand source exchange agreements • Automate source translation • Provide for world-wide connectivity
Improve current operations	• Upgrade support systems • Evolve electronic publishing, document exchange, and distribution capabilities

THE MODERNIZATION APPROACH

The Program's approach to modernization can be characterized as one of "evolutionary development." This approach is consistent with current U.S. Government policy and procedures designed to reduce the risk and cost of new system acquisition through the cautious, incremental building of system components. It emphasizes the use of already proven commercially available technology and other government developed or public domain products. Also emphasized is the use of standards to ensure the lowest cost migration path for future enhancements and to support the greatest potential for interoperability among and between system components.

Central to the evolutionary approach is the use of prototyping for rapid fielding and testing of system components that can be re-engineered and reused in later versions based on lessons learned from prototype users. Since 1990, the STI Program has initiated several prototype projects that address modernization objectives. Four of these prototypes are discussed in the following section. While all of the prototypes are intended to demonstrate and test a long term concept with the user community, some of the prototypes may evolve into production systems.

Table 2 provides a summary of modernization strategies, current projects and prototypes, and long-term concepts. Highlights of these are provided in the following section.

TABLE 2
NASA STI Modernization Strategies, Current Projects and Long Term Concepts

MODERNIZATION STRATEGY	CURRENT PROJECTS	LONG TERM CONCEPTS
User Feedback/Outreach Functions	NASA STI Users Group, Bulletin Boards, Consolidated HELP Desk, User Surveys, Customer Satisfaction Metrics, STI Awareness Campaign	Permanent electronic-based NASA STI Users Group
GUI, Gateway Interfaces, Value-Added Search Tools	NAM Prototype	Enterprise-wide tailorable GUI, Gateway(s) to all required sources, both internal and external
Full Text Search/ Multimedia	FTS Alternatives Evaluation; Nonprint Cataloging Project	RECON replacement/ migration to FT/image document retrieval; Extended search capabilities
Electronic Publishing	Electronic Publishing Prototype; ASTRO/CD Prototype	Full life cycle electronic acquisitions, publishing, and dissemination; optical archiving
Expansion of Coverage	NTC Interface, Exchange agreement enhancements	Expanded sources; increased gateway access and shared processing
Worldwide Connectivity	Country-by-country connectivity for electronic document exchange	Global STI Network
Automatic Translation	SYSTRAN Evaluation Prototype	Full life cycle support for translations, minimizing human intervention
Support Systems Upgrade	Downsizing; selected operational upgrades and process improvements; OCR Prototype	Enterprise-wide MIS, Integration with operational processes

CURRENT PROJECTS AND LONG TERM CONCEPTS

User Outreach/Feedback Functions

The past two years have seen the implementation of several new user input and feedback mechanisms including a consolidated centrally located HELP desk; several user surveys; monthly customer satisfaction reviews; more extensive quarterly functional reviews with each of the NASA user installations; and the initiation of a NASA Users Group. The current users group concept involves the formation of special discipline or technology-based focus subgroups that serve as forums for the evaluation of current products and for the generation of requirements for new products.

The most striking thing that our users and potential users tell us about their needs is the requirement for a greater awareness of the Program's offerings. In response, we have implemented an extensive user awareness campaign that includes the use of Conference exhibits, pamphlets, video, and other media. Many of these materials are also included in the orientation package presented to every new NASA employee. Continued expansion of this awareness will require more proactive one-on-one contact with our user community, in particular, with the scientists and engineers who manage critical NASA programs and projects.

The easy flow of information to and from our users depends on expanding access capabilities such as global E-mail, electronic bulletin boards, and online point-of-sale evaluation forms. These capabilities must be made available at the desktop along with the products that are used on a daily basis and are delivered over commonly used networks such as the Internet. In the long term, we see these capabilities made available through the evolution of prototypes such as the NASA Access Mechanism (NAM) described below.

GUIs, Gateway Interfaces, and Value-Added Tools

Implementation strategies for providing graphical user interfaces (GUIs), gateway communications, and other value-added tools are combined in the NAM prototype. The prototype was developed using the results of an initial analysis of researcher requirements at three NASA installations. Beta testing of the prototype at eight NASA installations in the Fall of 1992 will be used for further refinement of the product.

A snapshot of the NAM main menu is contained in Figure 1. The menu's first push button option, on the left, provides access to the three databases frequently used by the NASA user community: RECON, STN Inspec, and STN Math. Also provided under this first option is a database locator tool that assists users in identifying the best of the available sources. Other main menu options provide access to the NASA Aerospace Research Information Network (ARIN); Email access; a peer locator tool; bulletin board access; and access to utilities and information networks such as WAIS, USENET news, and an electronic version the the NASA Phone Book.

Figure 1
NAM Prototype Main Menu
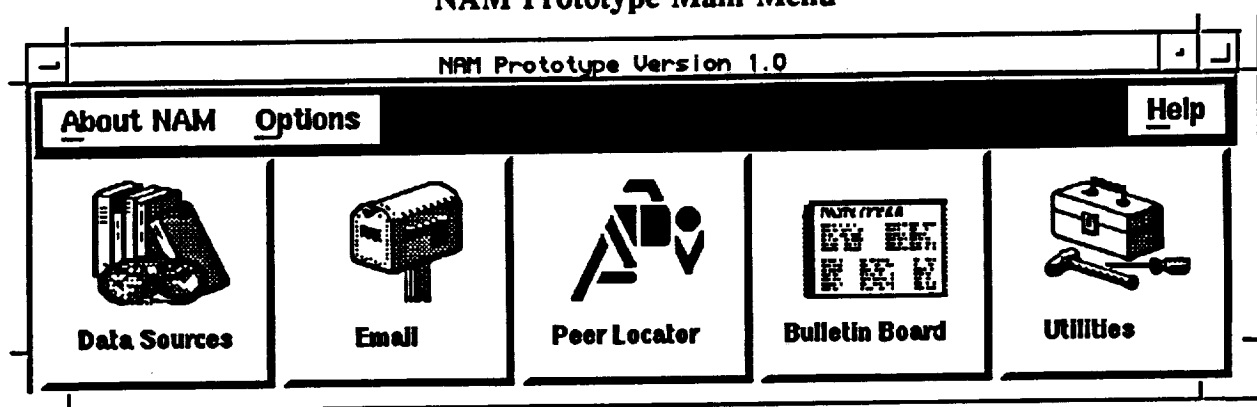
NAM database search screens support the entry of search parameters and the presentation of results within a Windows-based presentation format. Assistance is provided for three levels of user expertise along with tools for viewing, extracting, and saving retrieved information.

NAM is being developed in a multi-vendor platform environment. The product design emphasizes modularity and the use of applications and communications standards that will provide for migration to additional platforms. On the applications level, the OSF/Motif tool kit is used for the GUI and the Standard Query Language (SQL) is used for database functions; the screen formats ar X-Windows based. The communications tool kit is written in PERL application language and is TCP/IP based.

Evolutionary enhancements to NAM could include the capability to alter the user interface to the needs of specific user subgroups, the ability to perform graphics-based searching such as chemical structure searching, and the ability to visualize numeric data obtained remotely.

A long-term strategy is to expand the application of the GUI and gateway technology developed under NAM to provide easy-to-use, uniform, and seamless interfaces to all NASA STI Program component and external partner systems.

Full Text Search and Multimedia

The long term concept for this modernization strategy is to replace the current RECON system with a commercially available alternative that will permit migration from abstract-only documents to full-text documents with embedded images and links to other media (graphics, video, and audio). The STI Technology Focus Group is now evaluating the required technology with an eye towards supporting extended searching capabilities as well (for example, fuzzy searching, concept searching, and natural language).

A CD-ROM prototype, Aerospace Scientific and Technical Research on CD-ROM (ASTRO/CD), provides an interim alternative to the use of the RECON back file. The first version of this prototype contains bibliographic citations of technical reports and journal articles accessioned into the NASA inventory database from 1988 to 1992. The prototype is being released to selected NASA users who will evaluate the product and participate in its refinement.

A supporting project is underway at NASA CASI to develop procedures and policy for the cataloging, labeling, packaging, and storing of multimedia materials. An immediate result of the project will be the production of a central catalog of NASA audio and video materials. Currently these materials are stored and distributed by each of the NASA Centers individually.

Electronic Publishing

The Program's long-term objective in the area of electronic publishing is to implement a full program-wide life cycle document management system that links distributed document creation sites with centralized distribution, administration, and archiving services. A first-phase prototype designed to evaluate this concept is underway at NASA Headquarters, tCASI and two of the NASA Research Centers. The prototype makes use of commercial off-the-shelf turnkey technology interfaced to existing local area networks and desktop publishing equipment.

Prototype evaluation results will be used in 1993 to define migration requirements, document retrieval, and database system interfaces as well as implementation phasing.

Expansion of Coverage

The objective of expanded coverage is being achieved through several projects designed to strengthen information exchange agreements and to develop new arrangements for sharing common processing such as document management, translation, and cataloging. An example of such an arrangement is a cooperative project with the National Translations Center (NTC), a clearinghouse located at the Library of Congress, that provides English language translations of technical reports, journal articles, conference papers, and patents. The STI Program makes NASA translations available through the NTC, the NTC provides NASA with regular updates to the clearinghouse's catalog of holdings. The NTC records are loaded into the NASA STI union catalog that is accessible at all NASA installations through the ARIN system.

In the international arena, the Program has been working with its partners in Australia, Canada, and Israel, and with ESA, to strengthen and improve information exchange processes [5].

World-wide Connectivity

The near-term approach to achieving connectivity between the STI Program and its international partners is based on developing country-by-country arrangements for selected electronic functions such as document exchange and Email.

The long-term concept, referred to as the "Global STINET." awaits the adoption of international data and communication standards and other technology that will permit the interoperability of and access to multinational STI databases.

Automatic Translation

The strategy for the Program's automatic translation project is to reduce the extent of labor intensive activity required for translating foreign STI and to speed the distribution of the product to the end user. In a first step prototype addressing this strategy, we adopted the U.S. Air Force-developed SYSTRAN system for translating Russian, German, and French STI documents. Although some benefits have been realized, the prototype requires considerable human intervention, especially for pre- and post-translation processing. Further evolution of the prototype awaits commercial development of extensions to support these processes.

CONCLUSION

The previous two years have given rise to early development of STI Program modernization concepts and first phase prototypes for testing these concepts [6]. Central to the effort has been the strengthening of user outreach and feedback functions that allow us to focus on the customers and their needs.

It is now possible to define measurable near-and long-term tactics to achieve our modernization goals. The next step in the process is to develop a working modernization plan that will guide our evolution to the target concept of a "library without walls."

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REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE MARCH 1993	3. REPORT TYPE AND DATES COVERED TECHNICAL MEMORANDUM

4. TITLE AND SUBTITLE
Modernization of the NASA Scientific and Technical Information Program

5. FUNDING NUMBERS

6. AUTHOR(S)
G. Cotter, J. Hunter, K. Ostergaard

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
NASA STI Program

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, DC 20546

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
TM-108984

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
UNCLASSIFIED - UNLIMITED
SUBJECT CATEGORY

12b. DISTRIBUTION CODE

13. ABSTRACT *(maximum 200 words)*

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14. SUBJECT TERMS
modernization, information, electronic media

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT UNCLASS	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASS	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASS	20. LIMITATION OF ABSTRACT UNLIMITED