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Technical Report

AD 640 100

STUDY OF MECHANIZATION IN DOD LIBRARIES AND INFORMATION CENTERS

BOOZ · ALLEN APPLIED RESEARCH INC.

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STUDY OF MECHANIZATION IN DOD LIBRARIES AND INFORMATION CENTERS

Submitted to

Defense Supply Agency
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BOOZ·ALLEN APPLIED RESEARCH INC.

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ABSTRACT

This report summarizes the on-site study of mechanization in DoD libraries and information centers. Included are presentations and evaluations on thesaurus building, file structure, input processing, serial control, selective dissemination of information, circulation control, equipments being used, recommendations on information retrieval systems, observations on organization, operation and application, and summaries on mechanization status, scope and size of collections, and COSATI subject area breakdowns. 76 facilities were visited; individual reports were generated for 35. Abstracts for the 35 reports and their DDC AD numbers are included.

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C. DD FORM 1473 FOR THIS FINAL REPORT

LIST OF FACILITIES SURVEYED

The following is a listing of the 76 major technical libraries and information centers of the Department of Defense that were visited during the BAARINC survey, together with their location and abbreviations. They are listed in alphabetical order, by abbreviations where abbreviation was possible.

ABBREVIATION	FACILITY
ACIC	Aeronautical Chart and Information Center Technical Library St. Louis, Missouri
AEDC	Arnold Engineering Development Center Tullahoma, Tennessee
AFCRL	Air Force Cambridge Research Laboratories Technical Library L. G. Hanscom Field Bedford, Massachusetts
AFFTC	Air Force Flight Test Center Technical Library Edwards AFB, California
AFIT	Air Force Institute of Technology Library Wright-Patterson AFB, Ohio
AFML	Aerospace Materials Information Center Air Force Materials Laboratory Wright-Patterson AFB, Ohio

ABBREVIATION	FACILITY
AFML	Ceramics & Graphite Information Center Air Force Materials Laboratory Wright-Patterson AFB, Ohio
AFOSR	Air Force Office of Scientific Research Washington, 25, D. C.
AFRRI	Armed Forces Radiobiological Research Institute National Naval Medical Center Bethesda, Maryland
AFWL	Air Force Weapons Laboratory Technical Library Kirtland AFB, New Mexico
AMC	Aeromedical Library USAF Aerospace Medical Center Brooks AFB, Texas
AMS	U. S. Army Map Service Library Bethesda, Maryland
APL	Applied Physics Laboratory--John Hopkins University Technical Library Silver Spring, Maryland
ARL	Aeronautical Research Laboratory Technical Library Wright-Patterson AFB, Ohio
ASDIRS	Army Study Documentation and Information Retrieval System Army Library The Pentagon Washington, D. C.

ABBREVIATION	FACILITY
BAMIRAC	Ballistic Missile Radiation Analysis Center University of Michigan Ann Arbor, Michigan
BCIC	Binary Constitution Information Center IIT Research Institute Chicago, Illinois
BDIAC	Battelle-Defender Information Analysis Center Battelle Memorial Institute Columbus, Ohio
BUSHIPS	Bureau of Ships Technical Library 18th Street & Constitution Avenue, N. W. Washington, D. C.
CDC AA	U. S. Army Combat Developments Command Library Artillery Agency Administrative Division Fort Sill, Oklahoma
CDC CBR	USA CDC CBR Agency Documentary Library Branch U. S. Army Combat Developments Command Fort McClellan, Alabama
CPIA	Chemical Propulsion Information Agency Johns Hopkins University Applied Physics Laboratory Silver Spring, Maryland
DASIAC	Defense Atomic Support Agency Information and Analysis Center General Electric Company 816 State Street Santa Barbara, California 93102
DASA Field Command	Defense Atomic Support Agency Field Command Library Sandia Base Albuquerque, New Mexico

ABBREVIATION	FACILITY
DASA Headquarters	Defense Atomic Support Agency Headquarters Library The Pentagon Washington, D. C.
DELSIE	Defense Logistics Studies Information Exchange Army Logistics Management Center Fort Lee, Virginia
DISC	Defense Industrial Supply Center Technical Library 700 Robbins Avenue Philadelphia, Pennsylvania
DMIC	Defense Metals Information Center Battelle Memorial Institute Columbus, Ohio
DPG	Dugway Proving Ground Technical Library Dugway, Utah
EA	Army Edgewood Research & Development Laboratory Edgewood Arsenal, Maryland
EPIC	Electrical & Electonic Properties Information Center Hughes Aircraft Company Culver City, California
ERDL	U.S. Army Engineer Research & Development Laboratories STINFO Division Fort Belvoir, Virginia
FA	Frankford Arsenal Library Philadelphia, Pennsylvania

ABBREVIATION	FACILITY
FTD	Foreign Technology Division Library Division Air Force Systems Command Wright-Patterson AFB, Ohio
Ft. Detrick	Chemical Biological Laboratory Ft. Detrick, Maryland
Ft. Monmouth	Technical Documents Center Fort Monmouth, New Jersey
HDL	Harry Diamond Laboratories Technical Information Office Washington, D. C.
IRIA	Infrared Information and Analysis Center University of Michigan Willow Run Laboratories Ann Arbor, Michigan
MEL	Navy Marine Engineering Laboratory Library Annapolis, Maryland
MPDC	Air Force Materials Information Center 13919 West Bay Shore Drive Traverse City, Michigan 49684
NAFI	Naval Avionics Facility Technical Library Indianapolis, Indiana
NASL	Naval Applied Science Laboratory Technical Library U.S. Naval Base Brooklyn, New York
Natick	Natick Laboratories -- U.S. Army Technical Library Natick, Massachusetts
NAVUSL	Navy Underwater Sound Laboratory Library New London, Connecticut

ABBREVIATION	FACILITY
NCEL	Naval Civil Engineering Laboratory Technical Library Division Port Hueneme. California
NEL	Naval Electronics Laboratory Technical Library San Diego, California 92152
NMC	Naval Missile Center Technical Library Point Mugu, California
NODC	National Oceanographic Data Center Washington, D. C.
NOL	Naval Ordnance Laboratory Library White Oak, Maryland
NOLC	U.S. Naval Ordnance Laboratory Library Corona, California
	Nondestructive Testing Information Analysis Center U.S. Army Materials Research Agency Watertown, Massachusetts
NOO	Naval Oceanographic Office Library Suitland, Maryland
NOTS	Naval Ordnance Test Station Technical Information Department China Lake, California
NPRA	Naval Personnel Research Activity Technical Library San Diego, California
NPS	Naval Postgraduate School Library Monterey, California
NRDL	Naval Radiological Defense Laboratory Library San Francisco, California
NRL	Naval Research Laboratory Technical Information Office Washington, D. C.

ABBREVIATION	FACILITY
NSMSES	Naval Ship Missiles Systems Engineering Station Technical Library Division Port Hueneme, California
NUWS	Naval Underwater Weapons Research and Engineering Station Library & Technical Information Division Newport, Rhode Island
NWL	Naval Weakpons Laboratory Technical Library Dahlgren, Virginia
OPTEVFOR	Operational Test & Evaluation Force Technical Library U. S. Naval Station Norfolk, Virginia
Picatinny	Picatinny Arsenal Technical Library Dover, New Jersey
PLASTEC	Plastics Technical Evaluation Center Picatinny Arsenal Dover, New Jersey
RACIC	Remote Area Conflict Information Center Battelle Memorial Institute Columbus, Ohio
RADC	Rome Air Development Center Library Griffiss Air Force Base, New York
RC	Reliability Central Rome Air Development Center Griffiss Air Force Base, New York
Recon Central	Reconnaissance Applications Branch Reconnaissance Division Air Force Avionics Laboratory Wright-Patterson AFB, Ohio

ABBREVIATION	FACILITY
REIC	Radiation Effects Information Center Battelle Memorial Institute Columbus, Ohio
RSIC	Redstone Scientific Information Center Redstone Arsenal, Alabama
SEG	Systems Engineering Group Technical Information Reference Branch Research & Technology Division Wright-Patterson AFB, Ohio
TAC	Tactical Air Reconnaissance Center Shaw AFB, South Carolina
TPRC	Thermophysical Properties Research Center Purdue University West Lafayette, Indiana
USAMRA	Army Materials Research Agency Technical Library Watertown, Massachusetts
VESIAC	VELA Seismic Information & Analysis Center University of Michigan Ann Arbor, Michigan
	Technical Library, AFL 2302 Wright-Patterson AFB, Ohio
WVT	Benet Research & Engineering Laboratories Technical Information Services Office Watervliet Arsenal Watervliet, New York

I. INTRODUCTION AND SUMMARY

1. PURPOSE OF THE STUDY

The purpose of this study was to obtain detailed information relating to the mechanized systems being planned, developed, and used within DoD technical libraries and information centers. The information gathered was to be organized, analyzed, and documented to provide a basis for the following:

- Determination of the present status of mechanization in the subject facilities
- Assessment of the costs and effectiveness of the information systems
- Definition of significant developed and developing techniques and problem areas
- Promulgation of the information to aid in the development and improvement of related systems.

In all, 76 facilities were studied during the period of this project. These are identified on pages x through xvii and their collection characteristics are described in Appendix A. Of these, 33 had significant mechanized systems in development or operation. Detailed information relating to the operation, the mechanized processes, program systems, files and routines, equipment used, future plans, and costs of systems at individual facilities is separately documented in individual facility reports. Readers interested in the specific data collected at each of the significantly mechanized facilities are referred to these reports. Thirty-five individual facility reports have been published which include the 33 with mechanized systems as well as two nonmechanized facilities. (The latter were surveyed prior to the final decision regarding the reporting scheme.) Abstracts for each of the 35 reports appear in Appendix B.

Summarizations of the above information and analysis relating to the basic objectives of this contract are presented in this report. Throughout the report, abbreviations are used rather than complete names of the facilities surveyed. A glossary of the abbreviations appears on pages vi through xiii.

2. STUDY APPROACH

The study was conducted in three phases. Pilot Interviews, Data Collection, and Data Analysis.

Pilot Interviews in four libraries were completed in July 1965. The purpose of this phase was to establish a realistic and comprehensive survey procedure to insure adequacy of the information to be collected.

Interviews were conducted at the libraries at the Bureau of Ships, Ft. Detrick, Harry Diamond Laboratories, and Foreign Technology Division of the Air Force Systems Command. These were selected because of their proximity and relatively advanced degree of mechanization.

The Data Collection Phase began in July 1965 and continued for seven months. For this phase, the libraries and information centers were organized into 11 areas: Southeast; Southwest; Washington, D.C.; Boston; Columbus-Dayton, Ohio; Northern California; Ann Arbor-Suttons Bay, Michigan; Indianapolis-Chicago; New York-Philadelphia; Southern California; and, the Desert Region. Data were collected by two teams, each of which included a librarian and a computer specialist. Of the 76 facilities visited, 10 were DoD, 17 were Army, 26 were Navy, and 23 were Air Force. Facilities to be reported on in depth were selected on the basis of the degree of usage of computers or of novel application of other equipment. Each report was reviewed and approved by the facility concerned before publication.

Information analysis began in mid-December 1965 and continued for five months, the major activity being in the final two months. This final report of the project presents the results of the analysis and a summary of the information collected.

3. SUMMARY OF FINDINGS OF THE STUDY

(1) Status of Mechanization

Table 1 summarizes the mechanization status of the 33 facilities that have significant mechanized systems. Of these, six have relatively sophisticated overall program systems. These are BuShips (Ships System Command), FTD, Fort Detrick, APL, NOTS, and RSIC. Most of the facilities combine mechanized and manual operations. In almost every one of the 33 facilities, a mechanization improvement project was underway or planned.

It is notable that none of the facilities has developed novel programming techniques (e.g., automatic abstracting and indexing), and none has expressed the need or desire to do so. All are dependent upon proven and well-exploited software techniques.

Only one facility owned (leased) the computer it used (Mechanical Properties Data Center). It is significant to note, however, that facilities felt that the lack of control over equipment was the source of many of their problems. None used time-shared techniques; although TPRC has plans to do so, and Recon Central experimented for a while with a teletype communication link between human operators — one at the Central and one at the remote computer.

Mechanization Status

Table # 1

Key:

O = Operational
P = Planned
U = Under development or in testing
# = Discontinued

Facility	Facility Report Ad#	Classified Inventory Control	Input Processing		Retrieval	Serial Control	Circulation Control	SDI	Catalog		Accession List	
			Cards	Paper Tape					Cards	Book Form	Comp.	I. P.
AFIT	640-114		O								O#	
AMS	640-121		O		U						O	
APL	640-120		O		O			O	O		O	
ASDIRS	640-125		O		Manuel					O		
BAMIRAC, IRIA, VESIAC	640-130		O		O							
BDIC, DMIC, RACIC, REIC	640-113	O	O	O	Manuel							O
BUSHIPS	640-103		O		O	O		O	O		O	
AFCRL	640-109	P		O	U	U			O	U	U	O
DELSIE	640-118		O		O					O		
DISC	640-108		O						EAM		EAM	
EA	640-123		O		U	P	P	P			P	
EPIC	640-128		O		O						O	
FTD	489-996		O	O	O		P	O	O		O	
FORT DETRICK	640-102			O	O	O		O			O	
HDL	640-101		O		Manuel			O	O		O	
MPDC	489-998		O		O							
MEL	640-117		U		U							
NAFI	640-126		O	O								
NATICK	640-104		O	O		O	O	P	O			O
NMC	640-111	P		O	P					O	O	
NOL	640-122		O	O	O	P	P		O			O
NOTS	489-995		O	O	O	P			O		O	
NPS	640-110	P		O	O				O		P	
NSMSES	640-112		O							O	O	
NUWS	489-997	P	O							P		
NWL	640-119		O		O		U		U		O	
PICATINNY	640-106	U	O		U	P	O	P			U	
PLASTEC	640-107		O									
RECON CENTRAL	640-115		O		O							
RSIC	640-129	U	O		U	O	O	P	O	P	P	
SEG	489-999		O					O	O		O	
TPRC	640-127		O		O							
Reliability Central	640-116		P		P						O	

Seven of the facilities stored their thesauri in computer memory and used them for automatic error control and/or code conversion for natural language input. Only three found links and roles to be worth the added programming complexity.

Eighteen facilities stored their search files in an inverted form (e.g., a file ordered by accession numbers) and four in the direct form (e.g., a file ordered by descriptors). Searching a direct file can be a long procedure since the file must include a record for each acquisition in the library. Each of these records must be searched in serial sequence to determine if it has the desired combination of descriptors. An inverted file, on the other hand, has one record for each descriptor and, therefore, is only as long as the descriptor thesaurus. Furthermore, a search can be confined to only those descriptors of interest. Searching this latter type of file, however, requires a more sophisticated program (see Section VI, "File Structure"), but the total search time can be much shorter. For this reason, the use of direct files in mechanized searching is unusual, although direct files are often used after an inverted file search in order to obtain bibliographic information relative to the retrieved accession numbers.

Two kinds of retrieval system philosophies which employ a direct file search were encountered. One (e.g., NPS) is a two-tape file scheme wherein an abbreviated file (accession number vs. coded descriptors) is actually searched while a second detail file is driven in synchronism. When a selection is made on the abbreviated file, the printout is developed from the detail file, including the reference, bibliographic information, and abstract. The second approach (e.g., APL) is based on a unit-record concept in which each record carries detailed information describing the document. The primary advantage of both approaches is that the retrieved information is printed out in detail (e.g., with bibliographic data and abstracts) immediately without a secondary operation being required.

Four of the facilities (all information centers) have mechanized files of data that can be manipulated and reordered in the process of retrieval. The retrieved outputs of these are actually specific answers to specific questions. All of the other systems studied retrieve only document references.

Four facilities have developed SDI systems. Four produced or were planning permuted indexes that were to be available to the user. Two information center complexes, the University of Michigan group (IRIA, VESIAC, and BAMIRAC) and the EPIC, are planning or are involved in generalized information retrieval programs that serve a multitude of facilities. (These generalized programs represent a considerable cost economy, since a single program development can be used by several facilities. The generalized program approach can make the difference between being able to justify and afford a mechanized search process, and having none at all.)

Almost all of the libraries complained of a poor understanding of library problems on the part of the programmers, and, in general, the programmers criticized the librarians for not understanding the potentials and limitations of computer applications. Poor communications between librarian and programmer can be blamed for many of the system development problems experienced. Some of these problems manifested themselves only after the system was operating and improvements more difficult to undertake. For example, Boolean search capabilities were sometimes designed into the retrieval program with severe, although unintentional, limitations. One such limitation was the inability of the program to relate both the AND and the OR operators. Also, the capability for search complexability often seemed far more sophisticated than necessary to satisfy the actual user's needs.

In their relationships with programmers, the information centers had much less difficulty than did the libraries. This can be attributed to two conditions:

> The centers' staffs were usually more technically oriented and had a meaningful understanding of computer technology. They were able, therefore, to communicate with the programmer on his terms. (We encountered no programmers who could communicate with the librarian on his terms.)
>
> Some centers (e.g., TPRC and MPDC) maintained a staff member who had the ability to program.

It would appear that unless the libraries found themselves in a similar position, they would continue to suffer the consequences of poor communication.

We believe that a more businesslike approach to the programmer and an effective cost control program will reduce this problem as well as several others related to the development of mechanized systems. The following sections present these aspects in greater detail.

(2) Costs of Mechanization

In almost every library studied, cost information on system development was either not available, of questionable reliability, or not comprehensive. In addition, there was an almost universal lack of concern about development costs on the part of the librarians when these costs were not associated with manpower billets or hardware purchases. Information center operators, conversely, were generally very concerned about costs and maintained detailed records of current operating costs, although even in these cases the historical development costs were usually not available.

The lack of cost information appears to be the result of one or more of the following factors:

- Time is generally made available to a library on a computer that it does not own and, often, the library is not charged for the time used.
- In some cases, programming has been done in house at no cost to the library and with no records kept of man-hours expended.
- In other cases, programming was done by contractors who performed many services in addition to programming for the library, and the library programming costs were not separable from other costs.
- The historical operating costs for the premechanized manual system are not usually available for comparison.
- For those libraries with developing mechanized operations, the costs are mingled with other library activities, including use of the old system (card catalog, etc.), which the new system has not yet replaced.

We feel that incomplete cost records and insufficient concern about cost versus usefulness and value is probably the most detrimental influence to the development of many of the systems encountered. We believe that this criticism is valid in the majority of systems studied.

Reference to the individual facility reports will reveal a number of examples of the acquisition of a system which proved useless and had to be abandoned, or which was only marginally successful and later required extensive modifications. The survey data clearly indicate some cases in which a program of mechanization was initiated and pursued simply because it was the "thing to do". Several of these systems seemed remarkably able to operate and to expand in the vacuum of a nearly complete absence of considerations of user needs.

A sensible attention to the elements of system development and operating costs, as well as to the resulting system effectiveness (including satisfaction of user needs), is essential if the above situations are to be avoided. For this reason, we have included a discussion of pertinent cost factors in the following paragraphs.

1. The purpose of assembling cost information is to measure how resource consumption compares with resource allocation. The allocation is usually specified by a budget, which, in turn, should reflect the judgement of management concerning the relative value of each activity. This value judgement should include intangibles as well as tangibles. Applied to mechanized processes, this means considering and including the value of such elements as increased timeliness, flexibility, and quality; broader and/or deeper search capability; greater file detail; increased user satisfaction; etc. The elements of value (both tangible and intangible) used in determining budgetary allocation should be the same ones used in measuring the operating systems effectiveness. This provides a two-way check -- budget versus cost and expected value versus actual effectiveness.

2. As the cost information is accumulated, it should be compared to the budget. The budget should be subject to revision based upon the changing availability of resources and the changing view of the value of the system elements as derived from measures of performance effectiveness. (See the following Section on Effectiveness of Mechanization). Ideally, this approach will lead to the selection of the most

desirable courses of action while minimizing the effects of unwarranted optimism or undue pessimism. It should also permit a more sensible and orderly consideration of future developments such as service demand variations, new techniques, expanding and contracting missions, etc., and should permit the formation of a basis for coordination with other organizations (e.g., purchasing and computer programming groups).

3. Examples of elements that make up the overall cost of mechanized processes are:

- Library staff salaries (relative to the mechanized process)
- Materials cost
- Equipment purchase or rental cost
- Equipment space requirements
- Maintenance charges
- Computer time
- Programming cost (even if not charged to the library)
- Cost of contractor services
- Cost of acquiring new skills

These cost elements should be assembled and related to various units of the mechanized operation, such as cost of maintenance and update lists, cost per acquisition, per item cataloged, per search, per dissemination, etc. These figures will permit a cost analysis of the mechanized processes in terms of budget and, combined with the operation statistics, a determination of cost effectiveness. Finally, these figures can be maintained from year to year to develop a historical cost basis for comparisons, decisions regarding future allocations, staff alterations, and changes in service emphasis.

(3) <u>Effectiveness of Mechanization</u>

The following considerations have precluded a quantitative determination of the effectiveness of the systems studied:

- Factors of effectiveness for information systems have not been generally agreed upon. (The National Science Foundation and ATLIS are currently conducting studies toward this end.)

- The facilities which have mechanized processes that formerly were manual have generally not attempted to compare the two except in superficial ways.

Examples of factors that do carry effectiveness information and that should be used as a basis for evaluating the effectiveness of mechanized information schemes are:

- Through-put characteristics, including response time for retrieval requests. (This is the actual time from receipt of request to delivery of the answer--not just processing time.)

- Types, nature, frequency of inputs and outputs
- Cataloging rate
- Resource requirements, such as manpower needs, operator skill level, space, layout, etc.
- Number of files stored in the computer and materials on the shelves
- File capacity, level of detail, and breadth of subjects
- File organization
- File load
- File updating time
- Error rate
- Interarrival time of various demands upon the system, such as requests to catalog and retrospective search requests
- Backlog of requests
- Cataloging backlog
- Number of users accommodated by the process
- Number of requests
- Number of queries adequately satisfied
- Recall and relevance of search output.
- User satisfaction

These measures should be taken for worst, average, and best cases, and then compared to management expectations and user needs

The following comments characterize the qualitative evaluation of effectiveness as assigned by the facilities' staff to their own mechanized systems:

1. Work measurement and standard time data studies on the efficiency of the system used at the Picatinny Arsenal Technical Library indicate that the mechanized circulation system is more efficient than the previous manual one, e.g., the overdue portion of the system is considered five times more efficient.

In terms of hours per unit, the new system averages 0.15 hour per item for keypunching, sorting, pulling from shelves, preparing for mail, discharging and refiling returns, and processing on the computer. The old system averaged 0.18 hour per item. This represents a significant saving when the number of annual transactions is considered. The number of library personnel needed to handle circulation functions was reduced by two with the introduction of the computer-based system.

2. Since the introduction of mechanized processing, the Technical Information Reference Branch has been able to produce a regular semimonthly accessions list with no

increase in effort or manpower. In the eight years preceding mechanization, the Branch was able to produce manually only 56 such lists. Besides the accessions list, the computer also produced, in its first run, 4,700 catalog cards in 11 minutes. Normally, 30 days would have been required to type these cards, with additional time required for proofreading, correcting, and arranging them in file order.

3. The U. S. Naval Postgraduate School Library expressed satisfaction with the mechanized system in regard to retrieval relevancy, retrieval recall, and usefulness of the end product. The mechanized system conserves the time of the professional staff. They now devote about 10 to 15 minutes each to 300 student requests per month. Formerly, 1-1/2 hours would have been required for professional assistance with a manual search. The mechanized, versus manual, literature search saves about 500 manhours per month of the students' time.

4. The Air Force Materials Laboratory Library Staff found that, during searches, the new system caused a reduction of irrelevant information of over 56 percent and incurred less than a 5 percent loss of relevant information.

5. The library staff at the Redstone Scientific Information Center has praised its Alpha project as having made possible a greater volume of library service at a saving in staff time. In 1962, before mechanization began, less than 4,000 of a potential 20,000 patrons used the Library. A staff of 67 was required to serve these users. In 1965 there were 8,300 users, while the staff had been decreased from 67 to 43 members, with no increase in overall workload on the staff.

6. The Infrared Information Analysis Center personnel believe that the operation of their center has been improved by mechanization. Last year, with mechanization, they were able to answer five times as many requests as before. Prior to going on full-time computer use, IRIA personnel required two to three days to prepare a bibliography for a visitor. The time now required averages one and one-half hours, and bibliographies have been produced in as short a time as 45 minutes.

7. In 1964, the Foreign Technology Division Library conducted a controlled experiment on a data base of 100 documents. The computer search based on 30 user profiles retrieved an average of 85 documents. The manual searches

yielded 45 documents. Of those 45, about 15 percent, or seven documents, had been missed by the computer search. Relevance levels were 58 percent on the computer search and 63 percent on the manual search. It was also discovered that many users were glad to get an excess of material.

8. The Thermophysical Properties Research Center has found that most retrieval queries can be answered by manual reference to the Retrieval Guide or by consulting with one of the staff members. Furthermore, the Director believes that, at present, he can perform a search faster manually than by machine. This is with reference to the total real cycle time, which includes all the time consumed between the asking of the question and the receipt of the information by the requester. This condition exists because the total system is small as yet, and because the number of retrievals is only about 50 per year (not considering the publication of TPRC's Retrieval Guide which amounts to a retrieval of its entire file).

9. All four of the information centers at the Batelle Memorial Institute consider that their manually produced and searched files of extracts are preferable to a computerized

system. They point out that up to 80 percent of questions can be answered by direct reference to the extract files alone. In addition, a user of the files is automatically "referred" to other positions of the files by other clue words underlined on the cards he is using. A user who makes a personal visit to the centers, usually on a very tight air-travel schedule, has immediate access to the information itself, not merely to bibliographic citations. Furthermore, the subject specialists who deal with telephone queries often can answer questions on the spot by reference to the files. On the other hand, additional mechanization of the Center's printed outputs would be considered desirable for time-saving features where it is economically advantageous.

(4) Major Problems

The following paragraphs express the problem areas that were of concern to and reported by staff members at the facilities surveyed:

1. Computer Service

None of the libraries studied owns or leases computers; therefore, they are forced to rely on other organizational groups for computer services. As a result, computer service is often erratic and sometimes may become unavailable for extended periods of time. In one case, erratic service led to overdue notices being two weeks late. In another case, the replacement of a facility's computer required the library to return to manual methods until its programs were converted on a second-priority basis.

2. Motivation

In some cases a library initiated a program of mechanization not so much because it was needed or desired by the users but because the computer facility had computer time and programmers available. Even under these conditions, computer usage by the library usually remains on a second-priority basis. Also, because of poor communications between the programmers and the library staff, the library's needs and the programmers' areas of responsibility have not been clearly delineated prior to the development of the computer programs. This has led to extended delays in processing (such as six months to produce an accessions list by computer compared to three weeks by manual methods).

3. Changeover

Bringing a storage and retrieval system into operational use is greatly complicated by the problems of file conversion. Computer searching is effective only if a substantial part of the file to be searched is accessible to the computer. However the creation of machine files, particularly for the whole card catalog, often initially exceeds the resources available to the libraries, and the file conversion process may have to be stretched out over a long period. Thus, a library may have to operate two systems; the old system, using card catalogs, etc., and the mechanized system, for which capability is built gradually over a period of several years. This experience can be frustrating and discouraging to both the user and the searcher.

4. SDI

The facilities that use SDI systems have unique problems. The most difficult problem observed in developing an SDI system is the proper maturation of the interest profile. Often, this difficulty is not given adequate attention, with the result that participants soon become discouraged by the flood of irrelevant information and the lack of desired information. Experience has shown that in the area of profile development there is no substitute for patient, painstaking work on the part of both the profile developer and the participant.

Problems have also been experienced in the choice of methods used to notify SDI system participants of citations selected for their attention. Individuals may be unwilling to cope with the filing problems associated with distributing a single notification card per selected citation. Problems of this sort must be identified and eliminated, or the participant may lose interest in the system.

5. Staffing

Information facilities consider themselves to be understaffed for the job expected of them. Some of the difficulty in bringing a mechanized process into operation can be attributed to insufficient staff for organizing the system and preparing material for computer input.

6. Organization

The facilities reporting to research and development staff management generally feel that they have much better management support for their efforts toward mechanization (as well as their other activities) then do those reporting to administrative management.

4. RECOMMENDED MECHANIZATION GUIDELINES

The experiences of many of the facilities studied suggest the following guidelines for those now planning mechanized processes:

(1) Clearly establish the goals to be achieved by mechanization. Examples of these are the following:

- Increased service
- Faster service
- More search flexibility
- Greater search scope
- Lower personnel costs
- Fewer personnel required.

(2) Determine whether or not these goals can be achieved more economically by other methods than by mechanization--e.g., by improvements to the existing manual system, or by obtaining equipments such as EAM punched card machines for processing and relatively inexpensive devices for retrieval such as the "peek-a-boo" systems. This type of equipment can be owned and controlled by the information facility; thus, many potential problems are avoided.

(3) Determine the feasibility of computer processing and whether or not such an approach will really achieve the desired goals.

(4) If computer processing is to be attempted, consider how this can be done with a minimum of interference to the present service. As much as possible, plan to use the existing formats and schemes. Also, plan the system so that in event of computer nonavailability for extended periods, or loss of computer services altogether, the library operations will not be paralyzed. Specifically, maintain man-machine convertible files such as punched cards to back up the machine memory and use input and output formats that can also be created and handled manually.

(5) Determine with as much depth as practicable the way in which the conversion to the new system will affect the existing operation. Identify potential problem areas such as personnel retraining, user education, organization adjustments, communications arrangements, space preparations, the new system/old system parallel operation period, etc. Develop realistic plans for handling each of these.

(6) Begin the system development with a careful analysis of the existing system. This analysis may indicate areas that

could be eliminated or modified substantially, particularly in view of the different capabilities of the mechanized process Very useful aids for this type of analysis are flow charts which detail each operational function along with workload figures and the individual responsible for performing the function.

(7) The mechanized process development should proceed based on the analysis and (ideally) with full mutual understanding between the librarian and the programmer of what is to be accomplished. This aspect of development was one of the most poorly handled in the system studied during this project. The potential for costly errors and lost time inherent in a breakdown of the understanding is clearly extensive. To avoid such a situation, be particularly certain that the computer program developers understand what is to be done and that there is no serious obstacle to good communications, such as the political environment, terminology problems, too many other jobs with higher priority, etc. One good beginning is to obtain a written statement of work and a work schedule from the program developers.

(8) Start conversion to mechanization with a relatively small part of the system that can continue to function manually during the development phase. (An example of this is the production

of a book catalog or catalog cards.) A planned approach will permit the developing of experience and confidence before the difficult major development tasks are attempted.

(9) Be sure that the system planners are aware of the cost and effort required to convert the system's manual records to machine records: for example, to what extent information on each catalog card will have to be keypunched to create a computerized retrieval file.

(10) Do not start the program development until it is reasonably certain that time and resources will be available to complete it.

(11) Create and follow a cost budget that realistically reflects the anticipated value of the developing system as well as the available resources. Record costs as they accumulate, including reasonable estimates for those services that are supplied "free". Relate these costs to:

. The cost budget

. Costs of the old system

. Effectiveness of the new system

Modify the cost budget and direct the available resources to those areas that the above analysis indicates will yield the greatest return in terms of the goals established in step (1) above

(12) As the system implementation phase is entered, collect and maintain operational statistics such as:

- query handling frequency and characteristics
- user characteristics
- number of queries per user and/or user type
- frequency of use of use of each thesaurus term
- frequency of use of each file record
- peak demand periods
- file update frequency and characteristics

Most of these can be acquired by the computer program during its normal operation. An analysis of operational statistics will provide a current quantitative basis for performing system improvement modification as well for developing effectiveness estimates.

II. INPUT PROCESSING

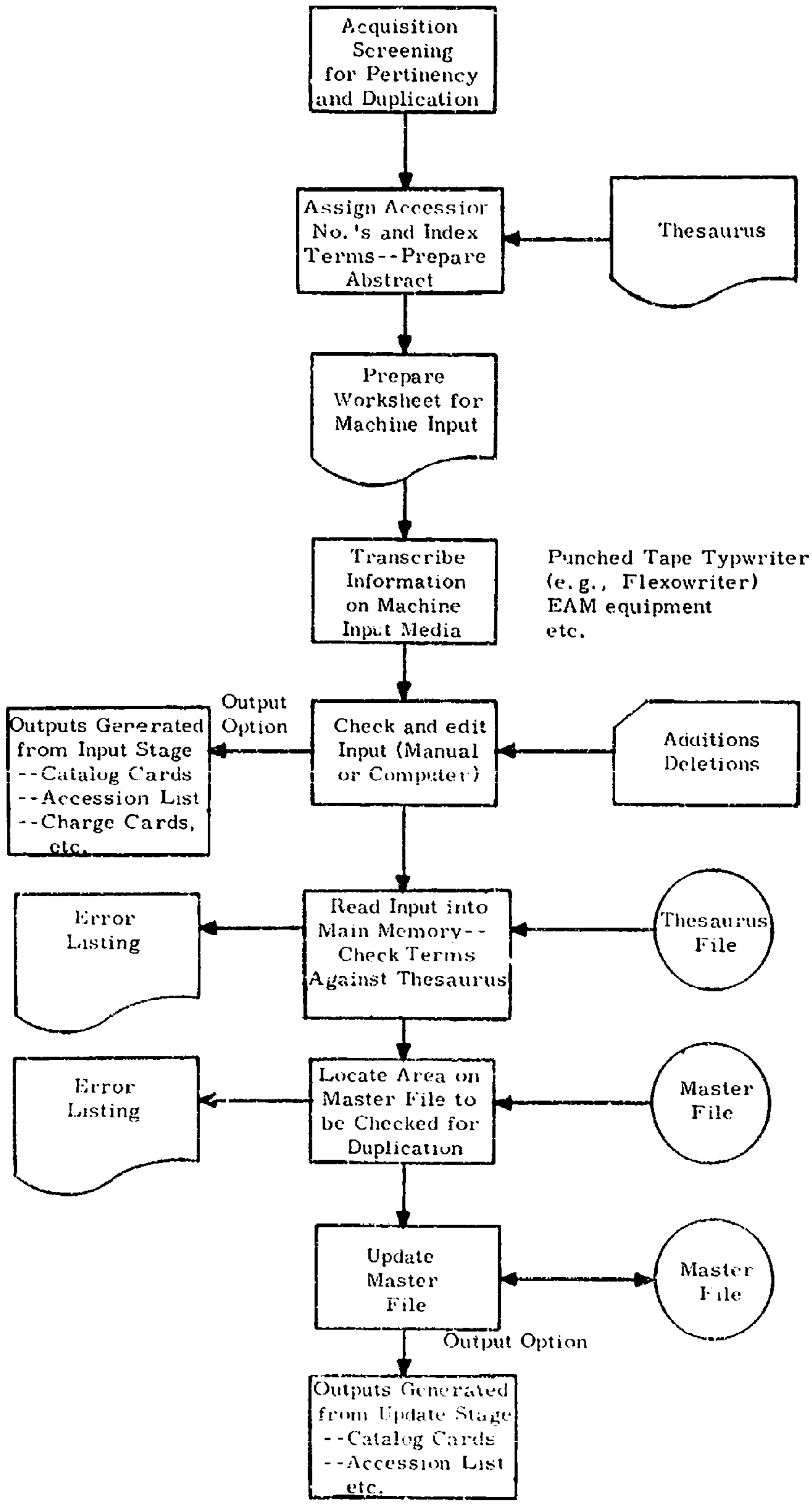
For the purpose of this section, we have defined input processing of documented information as the functions that take place from acquisition to establishment of the information in the retrieval system. The important functions are as follows:

- Acquisition
- Screening for retention and circulation
- Cataloging/indexing
- Transcription to machine-readable media
- Verification and other forms of error control
- Output of input data in various formats.

A representative process is presented in Figure 1. Acquisitions are first screened to eliminate duplication and to insure pertinency. Using the thesaurus previously established for the facility, cataloging is then accomplished. Machine inputs are next prepared. A variety of alternatives exist at this stage which are described in detail later in this section.

Figure 1

Input Processing



As shown in Figure 1, the generation of output formats (e.g. catalog cards, accessions lists, etc.) can occur at either of two stages in the process:

- They can be produced as a byproduct of off-line input preparation (card punching, tape punching, etc.). Examples of this approach are found in the systems of NOL and NWL.

- They can be produced as a byproduct of file updating runs. Examples of those using this approach are NOTS, FTD, and Fort Detrick.

Table 2 is a summary of the mechanization status of input processing at the various information facilities studied.

Facility	Media of Input		Production of				…on of …n List
			Catalog		Accession List		
	EAM Cards	Paper Tape	Com-puter	I. P.	Com-puter	I. P.	I. P.
AFIT	X				X		
AFML	X						
AMS	X			X	X		
APL	X			X	X		
Battelle Information Centers	X				X		
BuSHIPS	X		X				
AFCRL		X					
DELSIE	X		X				
DISC	X			X	X		
EA	X				X		
EPIC	X						
Fort Detrick		X	X		X		
FTD	X						
HDL	X						
MPDC							
MEL	X						
NMC		X					
NAFI		X					
Natick	X	X					
NOL	X	X		X		X	X
NPS		X					
NSMSES	X		X		X		
Picatinny							
PLASTEC	X						
Recon Central	X						
RSIC	X		X		X		
SEG	X				X		
TPRC	X						
Un. of Michigan Information Centers	X						

Table 2
Input Processing Summary

of			Edit List		File Corrections			
st	Charge Cards				Replacement by			
P.	Com-puter	I. P.	Reader/ Printer	Com-puter	Charac-ter	Term	Sub-Group	Record
			X		X	X	X	X
							X	X
				X				X
				X	X	X		X
			X					X
							X	X
			X		X	X	X	X
			X				X	
			X					X
			X					X
							X	
				X				X
			X			X	X	
			X				X	
				X	X	X	X	X
							X	X
				X				X
			X		X	X	X	X
		X		X		X		X
			X					X
								X
			X				X	
			X					
	X		X	X			X	
	X		X					X
				X		X	X	X
			X				X	X

1. ACQUISITION AND SCREENING

The receipt of a document initiates a number of administrative procedures such as filling out receipts, separating and establishing separate control for classified documents, separating the documents from interlibrary loan sources, checking for duplications, and separating requested reports from those received on automatic distribution. Those identified as user-requested usually have some form of distribution sheet attached to the document identifying the requester. When NWL changed over to the IBM 870/7030 system, however, they made provision to have the document forwarded to the requester before submitting it to subject analysis.

For the purpose of creating a record in the computer master file, it is usually necessary to provide only the title, author, date, classification, and source. Later, after the document has been returned to the library, the more time-consuming job of subject analysis may be performed to develop the descriptors and the abstract. This information can then be added to complete the document's record in the Master File.

Most information facilities add to their collection all reports received on distribution, with little or no screening, since distribution is usually based on their areas of interest. Some facilities, however (e.g., HDL, NOL, BAMIRAC, IRIA, and VESIAC) maintain a careful screening process, primarily accomplished by the information facility staff. In some of these cases, selected members of the scientific staff also perform an evaluation of some of the reports.

2. DESCRIPTIVE CATALOGING TECHNIQUES

Cataloging worksheets of a variety of forms were found to be almost universally used for assembling the data for transcription onto the input media. Of this class we have identified two basic types.

The first type has all or most of the repetitious information and information field identifiers pretyped on the form. Blank space is left for the variable information. This type can be further divided into the following kinds of worksheets:

- A worksheet that in total is designed to correspond in exact format to an EAM card that will be prepared from it. Figure 2 gives an example of this type as used by AMS.

- A worksheet that is arranged so that the data entered on each line of the worksheet corresponds to the entry to be punched on one entire card. Figure 3 gives an example of this type as used by NWL in its original system (IBM 7090). Figure 4 shows a similar worksheet used by SEG.

- A worksheet that lists the required data or refers to areas in the document for the data. This type of sheet does not contain any instructions or column guides for punching the EAM card. Figure 5 gives an example of this type as used by APL.

The second basis type of worksheet contains a minimum of information but provides information that is not immediately obvious from the document. Figure 6 shows this type of worksheet, which is used by NWL in its new system (IBM 870/7030). In this example, the worksheet is used only to list descriptor data.

Descriptive cataloging, preparation of abstracts, and subject analysis are then performed, in varying order, and this information is also entered on the worksheets. Some facilities attempt to reduce the amount of information to be entered on the worksheets by referencing data in the report itself (e.g., title, author, abstract, etc.) rather than copying these data on the worksheets. The APL Document Library uses this scheme, although the input data sheet contains sufficient space for the Library's entry, should one be necessary. The NOTS Library marks important data on the title pages of a report,

ACCESSION DATE ______________________

CATALOG DAT CATA

URBAN AREAS — C — GE

CARD A	AREA				TYPE		SUBJECT				AUTHORITY					SCALE									SLANT	S			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	5	26	27
1																													
2																													
3																													
4																													
5																													
6																													
7																													
8																													

CARD A	PFC	SPECIAL SERVICES NEGATIVE NO						EDITION		SIGNIFICANT DATE					TYPE REPRO	SOURCE				DESCRIPTION						SE A		SECO AUT	
										TYPE										1		2		3					
	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	71	72
1																													
2																													
3																													
4																													
5																													
6																													
7																													
8																													

AMS FORM 9 APR 65 3420-11

REPLACES EDITION OF 1 ... ON OF 19 ...

TA SHEET CARD—A

GENERALS—PARTS—MISC

FIGURE 2

AMS Worksheet

SHEET NUMBER OR NAME																		
27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45

SECONDARY AUTHORITY				CLAS	ACCESSION NUMBER						PRINTING DATE				ACC DATE		SHEET ANALYSIS	CONTROL
72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90

19 FEB 64, WHICH MAY BE USED

☐ URBAN AREA CARD

A CARD CROSS REFERENCE

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8

B CARD CROSS REFERENCE

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8

☐ UNION CATALOG CARD

FIGURE 3

NWL Worksheet
(Old System)

SECURITY CLASSIFICATION ________________

LIBRARY ACCESSION NUMBER 3 8

CARD 1	TRANS 2							
1		SOURCE ABBREVIATION 9 26	REPORT NUMBER 27 44	SOURCE 45				
2		SOURCE 9						
3		TITLE 9						
4		TITLE 9						
5		TITLE 9						
6		AUTHOR 9 38	DATE 39 44	CLASS. 45 50	NO. 51	ROUTING 57 62	MISCELLANEOUS 63	
7		AUXILIARY NUMBER 9 44	CONTRACT NUMBER 45 68					
8		DESCRIPTOR	CODE 9 14	DESCRIPTOR	CODE 9 14	DESCRIPTOR	CODE 9	
			15 20		15 20		15	
			21 26		21 26		21	
			27 32		27 32		27	
			33 38		33 38		33	
			39 44		39 44		39	
			45 50		45 50		45	
			51 56		51 56		51	
			57 62		57 62		57 6	
			63 68		63 68		63 6	
			69 74		69 74		69 7	
			75 80		75 80			

SECURITY CLASSIFICATION ________________

LIBRARY DOCUMENT INDEXING WORKSHEET
PMWC-NWL-5072/13 (REV. 5-63)

FIGURE 4

SEG Worksheet

TECHNICAL INFORMATION CONTROL CARD (SEPIR)

TI Number	6 OOTI-
Corporate Author/Originating Agency /Report No.	10 (24, 61) 11 (13)
Title *(Indicate substituted title by * as first character of title)* Do not break any word at end of a line.	20 21 22 23 24
Additional Report Info/ Date Pagination / Contract No. / Contractor or Monitor/ Document Security Classification.	30 31 32 33
Tracings: 1 = Subjects 2 = Secondary Report Nos. 3 = Contract Numbers 4 = Abstract	40 41 42 43 44 45
Subject Code Category	50

SEG FORM JUN 64 **10**   Previous edition of this form is obsolete.

FIGURE 4
:G Workshe
ECHNICAL INF
6 OOTI-
10 13 11 20 21 22 23 24 30 31 32 33 40 41 42 43 44 45 50
f this form is obsole
2-15

FIGURE 4

:G Worksheet

ECHNICAL INFORMATION CONTROL CARD (SEPIR)	WORKSHEET SECURITY CLASSIFICATION

6 OOTI- 24 61 10 13 11 20 21 22 23 24 30 31 32 33 40 41 42 43 44 45 50	I. D. NO. AND COPY NO. OF REPORT *(If classified)*
	KEYPUNCH INSTRUCTIONS: (1) Punch cards for all lines typed within double lines at left. (2) Punch blanks where this sheet has blanks. (3) Punch card numbers as shown in card cols. 1-2. (4) Punch all of card no. 00 as shown, cols. 1-12. (5) Duplicate card cols. 3-12 from card no. 00 to each following card.
	ORIGINAL TITLE
	PROCESSED BY
	PROOFED BY
	TO KEYPUNCH
	CATALOG CARDS RECEIVED

f this form is obsolete.

AF-WP-O-JUN 65 5M

FIGURE 5

APL Worksheet

THE JOHNS HOPKINS UNIVERSITY
APPLIED PHYSICS LABORATORY
DOCUMENT LIBRARY
INFORMATION RETRIEVAL SYSTEM
PRELIMINARY INPUT FORM

APL Document Library
FORM NO. 1
REV. MAY 1964

ACCESSIONS No. ______________________

CLASSIFICATION ______________________ ** (2)

SOURCE ______________________

REPORT ______________________ AD No. ______________________ ** (4)

TITLE & AUTHOR ______________________ PERIOD COVERED ______________________

PAGES __________ DATE __________ CONTRACT No. ______________________ **

ABSTRACT ______________________ **

DESCRIPTORS ______________________

FIGURE 6

NWL Worksheet
(New System)

TECHNICAL LIBRARY DESCRIPTIVE WORKSHEET
NAV-NWL-5070/21 (9-65)

			ACC. NOS.							DESCRIPTORS																						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	thru 80
1	0	0																														
2	0	0																														
3	0	0																														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	thru 80

and the indexer supplies descriptor data on a tracing slip. The object of these shortcuts is (1) to cut down on processing time by relieving catalogers of unnecessary duplication, and (2) to clearly present the data to the keypunch operator.

3. DATA TRANSCRIPTION AND EDITING

(1) Data Transcription

The media employed for transcription of the input data into machine-readable format are as follows:

- Punched cards (e.g., NWL, APL, SEG)
- Paper tape (e.g., FTD, NPS, Ft. Detrick)
- Combination of 1 and 2 above (e.g., NOTS, NOL).

In both the examples noted for 3 above, the indexing descriptor data resulting from the subject analysis are separately prepared for the system. Even in the cases in which only one input medium is employed, the indexing is accomplished separately by a specialist.

(2) Data Editing

The input data are then proofed and edited by obtaining a listing and checking the data against the worksheets. Some libraries obtain the listing by using a reader/printer. (SEG uses an IBM 407.) Others first convert the data onto magnetic tape and then obtain a listing of the data. (NWL uses an IBM 1401 as an off-line processor for card-to-tape and tape-to-printer operations.) Almost all, however, convert the data onto magnetic tape before the update run and obtain an editing printout of the data as they exist on the magnetic tape. One exception to this is NPS, who edit with their original paper data input tape. At the end of the taped update run, a list of the changes or additions is produced.

The APL Library employs a specially constructed editing printout to facilitate the location of errors. The printout, which is shown in Figure 7, consists of 100 spaces to each line, divided into 10 columns of 10 characters. Each line is also numbered vertically. This system permits the editor to locate the character number on the tape without tediously counting each character across the line to identify the error. In systems that permit replacement of a single character of an item in a record, when the record length is significant, this method

FIGURE 7

APL Edit Printout

```
           1          2          3          4          5          6          7          8          9          1
                                                                                                              0
  1234567890 1234567890 1234567890 1234567890 1234567890 1234567890 1234567890 1234567890 1234567890 1234567890

0 CC668  745 SS UNCLASS * UNIV OF  SOUTHAMPTO N.  ENGLAN D.  R-143.   ARL-TN-6 0-178.* RE COMBINATIO N OF OXYGE
1 N IN A NOZ ZLE--COMPA RISON WITH  EXPERIMEN TAL RESULT S FOR AIR  FROM GENER AL ELECTRI C RESEARCH  LABORATOR
2 Y.  27P.   SEP 1960.*  /BRAYAKIN /1960/YEAR /74555/ACC /U/IDEAL/G AS/DISSOCI ATION/HYPE RSONIC/NOZ ZLE/FLOW/A
3 IR/ATOMIC/ RECOMBINAT ION/OXYGEN /RECOMBINA TION/AERODY NAMIC/HEA TING/HYPER SONIC/FLOW /GAS/FLOW/ FLUID/FLOW
4 /GAS/DYNAM IC/FLUID/M ECHANIC/NO NEQUILIBRI UM/FLOW/RE SULTS ARE  PRESENTED  FROM CALCU LATIONS ON  THE EFFEC
5 TS OF ATOM IC RECOMBI NATION ON  THE FLOW O F AN IDEAL  DISSOCIAT ING GAS TH ROUGH A HY PERSONIC N OZZLE.  TH
6 ESE RESULT S ARE COMP ARED WITH  DATA FROM  SHOCK TUBE  WIND TUNN EL EXPERIM ENTS ON AI R PUBLISHE D BY THE G
7 ENERAL ELE CTRIC RESE ARCH LABOR ATORY FOR  SIMILAR CO NDITIONS.   QUALITATI VE AGREEME NT IS FOUN D BETWEEN
8 THE THEORE TICAL AND  EXPERIMENT AL RESULTS .S
```

Sample of an editing printout, showing numbered spaces and lines for the convenience of an editor.

measurably reduces the editing time. On the other hand, the special structure of the printout makes it more difficult to read, thus slowing down the editor and increasing the probability of missing an existing error.

The following four general methods of error correction were encountered:

- Replacement of a single character of an item or term within a record (e.g., APL)
- Replacement of a term within a record (e.g., BUSHIPS SHARP-LARC)
- Replacement of an entire subgroup of data within a record (e.g., NWL)
- Replacement of an entire record (e.g., NOL).

In general, it was observed that the longer the record, the more likely it was to find a finer level of replacement (e.g., a single character) employed.

4. COMPUTER INPUT OPERATIONS

As indicated in the block diagram for input processing, Figure 1, the descriptors assigned to describe the input are generally checked manually at the beginning of the process. New descriptors are sometimes generated or some newly generated descriptors may be rejected at this point. Even old ones may be discarded or modified in the checking process. Most systems employ this early manual check as well as an additional check of a computer printout of the update (input) tape for the thesaurus or master dictionary. A third method of checking is the automatic comparison of input terms by the update program against the thesaurus file in memory (e.g., Ft. Detrick).

APL has demonstrated an effective way to use the computer to assist in input checking. After the new accessions data have been entered on the work tape, the tape is run off against the master dictionary. As a result of this run, a printout is obtained of all descriptors used that are not in the master dictionary. The listing is then analyzed to determine which are incorrect and which are actually new descriptors. The errors are corrected by one of the four general methods previously described. New descriptors that are accepted must then be added to the thesaurus. This is accomplished in much the same way that the new documents work tape is created. Worksheets are filled out, and the new descriptors are transcribed into machine-readable format on EAM cards. The cards are checked, and the descriptors are converted to magnetic tape where they are used to directly update the thesaurus file (e.g., NWL) or to update the thesaurus file in conjunction with the document file maintenance run (e.g., NOL).

The number of EAM cards used to represent a document was found to vary quite extensively. The number used depends on such factors as whether natural language or coded descriptor terms are used, how many descriptors may be used, and whether or not the document record contains bibliographic data, abstracts, etc. In the original NWL system, where a maximum of 35 descriptors was allowed per document, a maximum of 10 cards (of 4 basic types) per record existed. In the new NWL system, there are 8 types of input cards, which can result in over 400 cards being input for a single document record. In the BUSHIPS SHARP-LARC System, the bibliographic file used 6 basic cards with up to 9 extensions each for a range of 6-60 cards per record. The subject matter file, which allowed 30 cards per link, could have a range of 1-780 cards per record. The SEG system has one card for each line on the worksheet, a maximum of 19 cards.

5. OUTPUTS

Outputs were obtained in one of three ways:

- As a byproduct of preparing the input data
- As a result of computer processing
- By combination of the two above

An example of the first output method is provided by NOL, which produces charge cards, catalog cards, and an accessions list as a byproduct of data preparation. The descriptive cataloging of the reports is performed on a programmed Flexowriter that is coupled to a keypunch. The processing renders temporary catalog cards on a multipart paper form, punched charge cards, and a punched paper tape. Once a week, the daily punched paper tapes are printed out on the Flexowriter to produce offset-press paper masters. The accessions list and permanent catalog cards on card stock are then produced from the offset master. NOL and NPS also input the paper tape to the information retrieval system to generate a bibliographic file which is used in conjunction with the document file during retrospective searches. It should also be noted that the NWL Library, in their new system (IBM 870/7030), has switched to obtaining their catalog cards and accessions list as a byproduct of input processing rather than by computer processing as was previously done.

The BUSHIPS LARC, NOTS, and SEG are examples of the second type, i. e., those systems that obtain their catalog cards and accessions lists from the computer. SEG obtains them by processing the input tape. The BUSHIPS LARC system obtains them from the updated master tape. This requires specifically retrieving from the master tape each item to be printed.

The main advantage in producing these items on the computer is the ability to reformat and reorder the data as needed. Also, obtaining the catalog cards and accessions list as a byproduct of the input data (e.g., NWL 870 system) can result in cards being filed sooner and accessions lists being distributed more frequently. The main disadvantage is the need for computer time and a possibly higher cost per item obtained.

APL and Ft. Detrick are examples of the third method of obtaining outputs. Both produce the catalog cards during input preparation and obtain their accessions lists from the computer. Ft. Detrick, which collects the descriptive cataloging data on paper tape, passes the tape back through the Programmatic Flexowriter to obtain the required number of catalog cards. APL produces 3 x 5 cards on the Synchrotape machine and duplicates the required number of copies. Ft. Detrick is planning to eliminate its card catalog in favor of a printout in book form. There would be one book for each filing method previously used in the card catalog (e.g., author, title, etc.). Other libraries are using or planning to use the book form (e.g., Redstone Arsenal, NSMSES). The main advantage given for this type of catalog is that in large facilities, the catalog books can be distributed throughout. The utility of the library to the user is thus presumably increased.

III. CONTROL OF SERIALS

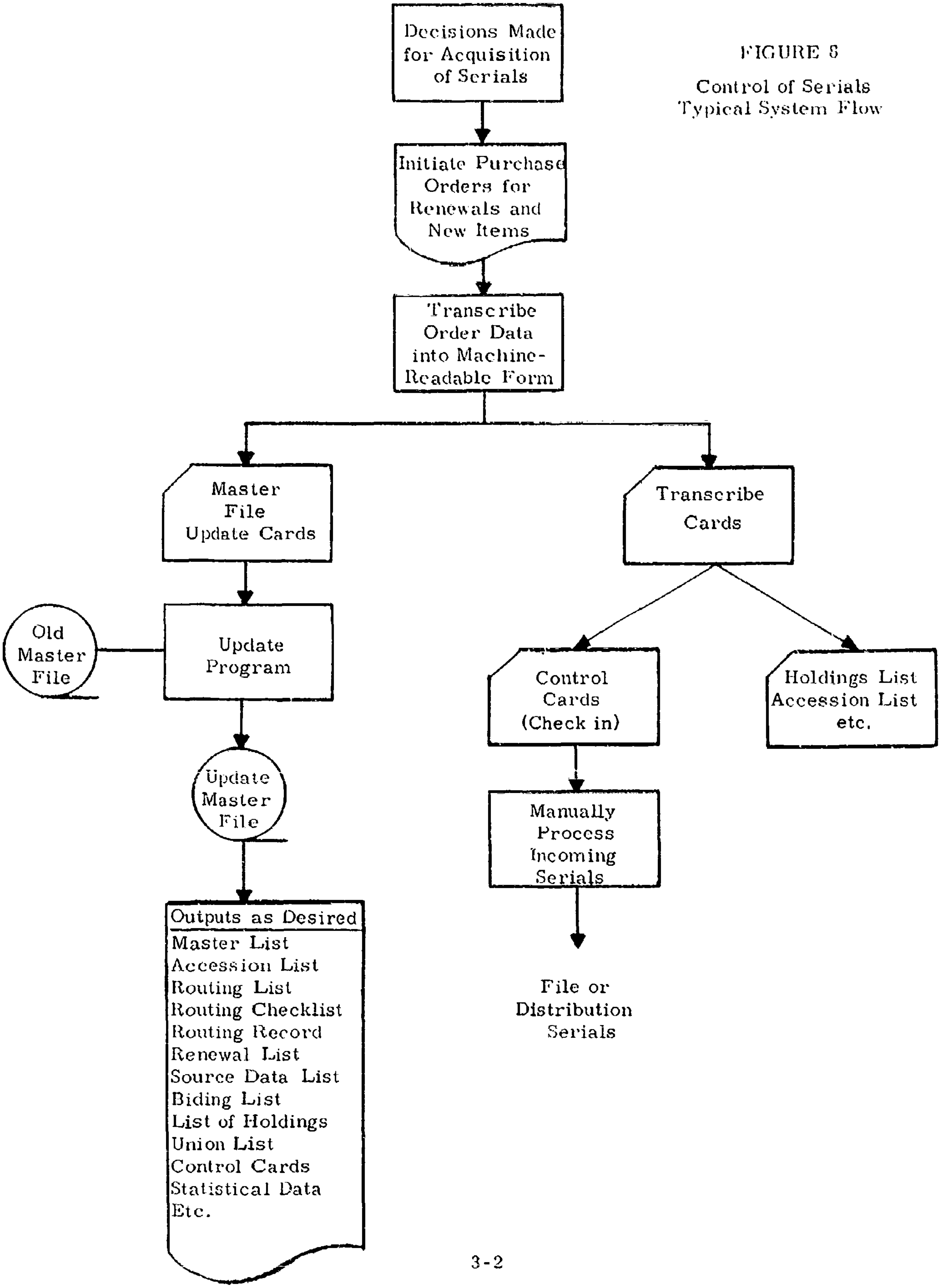
The main objective expressed by those developing mechanized serial control programs is the alleviation of the manual tasks associated with inventory control, ordering, and distribution. The mechanized programs are also typically planned to provide the tools for the publication of journal and serial holdings and the retrieval of cost, use, and other statistical data. The block diagram of Figure 8 depicts the two general types of mechanized serial control systems encountered during the survey.

The first type of system makes extensive use of the computer. All data pertinent to serials (title, source, and procurement data, publication frequency, renewal frequency, expiration date, number of copies that the library reviews, cost, routing data, binding information, etc.) are stored in a master file that is used to produce all required listings, routing sheets, and receipt control cards.

The second type is a more limited but more cheaply implemented and operated system that utilizes only EAM equipment. In this system, necessary data are kept on EAM cards which are used to process incoming serials and to generate holdings lists, renewal lists, etc. by means of a reader/printer.

FIGURE 8

Control of Serials
Typical System Flow



1. COMPUTER MECHANIZATION OF SERIAL CONTROL

Three installations, Ft. Detrick, Redstone Arsenal, the BUSHIPS, make extensive use of the computer in their control of serials. Others, like APL and NPS, maintain a master tape or master card deck and use the computer to print out a list of holdings.

The computerized serial control system begins with the decision to subscribe to a new serial or to renew an existing subscription. All the required data on a serial are entered on a worksheet and forwarded for processing. The data are keypunched, checked, and converted to magnetic tape, which is then used to update the master file of serials. The master file is then used to produce the various outputs indicated in the system diagram of Figure 8.

To control the receipt of serials, Ft. Detrick and Redstone Arsenal produce monthly a set of cards for those serials anticipated in the following month. As each item is received, the card for that item is pulled, batched with other similar cards, and inputed to the computerized master file of serials to record the transaction and to update the holdings record, binding record, etc. The remaining cards at the end of the period then serve to generate claiming notices. Ft. Detrick also uses the data recorded on the transaction cards to publish a monthly accessions list. The BUSHIPS system, which is in a transition stage, does not employ control cards. For each serial, all the routing slips required for the period are printed out. The remaining routing slips form the basis for notifying the suppliers of shortages. Redstone Arsenal and Ft. Detrick also use computer-generated routing lists to control distribution. At Redstone, routing assignments for every copy of a serial are determined at computer run time. Users are not permanently assigned to a given copy number.

Redstone Arsenal prints out the periodical master file monthly and semiannually produces a list of holdings. BUSHIPS prints out the master file but does not produce a list of holdings. Ft. Detrick, Redstone, and BUSHIPS, conversely produce a list of holdings but do not print out the masterfile. All three, however, print out a renewals list that indicate those serials due to expire. Redstone Arsenal produces the periodicals list five months in advance of the expiration date, and the BUSHIPS list is categorized into renewals required in two, three, and four months. After the decision to renew has been made, Redstone produces a verification list of titles to be renewed and new titles to be ordered. As an aid in placing orders, Ft. Detrick produces a separate serial supplier list containing all logistical data required for ordering. Both Ft. Detrick and Redstone Arsenal produce binding lists.

The following paragraphs describe serials outputs that are unique to particular information facilities.

BUSHIPS produces and circulates a routing checklist twice a year that shows those periodicals the Library has available for internal routing to various Bureau Divisions, Branches, and offices for their review and study. The user checks titles he wishes to receive regularly. BUSHIPS also produces a Routing Code Record, a listing that accounts for every copy of the periodicals being received and indicates the Bureau codes to which they are being routed.

Ft. Detrick produces a monthly First Copies List for new periodicals that gives title, issue, and date. This list is used for receipt reports and subscription payments.

Redstone Arsenal produces a monthly list of claims, by vendor, showing items not received, a yearly printout of foreign periodicals, and a monthly list showing the total active files and number of actual subscriptions by journals, services, and newspapers.

2. THE EAM SYSTEM OF SERIAL CONTROL

The type of system in which the periodical collection is maintained on EAM cards was encountered at HDL and Natick.

At HDL, four decks are produced, three decks of which contain one card for each title. The first deck is arranged alphabetically by title and is used for the list of holdings. The second deck is arranged by expiration date and includes the full renewal record. The third deck is arranged by source record for renewal purposes. The fourth deck contains a card for each issue of each volume expected throughout the year. These are then arranged by month, and, upon receipt of the issue, the card is pulled and used as a circulation record. Cards remaining at the end of the month are used as a basis for claiming.

At Natick, the serials are checked in on a Kardex file, and missing issues are reordered. The EAM cards are used to generate a master list of serials, a renewal list, a binding list, and a current titles checklist that is utilized by the user to check items to be continued.

Table 3 summarizes the mechanization status of serials control and outputs produced by information facilities for which individual reports have been written.

TABLE 3

Mechanized Serials Control

Library	Equipment			Routing List	Routing Check List	Holdings		Inventory List	Accession List	Renewal List	Binding List	Check in List	Use Statistics
	Computer	EAM	Flexowriter			Local	Union						
AFCRL	X		X			X		X	X	X	X	X	NO
AFIT	X	X				X							
AFML													
APL	X	X				X	X						
BuSHIPS	X			X	X			X	X	X			
DISC													
FTD													YES
Fort Detrick	X			X	X	X		X	X	X	X	X	NO
HDL		X				X				X		X	
MEL	X			P		X	P	P					
NATICK		X			X	X		X	X	X	X		NO
NMC													
NPS		X				X							
PICATINNY			P									P	P
RSIC	X	X		X		X		X		X	X	X	

IV. CIRCULATION CONTROL

Mechanized circulation control systems were operational in three of the facilities studied (Picatinny Arsenal, Redstone Arsenal, and Natick) and under development in one (NSMSES).

The functions typically included in these systems are as follows:

- Overdue item identification and production of recall notices
- Inventory list production
- Listings of items charged to a given borrower
- Listings of the circulation status and statistics of items.

Flow charts describing the operating systems of Picatinny, Redstone and Natick are presented in Figures 9, 10, and 11. The system planned for NSMSES uses circulation cards which are a product of the descriptive cataloging of technical reports. These cards are utilized manually as book slips. Picatinny and Redstone Arsenals keep their files on magnetic tape and use the computer to maintain the files and to produce circulation control lists. Natick, with a cheaper equipment complex, keeps the information on punched cards and uses a sorter and reader/printer to produce recall notices.

Comparing the Redstone and Picatinny systems, the flow diagrams of Figures 9 and 10 show that Picatinny begins by requiring the requester to fill out a library request card. The card is then checked by the librarian, who adds any additionally required information to the card (e.g., accession number of a particular report) and then has it keypunched. Redstone keeps prepunched cards in its books; these are duplicated, and the borrower's identification and the date due are added. Picatinny punches the data on the card before finding out whether or not the item is on the shelf and then must route the card to the keypuncher again to record whether the item has been put into circulation or should be marked for reserve. Redstone does not utilize reserve cards or keep reserve information in its system.

Both Redstone and Picatinny produce two circulation lists, one arranged by call number of item and the other by borrower identification (Redstone by borrower's name, Picatinny by borrower code number). Picatinny also produces a reserve list and individual monthly statements informing the user of items charged out to him.

NSMSES has under development a punched-card-oriented system for control of circulation. The intended system operation is as follows:

A manual record of all documents borrowed during a 24-hour period will be kept by the clerk at the checkout point. This will show the Julian date for that day, the accession number of the document, and the serial number and department number of the borrower.

When a document is returned within 24 hours, the charge will be deleted by scratching through the entry in the record. At 4:00 p.m. each day, the checkout record for the previous 24 hours will be picked up and taken to the data processing group to be put on EAM cards. The next morning, two cards for each transaction will be filed manually, one by employee badge number and one by document accession number.

As documents are returned, the cards will be removed from the file. A 30-day loan or control period is assumed. Cards will be sorted mechanically each day by Julian date, and the data processing group will make a weekly sort for overdues and will print out in triplicate a list showing accession number, borrower's number, and department number.

FIGURE 9

Picatinny Circulation Control System

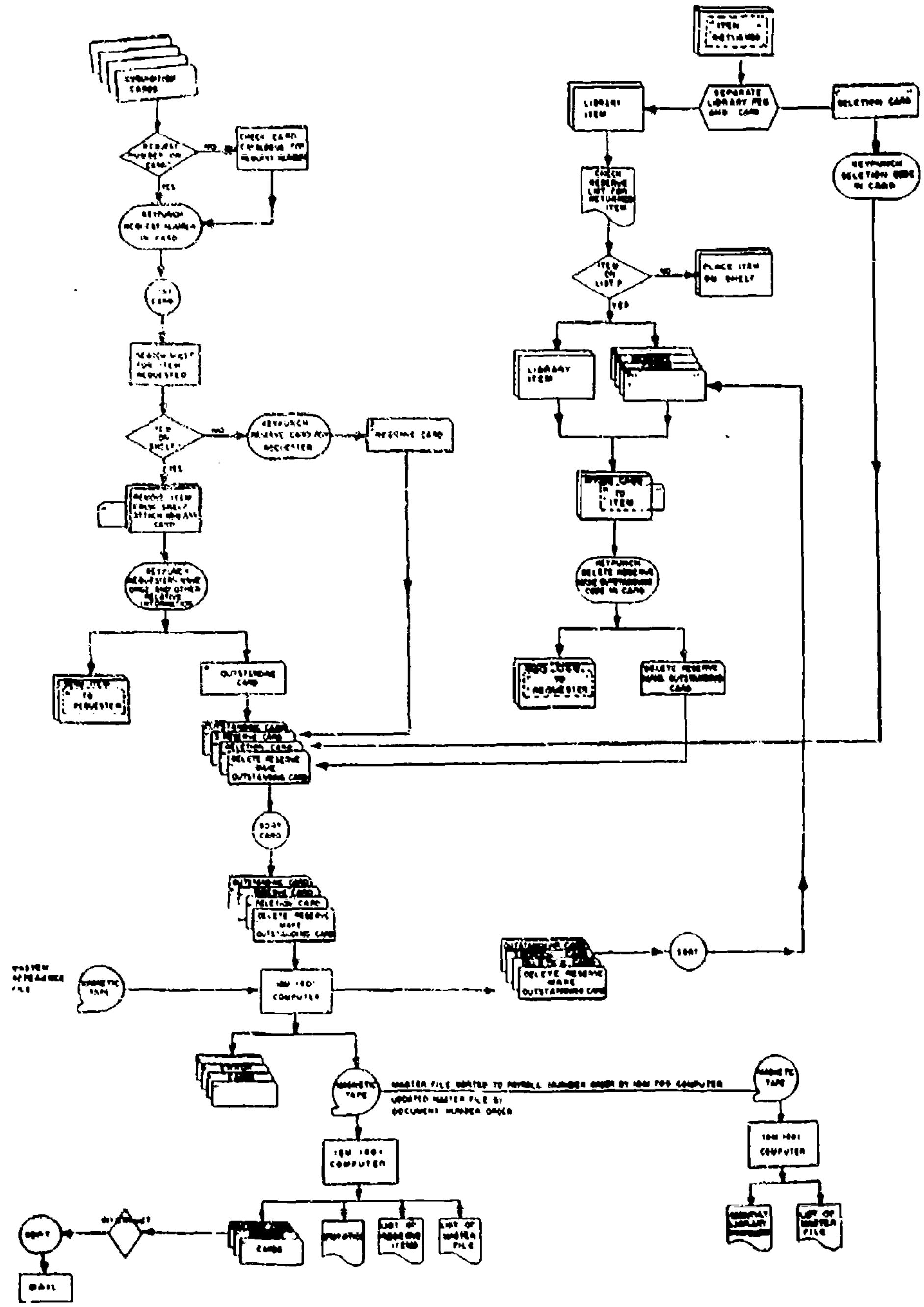


Figure 1: Circulation control flow chart

FIGURE 10

Redstone Circulation Control System

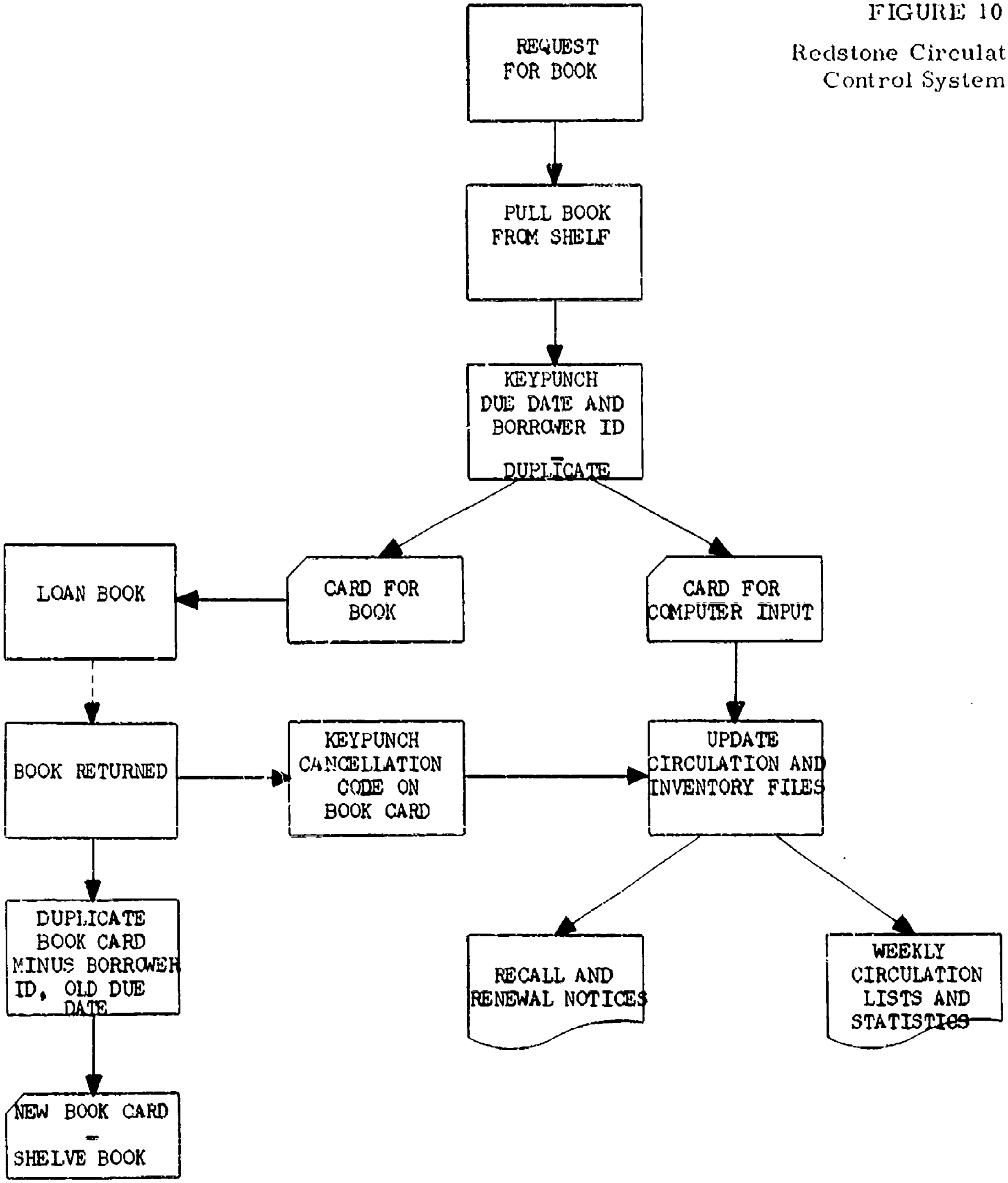
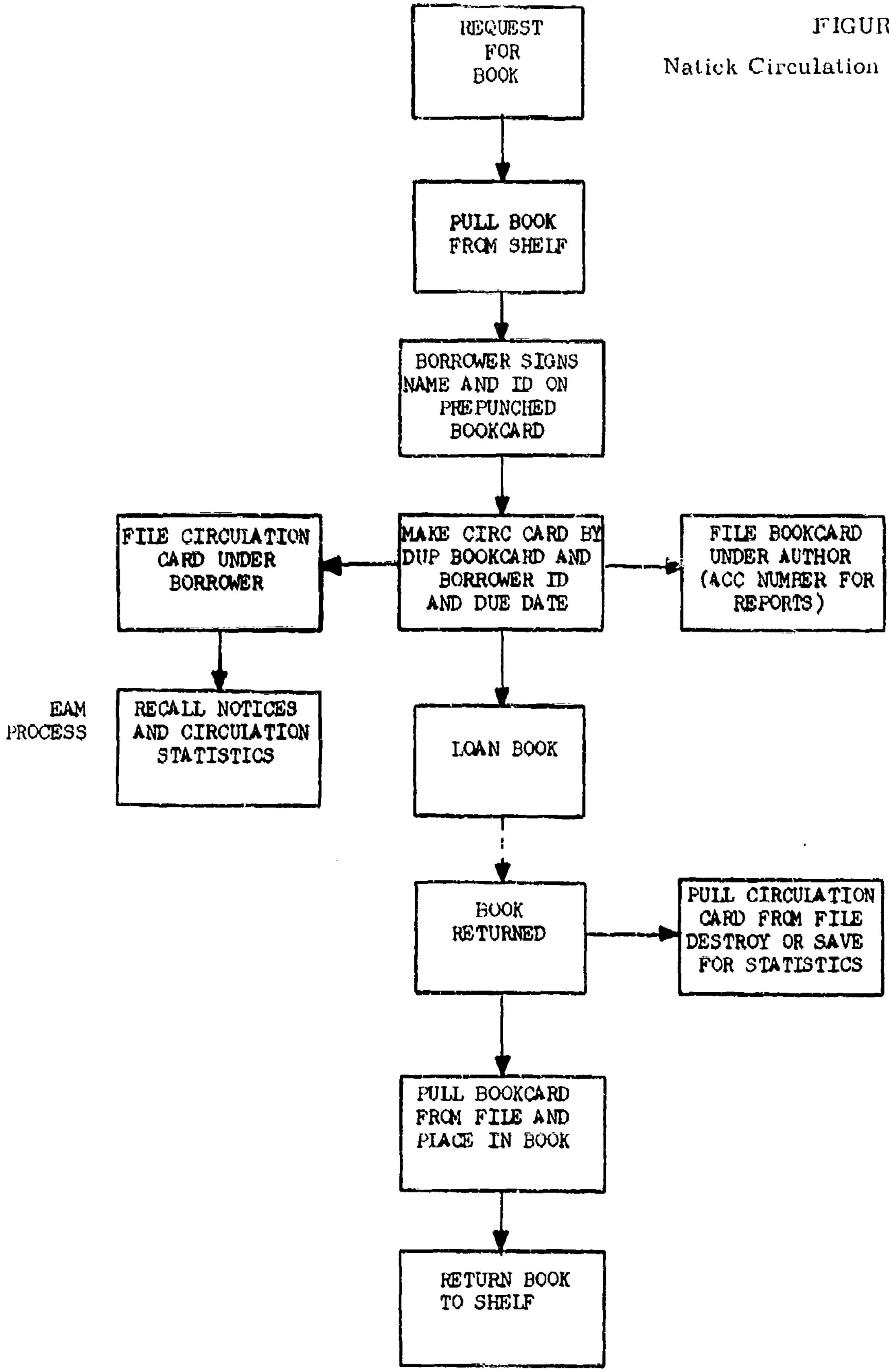


FIGURE 11

Natick Circulation Control System



V. THESAURUS GENERATION AND USE

In all of the mechanized systems studied a vocabulary "thesaurus" was utilized for subject indexing. The thesauri encountered varied from a simple alphabetic listing of subject terms to complex generic structures (hierarchical) with scope notes, cross references, and "see" and "see also" references. Some of the thesauri encountered were for manual use only, even though computer techniques were used. Others were stored in the computer memory where they were used for the automatic assignment ot codes and for detecting errors in input updating and search query formats.

Indexers and reference and retrieval staffs of the information facilities are the principal users of thesauri. In these instances, the user or search requester approaches the reference or retrieval staff with his problem, and the staff member consults the thesaurus for the terms to use in query formulation.

In contrast to this procedure, the permuted and coordinate indexes are examples of a sort of thesaurus that has been developed primarily for the use of the information requester. The purpore of these indexes is usually to permit the user to develop his own search query and to perform his own search without having to work through the retrieval staff member.

A wide variety of thesauri were encountered in this survey. A summarization of the more significant types is presented in Table 4, and these are further discussed in this section.

1. THESAURUS DEVELOPMENT AND USE

In the development of a vocabulary thesaurus, the facilities studied in this survey typically accumulated their initial terms from material being cataloged. In some facilities, however, these terms were added to a vocabulary base consisting of portions of the DDC and/or the EJC thesauri. In either case, this somewhat uncontrolled accumulation of terms soon required the establishment of controls restricting the addition of new terms and implementing a review of existing terms and their meanings. Scope notes and cross-references were also introduced, and terms were grouped and segregated into various structures. This general pattern was not unusual even in the cases of facilities that based their thesauri on those of DDC and EJC, such as Recon Central, NUWS, and NAFI.

In many instances, the facilities found the exclusive use of generalized thesauri, such as DDC's and EJC's, to be unsuitable for their needs because of variations in term meanings and a lack of sufficient detail in their fields of interest. (For example, one who deals with strategic information might consider satellites as a

Facility	Number of terms	Arrangement of terms	Codes	Links : Ro
AFML	10, 000	Hierarchical	Numeric	Link:
APL		Hierarchical	Alphabetic	Not U
ASDIRS	600	Hierarchical	Not Used	Not U
BuSHIPS		Hierarchical	Alphabetic	Both
Defense Logistics Studies Information Exchange	2, 000	Hierarchical	Not Used	Not U
Edgewood Arsenal	9, 500	Hierarchical	Numeric	Links
FTD	7, 000	Hierarchical	Not Used	Not U
Fort Detrick	10, 000	Hierarchical	Not Used	Not U
IRIA	140	Hierarchical	Alph. &Num.	Not U
Naval Missile Center		Hierarchical	Not Used	Not U
Naval Ordnance Lab	22, 000		Alphabetic	Not U
Non-Destructive Testing Information Center	400	Alphabetic	Numeric	Not U
Naval Postgraduate School	8, 000	Alphabetic	Alphabetic	Nume
NSMSES		Alphabetic	Not Used	Not U
NUWS		Hierarchical	Not Used	Not U
Naval Weapons Laboratory	3, 000	Alphabetic	Alphabetic	Not U
RACIC		Hierarchical	Numeric	Not U
Recon Central	8, 000	Alphabetic	Numeric	Not U
REIC	18, 000	Hierarchical	Numeric	Not U
PLASTEC		Alphabetic	Numeric	Not U

TABLE 4

SUMMARY OF REPRESENTATIVE THESAURI

Codes	Links and/or Roles	Scope Notes	Used in Computer Memory
Numeric	Links	Used	Yes
Alphabetic	Not Used	Used	No
Not Used	Not Used	Not Used	No
Alphabetic	Both	Used	No
Not Used	Not Used	Not Used	No
Numeric	Links	Not Used	No
Not Used	Not Used	Used	Yes
Not Used	Not Used	Not Used	Yes
Alph. & Num.	Not Used	Used	No
Not Used	Not Used	Used	No
Alphabetic	Not Used	Not Used	Yes
Numeric	Not Used	Not Used	No
Alphabetic	Numeric	Not Used	No
Not Used	Not Used	Not Used	No
Not Used	Not Used	Used	No
Alphabetic	Not Used	Not Used	Yes
Numeric	Not Used	Not Used	No
Numeric	Not Used	Not Used	No
Numeric	Not Used	Not Used	No
Numeric	Not Used	Not Used	No

political-geographical entity, while another might think of it only as an orbiting object in the astronomical sense.) These two shortcomings are the primary reason for the lack of enthusiasm about efforts to develop a common, comprehensive thesaurus.

Thesauri were developed by contract, by the information facility's staff, or by technical specialists in the specific subject areas. Examples of contract-developed thesauri may be found at NSMSES, Edgewood Arsenal, Ft. Detrick, and Dugway Proving Ground. (One thesaurus was developed by a contractor to serve both Edgewood and Dugway.) In the majority of the libraries surveyed, the library staff itself generated the thesaurus. Technical specialists were employed in thesaurus development by most of the information centers.

Only two of the facilities studied had utilized a thesaurus developed by another facility. NWL originally adopted NOL's thesaurus of descriptors and codes, and NAFI combined the BUSHIPS SHARP listing with several others as a basis for its own thesaurus.

The introduction and use of scope notes with a thesaurus was generally thought to be an important development, particularly as a system grows. Scope notes assist in identification of the exact term to use in indexing and in formulating a query for mechanized retrieval. If a thesaurus is to be stored within the computer's memory, however, the scope notes may take up an uneconomical amount of space. Some facilities (e.g., NOTS) avoid this problem by including in the mechanized thesaurus a cross-reference to scope notes actually contained in a manual card file.

2. THESAURUS CHARACTERISTICS

Generally, the thesauri surveyed were hierarchical term lists arranged by subject categories. Some also had the terms arranged alphabetically. (Among facilities that use the hierarchical type of thesaurus are APL, FTD, Ft. Detrick, Defense Logistics Studies Information Exchange, Edgewood Arsenal, Dugway, BUSHIPS, and AFML.) Facilities with large collections of information on weapon systems or chemistry usually have larger thesauri than other facilities because individual identifiers, compounds, etc., are included in the system.

Activities using permuted indexes usually substitute these for thesauri, although "see" and "see also" references are often built into these indexes (e.g., HDL, OPTEVFOR).

The majority of the thesauri studied were stored on punched cards and were not maintained in computer memory. Most of the facilities that store the thesaurus in the computer memory do so for two reasons:

(1) To detect errors in term usage as it appears in the computer input format in file updating and search routines. In this case, the computer automatically compares the incoming terms to the stored thesaurus and, if an invalid or misspelled term appears, it is printed out in an error listing.

(2) To automatically assign codes to the input terms for computer manipulation. This feature relieves the system operators from working in other than the natural language form of the terms. Besides assigning the codes, the computer also automatically decodes the terms if they are to be listed in the output after processing.

The depth of indexing for both manual and computer-based systems generally ranges from 4 or 5 terms per document to 25 to 30 terms; however, some facilities in the chemistry field used 80 to 130 terms for some documents (e.g., Edgewood Arsenal). In AFML's system, fewer than 4 or 5 terms are assigned to each document. Above this number, the computer automatically posts to higher terms in the structure.

There has been a trend away from the use of codes to represent thesaurus terms, except when assignment and translation of codes is done automatically by the computer.

Standard subject headings are used in the technical libraries in the cataloging of books and indexing of periodicals. In the information analysis centers, where portions of books or individual periodical articles are indexed, descriptors are used.

Links are used at BUSHIPS, AFML, and Edgewood Arsenal and are considered valuable. Roles have been dropped at the facilities that used them (BUSHIPS and AFML) because of lack of utility. (In the Wright-Patterson and DuPont studies, it was found that the use of roles actually decreased the possibility of retrieving certain documents.)

Some of the facilities (e.g. Edgewood Arsenal) perform statistical reviews of term usage to eliminate unnecessary words and to substitute new terms with narrower meanings for overworked terms.

3. EXAMPLES OF THESAURUS

Table 4 (page 5-3) summarizes significant characteristics of a representative sample (21 facilities) of the thesauri encountered in the survey. Detailed information on these thesauri may be found in the individual facility reports and as follows:

(1) Bureau of Ships

BUSHIPS has applied the EJC method in the development of their thesaurus. In the course of thesaurus development, they also considered the FROLIC method as proposed for the David Taylor Model Basin but decided that the EJC method provided a comparable indexing depth and flexibility without the complexity of FROLIC.

The descriptors in the BUSHIPS thesaurus are used in the form of seven-character alphabetic codes. The thesaurus is arranged hierarchically and includes synonyms and scope notes.

The thesaurus is maintained on the computer, where it is used to detect input errors.

(2) Recon Central

Recon Central uses a keyword listing of 8,000 descriptors consisting primarily of single words with a few double- and triple-word descriptors. Each descriptor is assigned a four-digit numerical code which is used to identify the descriptor in storage and retrieval operations. The keyword list is made up partly of FTD, DDC, and NASA keywords. The descriptors were selected independently of the actual document collection; therefore, some of them may not yet apply to any of the present collection. The thesaurus is not maintained in computer memory.

(3) Infrared Information and Analysis Center

A Dictionary of IRIA Category Numbers has been established which consists of approximately 140 descriptors in hierarchical arrangement. Each descriptor is assigned a three-digit code for storage and retrieval processes. Also, a Dictionary of Code Words has been compiled which includes alphabetic codes, words, scope notes, and meanings. The code words are assembled into compound descriptors of a maximum of three words and are used to describe the content of the document being indexed. The usage of the code words within the document being indexed is defined by the category numbers.

IRIA's thesaurus is not maintained in computer memory.

(4) Naval Ordnance Laboratory

NOL uses a thesaurus of descriptors with alphabetic codes, the latter made up of four-letter combinations. Early plans to use links were abandoned. It was found that a larger number of compound terms were needed than were originally anticipated to keep improper selections to a minimum. There are 22,000 descriptor codes in the thesaurus; 7,500 of these are for subjects, and the remainder cover equipment, trade names, projects, geographical locations, corporate authors, and other areas. The maximum length of the descriptor list is limited by the size of the computer memory to 32, 768 words.

The thesaurus is maintained on the computer and is used to detect input errors.

(5) Defense Logistics Studies Information Exchange

The Exchange set out to develop a glossary of indexing terms acceptable to all DoD agencies. The DoD definition of logistics was used as a basis for the glossary, which is now structured to five hierarchical levels.

Originally, no limit was placed on the number of terms, and no restrictions were placed on the terms to be used. Now, however, terms must be selected from the glossary, and new ones may be added only after careful consideration. Early in 1965, a detailed study was made of the glossary, and nearly all second-level terms were eliminated. Terms that receive only occasional usage will be studied for elimination. Currently, there are about 2, 000 terms; definitions will be added in the future.

(6) Army Study Documentation and Information Retrieval Service

ASDIRS originally based their thesaurus on the ARMITERM thesaurus. Term definitions are being added as the thesaurus develops. There are currently 600 terms in the thesaurus; on the average, 10 to 15 terms are assigned to each document. The thesaurus is not maintained in computer memory.

(7) Air Force Materials Laboratory

The AFML thesaurus was established on the basis of terms derived from documents in the indexing process. Twelve or thirteen terms are assigned to each document. Synonymous terms were placed under the same machine codes from the beginning of development. However, in a study performed at AFIT, roles were found inferior in utility to links. The use of links showed a reduction of irrelevant information by over 56 percent, while incurring less than 5 percent loss of relevant information. The AFIT study recommended the dropping of roles at AFML.* While compound terms are used freely, only one link per term is listed.

The use of many specific terms, especially in organic chemistry, had increased the thesaurus to between 45,000 and

* Complete results of this study are given in An Evaluation of Links and Roles Used in Information Retrieval, AD606192, Technical Documentary Report No. ML TDR 64-152 July 1964, AF Materials Laboratory RTD, AFSC, Wright-Patterson Air Force Base, Ohio.

50,000 terms To control this expansion, a fragmentation system was developed for organic chemistry and other specific areas that resulted in a reduction in the thesaurus to 10,000 terms.

The thesaurus has a hierarchical arrangement and uses numeric codes and scope notes.

A version of the thesaurus, consisting of a basic file of valid descriptor terms with numeric codes, is maintained on the computer to correct input errors.

(8) Nondestructive Testing Information Center

The Center uses a[illegible] alphabetical listing of 400 terms which is available for man[illegible] use by indexers and information requesters. Terms are added as the need arises.

(9) Applied Physics Laboratory

APL followed the free vocabulary approach until June 1965, when terms in use were reviewed for inclusion in a formal thesaurus. The thesaurus is about one-third complete and upon completion will have two sections: an alphabetical listing of terms (nonhierarchical) including their meanings, synonyms, alphabetic codes, use information, and related terms; and a list of field structures with a modified COSATI listing of categor[illegible].

(10) Foreign Technology Division

FTD's thesaurus is arranged hierarchically in 56 subject areas. It is maintained on the computer, where it is used for checking input errors. Scope notes are included in the thesaurus, although these have been reduced by about 15 percent. COSATI subject categories are used in information dissemination and accessions listings.

(11) Ft. Detrick

The thesaurus, which was developed under contract, was an empirical development resulting from a search of the open literature, the document index process, and interviews with Ft. Detrick staff members. The thesaurus has been published in three parts. Part 1 is a complete listing of descriptors with codes, in hierarchical arrangement; there are up to nine descriptors in a hierarchy. Part 2 is a condensation of Part 1. Part 3 is a straight alphabetic listing of all descriptors with codes. There are approximately 10,000 descriptors. The thesaurus is maintained in computer memory and is used for detecting input errors.

(12) Naval Postgraduate School

NPS's file of descriptors is maintained on punched cards, and new descriptors are added as necessary. There are 8,000 terms in use at present. Alphabetical listings of terms are used together with a uniterm code number.

(13) U. S. Naval Underwater Weapons Research and Engineering Station

A thesaurus is being developed. In the meantime, DDC's thesaurus and COSATI listings are being used.

(14) U. S. Army Natick Laboratories

DDC's thesaurus is used in conjuction with Natick's own subject authority file.

(15) Plastics Technical Evaluation Center

PLASTEC uses a maximum of eight precoordinated terms per document. An alphabetical printout of previously used terms forms the thesaurus. New terms may be added as necessary. Terms are coded for information storage and retrieval.

When a term is used in more than 25 documents, precoordinated term groups are created to reduce term usage and to increase specificity. Coordinated terms are connected by a hyphen and arranged in the printouts by the first term of the pair. The higher-order term, which is generally a property or use-oriented term, is placed first in the pair. A list of style rules has been developed to assist toward consistent indexing. PLASTEC's thesaurus is not maintained in computer memory.

(16) Naval Missile Center

NMC uses DDC's thesaurus, with added terms as required. A maximum of five descriptors is assigned to each document. A printout of descriptors used in any one year is made as desired. The NMC's thesaurus is not maintained in computer memory.

(17) U. S. Naval Ship Missiles Systems Engineering Station

The keyword thesaurus used by NSMSES is NAVWEPS DD 24650, 2nd edition, prepared for NSMSES by a contractor who will continually revise the thesaurus. A keyword may consist of several words; since such groups may not fit into the space available, the thesaurus contains abbreviations for them derived from the actual documents and from MIL-STD-12B.

A keyword listing is printed monthly from the master file of the retrieval system. (There is no separate thesaurus maintained on the computer.) A maximum of four keywords may be assigned to a document.

(18, 19) Battelle Memorial Institute--Radiation Effects Information Center, Remote Area Conflict Information Center

Clue words underlined on extract cards are the basis of Battelle's indexing system. These clue words are not subject headings or keywords from a pre-established thesaurus but are words which, in the opinion of the specialist or scientist performing the review, provide the best clues to the content.

RFIC's clue word list contains about 18,000 words at present, and about 1,000 new terms are being added each year. They are numerically keypunched on EAM cards, coded, and filed by hand in a card file that is manually updated continuously as new clue words are reflected. Filing of the cards is by code number.

Each clue word used in RACIC's files is keypunched on an EAM card. Also punched on cards are card sequence number, a clue word classification number, and the higher-order hierarchical clue word file into one of the following six general subject areas: biological science, chemistry, electronics and communication, mobility, social studies, and weapons. RACIC is experimenting with a coordinate index of clue words with accession number cross-references established by links.

(20) Edgewood Arsenal

A word list of 12,500 terms was reduced by a contractor to 9,500. The basic thesaurus was developed during two nonconsecutive one-year contracts. In the first contract, an attempt was made to remain compatible with the DDC thesaurus, but this approach resulted in 40,000 terms including identifiers. The thesaurus has been reduced to a compilation of terms used at Dugway as well as edgewood. Additions are generated from indexing. Based on use frequency counts, infrequently used terms have been dropped, and words used very frequently are reviewed for further breakdown.

The thesaurus is not maintained in the computer memory. A hierarchical format is used. Links are used although they are not considered worthwhile on the 35,000 items now in the collection. The Library believes they might be helpful when the collection grows to around 100,000 items.

(21) Naval Weapons Laboratory

The NWL thesaurus, containing 2,500 to 3,000 descriptors and approximately 3,000 identifiers, was based originally on NWL's four- to six-letter code listing. New terms are reviewed for potential importance. Codes are being dropped, and natural language will be used in NWL's second-generation systems. A computer printout of descriptors and descriptor codes is made as required. The thesaurus is maintained in computer memory to detect input errors.

VI. FILE STRUCTURE

Two general classes of files were encountered: serial and inverted. The great majority of facilities studied utilize the inverted file in their search process and then resort to a serial file, often off-line on punched cards, to print bibliographic information corresponding to retrieved accession numbers.

In the serial (direct) file, all information relating to documents is stored in an ordered sequence, usually by alphabetic or numeric characters (accession number, LC number, etc.). Access to all information pertinent to a specific document is gained by locating in mass storage the block containing the correct unique identifier (accession number, etc.).

In the inverted file, such as the traditional card catalog of authors or subjects, items are filed in batches under the subject headings, descriptors, or authors. There are also various combinations of these basic file structures that have been developed in specific cases.

The selection of file structure is critical to a library's operation. File structure can greatly influence the following:

- File maintenance effectiveness
- Retrieval effectiveness

- Staffing needs
- Growth capabilities
- Resource requirements.

Simpler and cheaper file updating and maintenance is generally possible with a serial file structure. Updating information can be sorted by accession number and the appropriate file information blocks located and updated in simple sequence. Maintenance of inverted files is more complex, since the updating information pertaining to an accession numbered entry must be entered under each term to which the entry is indexed. However, file search is generally much faster using the inverted file.

1. SERIAL FILE

The common method of searching a serial file is to examine it record by record and to check for the presence of the required descriptor or descriptor combination assigned to each document. In its simplest form, the criterion for rejection of an item is the absence of at least one of the required descriptors.

The chief drawback to this method is that, although the probability that any given item in the file will be relevant to the query is quite small, every item in the file must, nevertheless, be examined. The factors that make this exhaustive approach at all practicable are the high processing speed and memory capability of the computer. These characteristics permit the combining of a number of queries so that only one pass through the file is needed for the several queries.

A scheme is employed at NOL which reduces the amount of file that must be searched. In NOL's approach, document records are grouped serially in a rough sort by common characteristics, and these characteristics are identified by a binary code. NOL's strategy is to separate extraneous material as quickly as possible and then to screen promising material at finer and finer levels of discrimination until only relevant material remains. The method is based on comparison of data in the single field of binary digits making up the grouping code and rejection of the unwanted items on a statistical basis.

The essential feature of this method is the assignment of a random pattern of bits (1's and 0's) to each descriptor in the dictionary. The number of 1's placed in each pattern is adjusted to be proportional to the discriminating power of the descriptor. Terms with a high frequency of occurrence offer little selectivity, so they are encoded with relatively few 1's, and vice versa. The pattern for the totality of descriptors that have been assigned to one particular document is formed by superposing the patterns for each individual descriptor. Similarly, the pattern assigned to the batch (up to six documents per batch) is formed by superposing the patterns for each document. The query patterns are formed in a similar manner.

During a search, each of the batches is successively compared with the list of query patterns. Unless the binary field of the batch code contains a 1 in every position where the query has a 1, it will be rejected. If a match occurs, then the next level of screening is performed, which is to compare the code of each of the documents in the batch against the query pattern. Again, only those documents that pass this screening go on to the next level, which is to compare the individual query terms against the document terms. Thus, the final result is a list of just those items that are pertinent to the query and no others.

The extent to which the above variation overcomes the input/output limitations imposed by the series file structure was not quantitatively determined by the survey. This technique, however, when combined with strategic storage of records based on frequency of use of descriptors, could result in significant savings of computer time.

2. INVERTED FILE

The usual method for searching an inverted file is to first determine all of the accession numbers that pertain to each descriptor and second to determine if a given accession number appears the proper number of times to satisfy the Boolean criteria (AND, OR, NOT operators). The result of such a search is a list of accession numbers which must then be related manually or automatically to another file (a serial file) to obtain corresponding bibliographic information, abstracts, etc. The latter file is usually maintained on EAM cards or other media external to the computer in order to avoid using a large amount of memory space for what is usually only a printing operation. The Ft. Detrick search scheme is typical of this type of approach.

The main disadvantage of searching only the inverted file is that it limits the search to descriptors. Other items of interest, such as bibliographic information, keywords in the abstracts, titles, etc., cannot be searched automatically. The solution for this is to increase the variety of files, but this approach complicates the programming and the system operation. A particularly difficult situation arises when several different types of information facilities are compelled by economics to utilize the same general retrieval program. Examples of this situation are the University of Michigan analysis centers (IRIA, VESIAC, and BAMIRAC) and the Electronic Properties Information Center. EPIC has rejected the use of inverted files for its generalized retrieval program planning because of the lack of versatility in search criteria.

3. FILE ELEMENTS

Another aspect of file structure, which affects computer search and update time and compactness of the files, is whether or not the document file should contain subject data (descriptors), bibliographic data, and abstracts. The APL Library is an example of a system that stores all three together for each document. NWL in its original system included subject and bibliographic data and in its new system is adding abstracts. NPS and NOL exemplify libraries that maintain separate subject and bibliographic files. In these systems, the bibliographic file is only searched for documents that were called out during the search run on the subject file. FTD maintains a coded subject file whose search output lists the document numbers of the hits obtained. While the approaches varied, most of the facilities studied believed that, at the minimum, bibliographic data should be included in the search output.

VII. STORAGE AND RETRIEVAL

1. SYSTEM FUNCTIONS

The basic functions of a mechanized retrieval system are defined, for the purpose of this analysis, as follows:

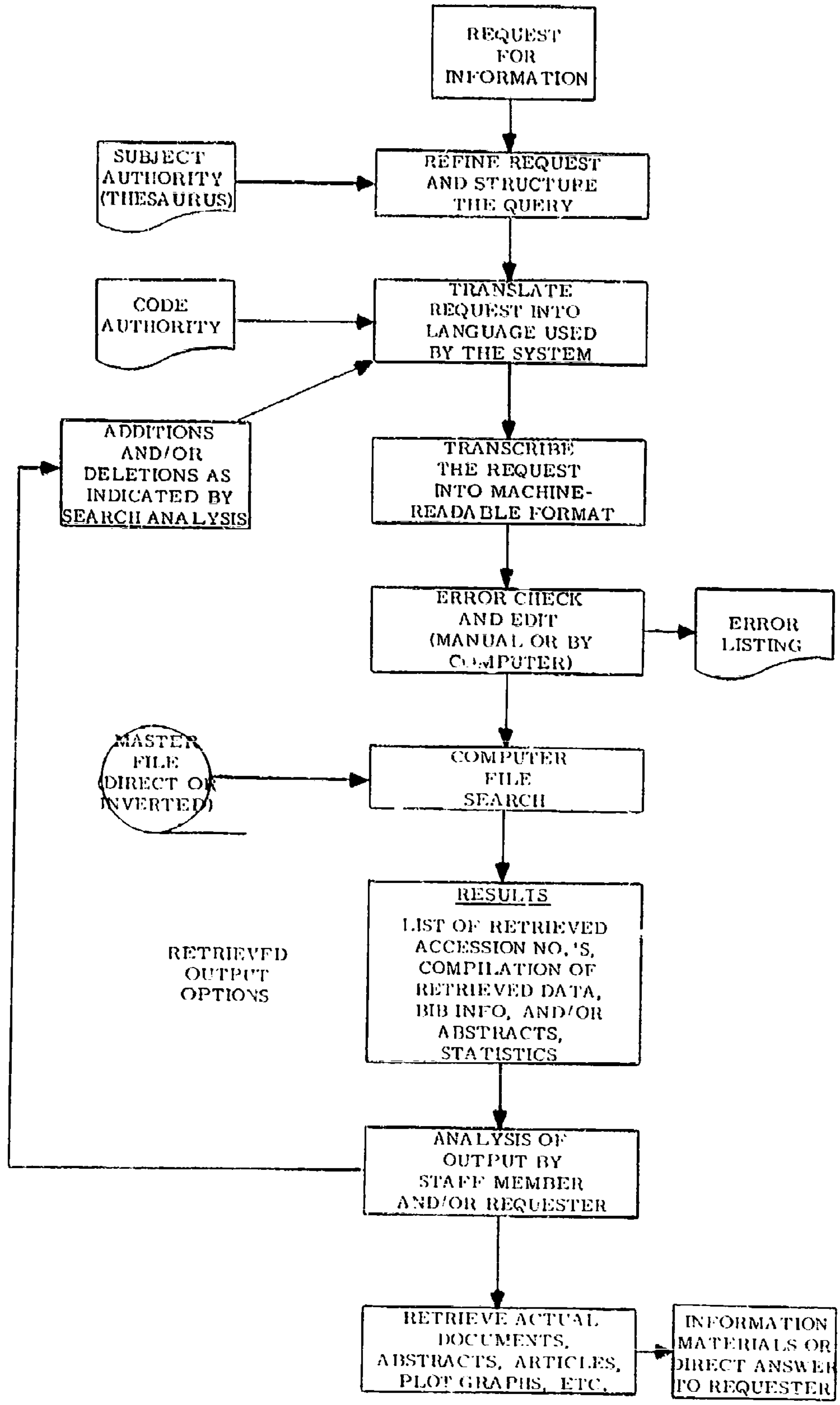
- Communication and refining of the request
- Conversion of the request to machine-readable form
- File search
- Analysis of retrieved material
- Preparing the response and communicating it to the requester.

The block diagram of Figure 12 depicts a typical retrieval system flow.

2. COMMUNICATION OF THE REQUEST

Initially, the request for information is phrased in the user's language. The question may be transmitted verbally or in written form and may be formulated with or without the assistance of an information facility staff member. In most facilities surveyed, however, the assistance of a member of the facility staff is usually employed in formulating requests for information. The staff member analyzes the request, discusses it with the requester, and finally structures the query or queries into the most suitable form.

TYPICAL RETRIEVAL
SYSTEM FLOW
FIGURE 12



The formulation of a query commonly involves the filling out of a query worksheet. One such worksheet (NWL) is presented in Figure 13. This one allows the actual question to be entered on the form. Most worksheets require only the subject descriptors and qualifying information (e.g., limits on date of publication of pertinent documents), as shown in Figure 14 (NPS), or are tailored for machine data conversion (Edgewood--see Figure 15). The refined question is entered on the worksheet using subject descriptors, qualifiers, a link and role relationship, logical operators, etc. A thesaurus is generally used at this stage to obtain the correct terms for translating and for checking for synonyms, abbreviations, etc.

3. CONVERSION OF DATA TO MACHINE-READABLE FORM

Before the query data can be entered onto some standard input media, such as punched cards or paper tape, a formatting step is usually necessary. Although some facilities (e.g., NPS) have arranged to use a portion of the query formulation worksheet (see Figure 14), the majority require a new worksheet (the program coding sheet) as shown in Figure 16. In some cases, the staff searcher and query coder are different members of the staff, with the latter being more familiar with the mechanized system.

FIGURE 13

NWL Query Worksheet

TECHNICAL LIBRARY LITERATURE SEARCH REQUEST
NOW-NAL-5070/20 (6-65)

DATE	
REQUESTOR	ROUT. SYM.	EXT.	REFERENCE LIBRARIAN	EXT.

QUESTION	DESCRIPTORS
Air Blast pressure Control of blast Warheads Continuous rod Projectiles Bombs	1. Air Blast Pressure 2. Control Blast Pressure 3. Continuous rod Warheads Pressure 4. Projectiles Pressure 5. Bombs Pressure

MACHINE INFORMATION RETRIEVAL APPLICATION
TECHNICAL REPORTS and CLASSIFIED MATERIALS SECTION
12ND PGS 73 (1-66)

FIGURE 14
NPS-Query Worksheet
United States Naval Postgraduate School
MONTEREY, CALIFORNIA

The Library's Retrieval System is available for literature search of documents received by this department since NOVEMBER 1960

NAME: EMILY ALLEN | SCHOOL OR DEPT: | DATE:

☐ FACULTY ☐ STAFF ☐ STUDENT ☐ OTHER | ROUTING OR BOX NO:

☐ I wish to have the printed output sent to me ☐ Retain output pending my collection

AREA of SEARCHES REQUIRED Please specify the subject field(s) in which you are interested by using the terms established in the Glossary of Descriptors and Uniterms. For more detailed instructions in the completion of this section, please request the assistance of the staff. Up to six searches may be requested on this form.

1. CROYOGENICS
2. INFORMATION - RETRIEVAL
3. SOUTH VIET NAM
4.
5.
6.

SOURCE or SOURCES (If you wish to have these searches restricted to a particular source or sources (Example: NOTS, China Lake, General Electric, etc.) please specify below)

a | c
b | d

DATE or INCLUSIVE DATES of ISSUE (If you wish to have these searches restricted to documents issued on a particular date (month and year), prior to a particular date, after a particular date, or between two inclusive dates, please specify.)

a | c
b | d

To be completed by Library Staff

TO
Processing Department

NAME OF REQUESTER:

```
ALLEN/1/00001257/CRYOGENICS////"
ALLEN/2/00001634000004756/INFORMATION/RET
       RIEVAL//"
ALLEN/3/00047377/SOUTH/VIETNAM///"
```

1. Please prepare synchrotape exactly as prescribed above
2. Allow a minimum of 10 to 12 inches of tape feed prior to punching
3. After all data have been punched on a tape, punch at least three seven level holes (non print keys on the Synchrotape or stop code on Flexowriter)

QUESTION NO	DATE	REQUESTER'S NAME	
04	110665	Kracke, Robert D.	*
(1-6)	(9-14)	(17-22)	(74)

QUESTION NO	SEARCH NO	DATE	TYPE QUESTION	NO. OF DESCRIPTORS IN SEARCH	DESCRIPTOR NO	DESCRIPTOR NO	DESCRIPTOR NO.	DESCRIPTOR NO.	DESCRIPTOR NO	
04	01	110665	2	02	066817	077324				*
(1-6)	(7-8)	(9-14)	(17)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

QUESTION NO	SEARCH NO	DATE	TYPE QUESTION	NO. OF DESCRIPTORS IN SEARCH	DESCRIPTOR NO	DESCRIPTOR NO	DESCRIPTOR NO.	DESCRIPTOR NO.	DESCRIPTOR NO	
04	02	1106:5	2	02	066817	036097				*
(1-6)	(7-8)	(9-14)	(17)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

QUESTION NO.	SEARCH NO	DATE	TYPE QUESTION	NO. OF DESCRIPTORS IN SEARCH	DESCRIPTOR NO	DESCRIPTOR NO	DESCRIPTOR NO.	DESCRIPTOR NO.	DESCRIPTOR NO	
04	03	110665	2	02	066817	000270				*
(1-6)	(7-8)	(9-14)	(17)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

COL. 17 1 'BUT NOT' (PRECEDE EXCLUDED DESCRIPTOR NO. WITH '-')

2 OTHER THAN 'BUT NOT'

NOTE: ALL COORDINATES OF AN 'AND' PHRASE MUST RECEIVE THE SAME SEARCH NUMBER.

SRFIA FORM 16 (TEST)

15 OCT 64

FIGURE 15

Document Search Request (STINFO)

PROGRAMMER J. P. CUMMINGS

PROBLEM

SHARE 7090 SY
Symbolic Coding I

*FOR REMARKS

LOCATION 1 2 3 4 5 6	7	OPERATION 8 9 10 11 12 13 14 15	ADDRESS, TAG, DECREMENT/COUNT 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
H2.3,1	0	0, F.K.	HILL * $AREA/COMPRESSIBLE

The Johns Hopkins University
APPLIED PHYSICS LABORATORY

: 7090 SYSTEM

olic Coding Form

FIGURE 16

APL-Query Worksheet

PAGE 1 OF 1 PAGES

DATE

IDENTIFICATION 73 80

COMMENTS

35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
S	I	B	L	E	/	B	O	U	N	D	A	R	Y	/	L	A	Y	E	R	/																	

After coding, the query is punched onto cards or paper tape, checked for errors, and then applied to the computer for conversion to magnetic tape. Commonly, a printout of the query data as they appear on tape is obtained for checking and editing.

4. FILE SEARCH

The computer may now check each query for validity (format, consistency, etc.), check the descriptors against the master dictionary (thesaurus), and combine the queries of a class into one integrated search which is then used to examine all the records in the master file. The conclusion of the file search is usually an output tape containing the retrieved data, which is then taken off-line for listing. The off-line step is used to avoid tying up the computer for a simple print operation of a bulk file of, say, EAM punched cards containing detailed bibliographic information. (Types of files and associated retrieval schemes were discussed in Section VI of this report, File Structure.)

The output data are formatted in as many ways as there are retrieval systems. Only one installation, FTD, reported making any extensive analysis of user requirements in determining the quantity, type, and format of the output data. In general, the following types of output listings are produced:

- A summary list containing the number of hits found for each query (see Figure 17)
- A coded list that contains the accession numbers of all hits found for each query and may also contain other coded data (see Figure 18)
- A list that contains bibliographic data for each accession number listed and sometimes additional information such as abstracts, descriptors, etc. (see Figure 19)
- A list of numerical data.

5. ANALYSIS OF RETRIEVED MATERIAL

Regardless of the form of the retrieved output, the staff searcher or the user must analyze the information in order to determine its relevance. This task becomes quite difficult if the retrieved output form contains only a listing of codes or accession numbers. In such a case, the card catalog must be searched, or the document itself must be analyzed--a time-consuming process. Thus, from the standpoint of the analyst and user, a search output should also consist of titles and, if possible, abstracts. This sort of listing permits a browsing process that is an efficient version of that done in a card catalog.

If a searcher feels that the information he desires is not in the output obtained due to too-restrictive search or improper query, or if too much data have been produced because the query was too general, he can rephrase the question and search the file again. A mechanized

FIGURE 17

APL- Search Output

SUMMARY OF RESULTS

SEARCH IDENTIFICATION	PRINTOUT MAXIMUM	NUMBER OF HITS
JPC.1	0	1983
JPC.2	0	0
JPC.3	0	130
JPC.4	0	585
JPC.5	0	306
JPC.6	0	183
JPC.7	0	502
JPC.8	0	97
JPC.9	0	1060
JPC.10	0	73
JPC.11	0	1884
JPC.12	0	959
JPC.13	0	180
JPC.14	0	226
JPC.15	0	147
JPC.16	0	553
JPC.17	0	1076
JPC.18	0	1421
JPC.19	0	514
JPC.20	0	4588
JPC.21	0	847
JPC.22	0	359
JPF.1	999	23
SPQ.1	900	18
SPQ.2	900	21
SPQ.3	900	39
SPQ.4	900	24

IDENTIFICATION

REQUEST	REQUESTOR	STAFF MEMBER
000100	3526	MC

CODE WORDS AIRC FLIG TEST

0002 DOCUMENTS FOUND

AGENCY	ACCESSION NUMBER
ASRC	166582
NASA	168302

OUTPUT 1 - ACCESSION

FIGURE 18

NOL Search Output

LIMITATIONS

D STAFF MEMBER	DATE	SECURITY	CIRCULATION
L MC	L) 65	L)	
U	U) 00	U) U	

TEST

SECURITY LEVEL	DATE	IMPORTANT CODE WORDS			
U	06 65	AIRE	TELV	ARTT	FIRI
U	10 65	FLIG	WINU	EFFE	ANGE

ON NU T 1 - ACCESSION NUMBERS AND IMPORTANT CODE WORDS

FIGURE 19

APL-Search Output

105789
UNCLASSIFIED

POLYTECHNIC INSTITUTE OF BROOKLYN, DEPARTMENT OF AEROSPACE ENGINEERING AND APPLIED MECHANICS. RPT. PIBAL-R-615, AFOSR-64-1786.

A MOMENT METHOD FOR COMPRESSIBLE LAMINAR BOUNDARY LAYERS AND SOME APPLICATIONS, BY P.A. LIBBY AND H. FOX. SEPTEMBER 1964., AF-AFOSR-1-63.

AN INTEGRAL METHOD BASED ON MOMENT TECHNIQUES AND ESPECIALLY USEFUL FOR COMPRESSIBLE LAMINAR FLOWS IS PRESENTED. THE DESCRIBING PARTIAL DIFFERENTIAL EQUATIONS ARE FIRST TRANSFORMED TO THE LEVY-LEES VARIABLES AND THEN CONVERTED TO INTEGRAL CONDITIONS WITH NU TO THE THE M POWER AS A WEIGHING FACTOR. A TECHNIQUE FOR HANDLING THE VARIATION IN TRANSPORT PROPERTIES WHICH EXPLICITLY ARISES FOR M GREATER THAN 0 IS DESCRIBED. THE RESULTANT EQUATIONS ARE APPLIED FOR M = 0, 1 WITH THE COMMONLY EMPLOYED FOURTH AND FIFTH DEGREE POLYNOMIAL PROFILES FOR VELOCITY AND STAGNATION ENTHALPY. THE DISTINCT CLASSIFICATION OF SIMILAR AND NONSIMILAR FLOWS WITHIN THE SAME ANALYTIC FRAMEWORK IS EMPHASIZED. THE ANALYSIS IS APPLIED TO A VARIETY OF FLOWS FOR WHICH MORE ACCURATE RESULTS ARE AVAILABLE AND IS FOUND TO YIELD SATISFACTORY RESULTS IN MOST CASES. THEREFORE, THE PRESENT METHOD IS CONSIDERED TO IMPROVE SOMEWHAT THE CONVENTIONAL INTEGRAL METHOD (M=0) WITHOUT EXCESSIVE LABOR. (AUTHOR).

/+LIBBY/+FOX/1964/YEAR/105789/ACC/U/=AF-AFOSR-1-63/.PIB/
/COMPRESSIBLE/LAMINAR/BOUNDARY/LAYER/MOMENT/TECHNIQUE/FLUID/MECHANIC/INTEGRAL/SOLUTION/TECHNIQUE/WALL/EXTERNAL/FLOW/CONDITION/
NONSIMILAR/FLOW/AL-FLUID/

system in which only minutes are required to rephrase a question encourages the repetition of in-depth searches until the desired information has been obtained. A manual system would soon discourage both the user and the reference librarian.

6. COMPARISON OF RETRIEVAL FUNCTIONS

The following paragraphs compare the functions encountered in the retrieval systems surveyed. Table 5 summarizes this comparison.

(1) Search Query Formulation

The basis for formulating a search query is the specification of descriptors which may be related with the Boolean connectives AND, OR, NOT, EQUAL, etc. The use of connectives appears to be the most confusing aspect of mechanized retrieval. The range and usage of logical and pseudological operators varies widely from no usage (excluding the intrinsic AND requiring all descriptors to be included for a match), as in the NPS system, to the approximately eight connectives utilized by APL. APL is very consistent in their use of connectives, although this tends to cause errors in coding.

NWL uses an AND/OR key in which the descriptors on any one query card are all AND related, and AND/OR relationships may exist between cards. However, this query technique is limited

Key: C=Card Catalog
P=Planned

LIBRARY	Storage Equipment			Number of Documents in Retrieval System		Questions per Month			Queries per Month	
	Com-puter	Drilled Hole Optic'ly Sensed	EAM Cards	Present	Y'rly Rate of Input	Total	Current	Expected	Current	Expected
AMS Maps			X	2×10^6	21,000					
AMS Repromats				110,000						
APL	X			18K	8K					
ASDIRS		X	X							
BATTELLE Info. Center	Manual Card File									
BuSHIPS	X			Links-Roles		1200				
CAMBRIDGE	X									
Defense Logistics Info. Exchange	X			6 K	1.5K					
DISC			X	600BKS						
Edgewood	X		X	35K			25%			
EPIC	X									
Fort Detrick	X									
FTD	X			40K	60K-70K					
HDL	X		X							
Mechanical Prop. Data Center	X		X							
Naval Postgrad School	X		X	25K	$\leq$ 5K	300			25	
NOL	X			70K	20K				200	
Non-Destructive Testing Center		X								
NOTS	X		X	66K			25%			
PICATINNY	X			7K						
PLASTEC	X			7K						
REDSTONE										
TPRC	X		X							
University of Mich. Info. Centers	X		X							

Table 5

Storage and Retrieval

es per ...nth ... Expected	Thesaurus: Language: Code	Thesaurus: Language: Natural	Thesaurus: Used for Input Checking	File: Inverted	File: Direct	Outputs: Catalog C/B	Outputs: Acc. List	Outputs: Charge Cards	Outputs: Coordinate Index C/B	Outputs: Search: Acc# and Code	Outputs: Search: Bibliography	Outputs: Search: Abstr.	Outputs: Search: Desc
		X	X		X	C	X			X	X	X	X
	X					B					X		
		X		X			X		X	X	X	X	
		X	X		X	C	X			X	X		
					X	X	X	X					
		X	X	X					X	X	X	X	
						EAM	EAM						
	X			X						X	P		
							X			X	X	X	
	X	X	X	X	X		X			X	X	X	X
		X	X	X			X			X	X		X
		X				C	X						
	X			X						X	X	X	X
	X				X		P			X	X		
	X		X		X	C	X	X		X	X		X
		X		X						X	X	X	
	X			X		C	X		C	X	X		
	X			X					X				
	X					C	P						
	X			X					X				
				X						X	X	X	

to a total of three cards. Thus, where lengthy descriptors are used (provision is made for "type 3" descriptors, which are 21 to 40 characters in length) so that only one or two descriptors may be entered on a single card, multiple queries for the same question must be made up in order to employ the logical operators. The following table indicates the usage of the AND/OR key to satisfy the relationships expressed between the cards.

Condition	AND/OR Keypunching* Card 1	Card 2	Card 3
One Card only	0	-	-
Card 1 AND Card 2	1	1	-
Card 1 OR Card 2	0	0	-
Card 1 AND Card 2 AND Card 3	1	1	1
Card 1 AND Card 2 OR Card 1 AND Card 3	1	0	0
Card 1 OR Card 2 OR Card 3	0	0	0
Card 1 AND Card 2 OR Card 3	1	1	0

Other information facilities (e.g., FTD and Ft. Detrick) also use "MUST" terms. A "MUST" term must appear with one or more of the other terms requested in order to qualify as a hit.

* A one (1) signifies a punch, zero (0) means leave blank, dash (-) means not applicable

FTD also uses "qualifiers" in the retrieval program. A requester can "qualify" a query by date, country, classification, type of document, number of term hits, and others.

Ft. Detrick combines its "MUST" relationship with such qualifiers as all documents having x or more of the set of descriptors listed in the query. In general, the following types of search questions may be accommodated by the computer program for retrieving document references contained in Ft. Detrick's Retrospective Search File:

- (ABC, ... n)--a request for all documents having all descriptors, A and B and C, etc. (maximum of 20) appearing together
- (X, D, E, F, . . . n)--a request for all documents having x or more (maximum of five) of D, E, F, etc., appearing together. For example, if x is given by the requester as 2, then the request is for at least two of D, E, F, etc. (i.e., D and E, or D and F, or E and F, or D and E and F)
- (-I, J, . . . n)--a request for documents <u>not</u> having descriptors I or J or n appearing
- (-x, K, L, M, . . . n)--a request for documents not having x or more (maximum of five) of K, L, M, etc., appearing together as in the second item above.

The above criteria may be assembled together as desired, but only in an AND relationship. For example, the specification (A and B and C) AND (2 of D, E, or F) is allowable, but (A and B and C) OR (2 of D, E, or F) is not allowed in a single search.

The latter specification would require two independent searches, the first excluding the second specification, and the second excluding the first. Note that multiple searches, since they are recorded independently, may result in redundant selections.

Edgewood Arsenal employs three Boolean operators: AND, BUT NOT, and OR. The last may be used with only two terms. However, the operators are not applied until the end of the file search. That is, the search produces accession numbers that relate to all descriptors without regard to the operators. The queries are then reconstructed to determine what Boolean relationships exist in each query, and the output file is evaluated and edited against these relationships.

Performing this operation at the end of the search, however, requires assembling and then working with another file, which adds more input/output time to the process. Systems such as Edgewood's are normally input/output limited; i.e., tape-handling time far exceeds the time required for the computer to process the data, and the computer must then sit idle while inputing or outputing the next record to or from tape. Consequently, considerable time is spent in producing and working with a tape of document hits, many of which must now be discarded. Two tests of the Edgewood system operation have shown that approximately

9 and 11 hours have been required for search runs of 60 and 80 questions, respectively. This ratio is greater by a factor of approximately 10 than that of most other systems encountered.

Discussions with the programming staff at the Arsenal have indicated that the main problem was the program requirement for extensive repetition of data associated with the reformatting of the search question. It is expected that rewriting this part of the program will result in a time saving of 40 to 65 percent. However, although this is a considerable improvement, the running time is still greater than that being achieved by most others. A contributing factor may be the computer--a Honeywell 400--which is a medium-speed, small-core machine.

It should be noted that only 15 percent of the document collection of approximately 25,000 is presently included in the file. To handle the enire collection, a new system approach may be necessary, especially if a more powerful computer is not available.

(2) Computer Availability

The availability of computer time, and consequently the response time for a search, varies widely. At NOL, computer time is made available daily during prime hours. At APL, searches are normally accomplished overnight but at times must be extended to two days because of unavailability of computer time; at NPS it takes two days for a requester to receive his bibloigraphy. Lack of computer time availability and the low priority assigned to the Library is causing Redstone Arsenal to think in terms of weekly searches when it inaugurates its technical documents retrieval system. TPRC is installing a radio-teletype circuit with the computer area located several miles away. TPRC's opinion is that much more time is spent in mailing and processing a request, delivering and receiving materials to and from the computer, and communicating the answer than is spent in computer running time.

(3) Combination of Queries for Processing

As a part of their programming technique, all installations combine queries into one search list, so that a file can be searched in one pass. However, the number of queries that can be combined in a single search operation varies from a low of 10 on one file at FTD to 5,000 descriptor/role pairs on the BUSHIPS SHARP-LARC System. The most common limit is around 50 queries. In most retrieval programs, the combined and reformatted queries list is held in core during file scanning; therefore, core limitation was the most quoted response to the question of what determined the size limitation of the search.

(4) Thesaurus Check by Computer

An additional item found in many search runs was a check of the coded or natural language descriptors in the query against the thesaurus. Because an incorrect descriptor (either erroneously spelled or coded or nonexistent) would normally prevent any document from responding to the query, such a check is a valuable part of a search run. The limited number of evaluations conducted on existing retrieval systems reveal that a relatively high number of errors occur at facilities where descriptor codes are used (e.g., BUSHIPS Project SHARP--Evaluation of Indexing Procedures and Retrieval Effectiveness, NAVSHIPS 250-200-3). This is one of a number of factors that prompted a switch to natural language by BUSHIPS and NWL in their new systems. The use of natural language decreases input errors and is also more amenable to computer error detection techniques, particularly because a coding error often produces another valid (although incorrect) code.

(5) File Processing and Information Retrieval

One of the few areas of agreement encountered during the survey is the need to provide the requester with something more than a list of accession numbers that satisfy the query. A typical method is to provide bibliographic data as part of the search output for each query. Some, such as Edgewood Arsenal, do not as yet provide bibliographic data. The only output data currently available to the requester are the accession numbers of the documents found.

Ft. Detrick maintains an abbreviated bibliographic file that contains the title and author (corporate and personal) for each document. This file is used to add bibliographic information to the list of retrieved accession numbers following the output of the retrospective search run.

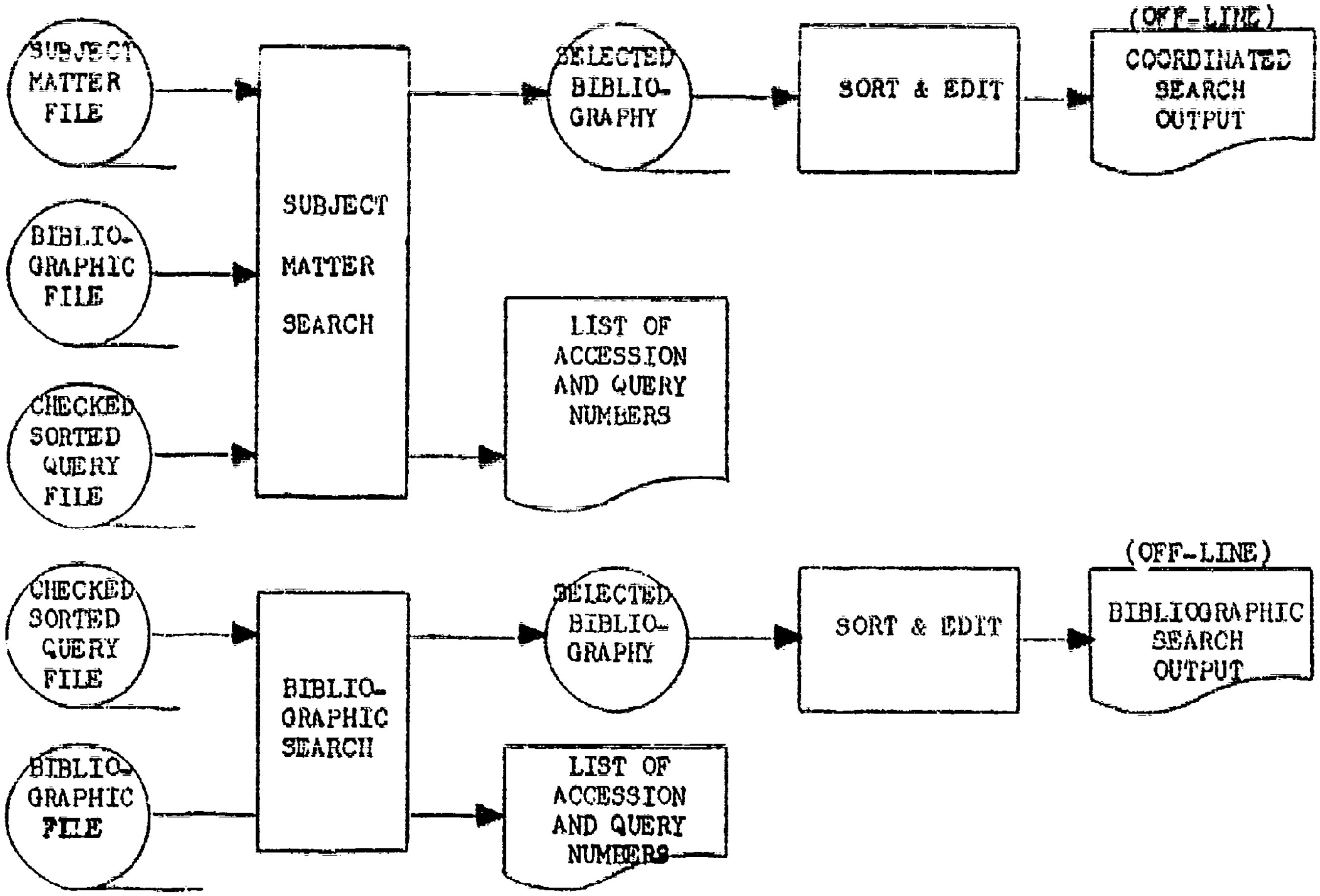
NOL has added a more inclusive bibliographic file to its original system, which includes title, source, author, date, number of pages, and contract number. As yet, this file does not contain entries for all documents in the subject file; therefore, two outputs are produced. First, a coded output is produced which contains the query data, accession numbers of hits, agency, date, classification, and the four most important descriptor codes for each hit (see Figure 18). Then the output file is run against the bibliographic file, and a combined output is produced containing query data and bibliographic data for each hit for which data exist in the bibliographic file.

The APL system, on the other hand, provides accession number, full bibliographic information, abstract of the document, and all associated descriptors for each selection (see Figure 19).

An option is also available that limits the number of selections to be printed out. Each document entry in APL's serial file contains all data pertinent to it.

Another difference being employed by APL is a scheme by which it is possible to obtain the number of hits that would be generated for a query without getting a printout of the hits. By using this scheme, it is possible to phrase a query on various levels to determine the amount of data available before asking for the actual data. The benefits of this are partially undermined by the loss in time, since it is now necessary to wait for the next time the computer is available in order to obtain the document data desired.

Some libraries separated subject matter and bibliographic files, as was briefly discussed in Section VI, File Structure. Adaptations of this method are employed by NPS and BuShips. In these systems, the bibliographic file is mounted along with the subject matter file. As hits are scored on the subject matter file, the bibliographic file is stepped to the same accession number of the hit, and the bibliographic data are simultaneously recorded. In addition to this coordinated search, the BuShips system allows for an independent search on the bibliographic file if this is desired. The simplified block diagram below depicts the new BuShips retrieval system.



(6) Permuted and Coordinate Indexes

1. Permuted Indexes

In a permuted index, titles of documents are listed in alphabetic order by title keyword, each title being listed as many times as there are keywords in it. In order to prevent words of no index value from being listed, a predetermined group of words of this class (e.g., applications, work, the, to, etc.) are set in the computer program for permutation suppression. Permuted indexes are produced and used at HDL and SEG, and one is in development at NAFI.

HDL's index publication, known as the ABC Dictionary, is printed from an updated master tape file of titles and/or concept statements. The latter are assigned to each document processed by staff analysts and are based on the use of important keywords. A sample page from the Dictionary is shown in Figure 20.

Copies of the Dictionary are maintained in the Library for manual reference by both users and library staff. The Dictionary provides a means for searching the document file. The user scans the Dictionary for the desired term or terms (in much the same way he would scan a card catalog arranged by subject terms) and obtains desired document reference codes from it.

2. Coordinate Indexes

A coordinate index is a listing of keywords (descriptors) with corresponding document references such as accession numbers. The searcher looks through the index for the accession numbers that appear under all of the keywords he wishes to "coordinate". A sample search would be

FIRST GENERATION ABC DICTIONARY (SAMPLE)

```
                                   RUBY MASER* AMPLIFIER  GAIN-14,  F7-BANDWIDTH =                 IFAT
               DERIVATION OF POWER-GAIN IN TUNNEL-DIODE* AMPLIFIER =                               AFGV
                  MINIATURIZED ELECTROCARDIOGRAM* CARRIER AMPLIFIER =                              AFSI
                EFFECT OF FET* IN LOW NOISE HIGH IMPEDANCE AMPLIFIER =                             AGAU
ALYSIS OF PHASE DISTORTION* DUE TO AGC IN  F8 TRANSISTOR AMPLIFIER =                           AN  AERU
-FREQUENCY COMPENSATION* OF DRIFT-TRANSISTOR AND OF TUBE AMPLIFIER =                         HIGH  ADRX
R, GAIN, AND STABILITY, IN MICROELECTRONIC* SMALL SIGNAL AMPLIFIER =            RELATIONSHIP OF POWE  AFTL
  TORTION* IN BALANCED AND UNBALANCED CLASS-AB PUSH-PULL AMPLIFIER =          ANALYSIS OF HARMONIC DIS  AFTL
 LITY* EQUATION FOR DIFFERENT TYPES OF TRANSISTOR VOLTAGE AMPLIFIER =       DISCUSSION OF THERMAL STABI  AFWS
PLIFICATION AND GAIN OF FORWARD AND REFLECTED WAVE LASER* AMPLIFIER =       THEORETICAL ANALYSIS OF AM  AEUG
EL-DIODES* =                          NEGATIVE-RESISTANCE AMPLIFIER AND BISTABEL PULSE-CIRCUITS USING TUNN  AFCH
                  PERFORMANCE OF PARAMETRIC-DIODES* IN AMPLIFIER AND FREQUENCY MULTIPLIER-CIRCUITS =     AFOJ
                    TUNNEL-DIODE* EQUIVALENT-CIRCUIT, AMPLIFIER AND FREQUENCY CONVERTER =              AFOY
                         INSTABILITY IN THE REMAG* AMPLIFIER AND GENERATOR =                           AOZW
       DESIGN AND ANALYSIS OF  F8 NEGATIVE-RESISTANCE* AMPLIFIER AND OSCILLATOR USING TUNNEL-DIODE* =   AMMF
   HIGH-FREQUENCY-TRANSISTOR  F9,  PNZ AS OSCILLATOR OR AMPLIFIER AT TWICE THE CUTOFF-FREQUENCY =       AAWS
                            FREE-RUNNING AND PULSE AMPLIFIER AVALANCHE SWITCH-CIRCUITS* =               AFWX
ENT OF TRANSISTOR* PARAMETERS AND EQUIVALENT-CIRCUIT FOR AMPLIFIER DESIGN =                MEASUREM  ADLV
 PUT =                 CONSTANT TEMPERATURE ONE-TRANSISTOR AMPLIFIER FOR SE PHOTOVOLTAIC-CELLS*  VPZX.6-OUT  AENX
             POWER-SUPPLY, CHOPPING OSCILLATOR AND TUNED AMPLIFIER FOR SENSITIVE PHOTOMULTIPLIER* =     AEOY
OMETER* =                                      HYBRID DC AMPLIFIER FOR THERMOCOUPLE* AND RESISTANCE THERM  AFFB
GE OF 80-DB =                                    LIMITER* AMPLIFIER OPERATING AT  F7X.8 WITH A DYNAMIC-RAN  AGFW
               BIAS OF TUNNEL-DIODE* USED AS SWITCH OR AMPLIFIER OR OSCILLATOR =                       AAXS
HING-EQUIPMENT* =              TRANSISTOR FERRITE-CORE AMPLIFIER PROVIDES BASIC LOGIC-CIRCUIT FOR SWITC  AFWE
   MINIATURIZED ELECTROCARDIOGRAM* TRANSISTORIZED CARRIER AMPLIFIER SYSTEM =                           AFVH
                  HALL-EFFECT MULTIPLIER* USING FEEDBACK AMPLIFIER TO REDUCE PHASE-SHIFT-DISTORTION =   AAVL
       INDUSTRIAL PREPAREDNESS-STUDY* FOR DEVICE 7,  F8X.7 AMPLIFIER TRANSISTOR=                       AEFT
       PHASE-SENSITIVE 5-STAGE TRANSISTOR HOMODYNE-TYPE AC AMPLIFIER USED IN RADIATION DETECTOR* =     AFHX
*                         EXCITATION OF 8-INCH RUBY LASER* AMPLIFIER USING ELLIPTICLA XE FLASH- LAMPS  F300  AONI
 =               DESIGN ANALYSIS OF HIGH INPUT IMPEDANCE AMPLIFIER USING FET* AND NPN BIPOLAR-TRANSISTOR  AGOM
                 STABLE DC OPERATING-POINT OF TRANSISTOR AMPLIFIER USING ZENER-DIODES =                AFAY
 PEDANCE* INDEPENDENT OF OUTPUT-LOAD =           FEEDBACK AMPLIFIER WITH ADJUSTABLE TO INFINITY INPUT-IM  AAUO
           TEMPERATURE-STABILIZATION* OF TRANSISTOR AMPLIFIER WITH ZENER-DIODE FEEDBACK-NETWORK =      AEBS
       WIDE-FREQUENCY RANGE GAIN-CONTROL* FOR TRANSISTOR AMPLIFIER WITHOUT VARYING DC BIAS =           AGDL
               DESIGN OF A COMMON-EMITTER DISTRIBUTED AMPLIFIER*  F0 TO  F9 =                          ADFI
              DESIGN OF RESISTANCE-COUPLED TRANSISTOR AMPLIFIER*  F4-5,  GAIN-P60 =                    ADKS
                 TRANSISTOR RC-COUPLED HIGH-FREQUENCY AMPLIFIER*  F8,  GAIN-P12 =                      AEOH
                       ONE-STAGE HIGH-GAIN TRANSISTOR AMPLIFIER*  F8,  GAIN-P8.5 =                     AEOG
                           THREE-STAGE CASCADED AMPLIFIER*  F8X,  F8X.32-BANDWIDTH,  GAIN-P34 =        AEOI
```

ultrasonic welds in missiles, in which the searcher would select those accession numbers that appeared under all three keywords.

Coordinate indexes are produced and used by REIC at Battelle, by NOTS, and by NSMSES. An example of REIC's list is shown in Figure 20. This list is printed twice, and both copies are bound together in one volume. This is a convenient arrangement which permits the searcher to simultaneously look at two terms, one for each list, to determine if an accession number appears under both.

A mechanized form of coordinate index uses cards with drilled-holes and a means for optical sensing commonly referred at as the "peek-a-boo" system (e.g., the Termatrex system of USAMRA and the Keydex system of Recon Central). This system utilizes plastic cards, each representing an index term from the thesaurus. Each document number that carries the index term is represented by the position of a hole in the card. Documents are retrieved by superimposing the index term cards for all terms in the query, observing the coincident holes, and then reading the X and Y coordinates of the holes.

FIGURE 21
REIC-Coordinate Indes

SECTION I
RADIATION ENVIRONMENTS

Alpha Irradiation								
17350	19581		20243	18634		19046	20237	17358
				19074		20906		17840
				19154A				17990B
								19155A
Deuteron Irradiation								
21010		20282			19555		18657	17048
								18558
								19148
Electromagnetic Irradiation								
	20251				21065			21028
Electron Irradiation								
20300	17701	17532	17903	17904	17815	17366	18047	15078
20940	18051	17832A	17993	18054A	17905	17616	19117	18568
	19171	17832B	18633	18054B	18025	18016	20307	18588D
	19191	17902	19003	18054C	18105A	19076	21027	19058
	19581	18002	20953	18074	18105B	20206	21047	19118
	20931	18642	20973	19004	18615	20946		20248
	20941	19002	20993	18614	20305			20258
	209810	19582	21013	19074A				20998
	21011	20272	21043	19074C				
				20994				
				21004				
				21044				
Electrons Less than 1Mev								
18680	19051	19022	17993		17295	17906	17847	18048
20250		19562	18003		18045	19106B		18598
		19622	19193		18675	20306		18618
					19085			21038
					20965			
					21045			
Electrons 1Mev								
18540	17291	17342	17813A	17914	18045	17636	20277	17958
20950	18561	18022	18003	19024	18545A	17906	20287	18558
	19051	20262	19103	19084	18545B	18026	21057	18618
	19151B	21052	19193	19504	19185D	18616		
	20251	21062	21003		20945	18676		
	21051					20276		
Electrons 2Mev								
18540	17361B	17902	18003	18574	18095A	17376	19577A	20288
19010A	19051	19152	18653	19604	18095D		19577B	21048
19010B	20251		19143	20974	18545A			
19030A					18545B			
					20285			
Electrons 3Mev								
	17301		18003	17974		18526		
	19051		19023A	18584				
Electrons 4Mev								
	19051	20972	18003		19575	20966	20957	
			19013					
Electrons 5Mev and above								
	19051	17302	18003	17354	21005	17896A	17897A	19088
		19032A				17896B	17897B	
		19032B				16896C	19617	
		19052				18646	20267	
		19152				19086		
		19172						
		19622						
		21052						
Gamma Irradiation								
17690	17341	17362	17353	17284	17635	17616	17527	17690
17910	17821A	17532	17523	17624	17845	17896A	17617	17908
18000	17821B	17702	17653	17654	17995	17896B	17697	17990A
18080A	18021	17822	17703	17704	18085	17896C	17857	18089
18080B	18081	18102	17823A	17974	18565A	18566	17987	18098A
18080C	18091B	18542	17823B	19054A	18565B	18636	18077	18098B
19020	18101	19062	17833A	18054B	18575	18656J	18567	18578
19040	18571	19082	17833C	18054C	18615	18656K	19027	18638
19580	19061	19102	17893	18094	19595	18656L	19037A	19158B
19590	19071	19592	18633	19074A	20265	18656P	19167	19158C
20290	19121		18643	19574A	20305	18656Q	20987	19578
	19161		19042	19574B	20985	19066	20991	
	19571		20263	19584	20995	19156	21017	
	19581		20973	20274	21015	19166	21027	
	19591		21003	21014	21045	20936		
	20291					21046		
	20981D							
Gamma 10^6 ergs g^{-1}(C) and Less								
17930	17531	17612		17614		17306	18067	
19140	17641	18562		17694		18086	18537	
20960	19681	18592A		19614			19017	
		20252		20264			20097	
Gamma 10^7 ergs g^{-1}(C)								
18090A	17661	17812	17913		19555	17956	18107A	17088
18090B	18681	18082A	18523		19015B	18076A	18107B	19028
18100A		18082B	18553			18096	18537	19078
18100B		18562	19033			19026	19017	19098
18100C		18592A	19143			20966		19138
19030B		18508B						19603
19140		19012						
20980		19572						
Gamma 10^8 ergs g^{-1}(C)								
17640	17361	18562	17643	19034	19015B	18066A	17207	18559
18070A	17891	18582B	17913	19144	19035	18066B	17907	19028
18070B	18061	18592C	18003			18066C	18067	19098
18100A	18071A	19022	19143			18076B	18597	19138
18100B	18071C	19572	19153			18096	18637	
18100C	18581A	21042	20273			18556A	19017	
18580D	18581B					18656W	19607	
19570	18581C					19586		
19600	19091					20866		
	19161A							

Each card can handle a 100 x 100 matrix and therefore has a capacity for 10,000 documents. The advantages of this system are its relative simplicity, quick availability, and comparatively low cost. In addition, reading errors are reported to be rare.

VIII. SELECTIVE DISSEMINATION OF INFORMATION

The basic purpose of a Selective Dissemination of Information (SDI) system is to discriminately inform users of new acquisitions in their areas of interest by means of the same basic principle used in retrospective searches, i.e., search by subject content. By previously establishing the user's subject interests (referred to as a user profile) and applying these to the subject description of new accessions, specific new arrivals of potential interest to the user can be identified. The user can then be advised of, or have routed to him, only those items that are relevant to his indicated areas of interest. In addition, the facility can accumulate statistics for its SDI operation that will form the basis for the following:

- A better understanding of information needs of the various jobs
- A better definition of the areas of research
- A method of identifying individuals with mutual or similar interests

Four of the installations studied had SDI systems in operation. These were Ft. Detrick, HDL, APL, and FTD. Two other SDI systems were in various stages of development at BUSHIPS and SEG. The systems used at Ft. Detrick and FTD will be described as representative of the group.

Figure 22 presents a generalized flow chart of an SDI system applicable to both Ft. Deterick and FTD. The significant aspects include the following:

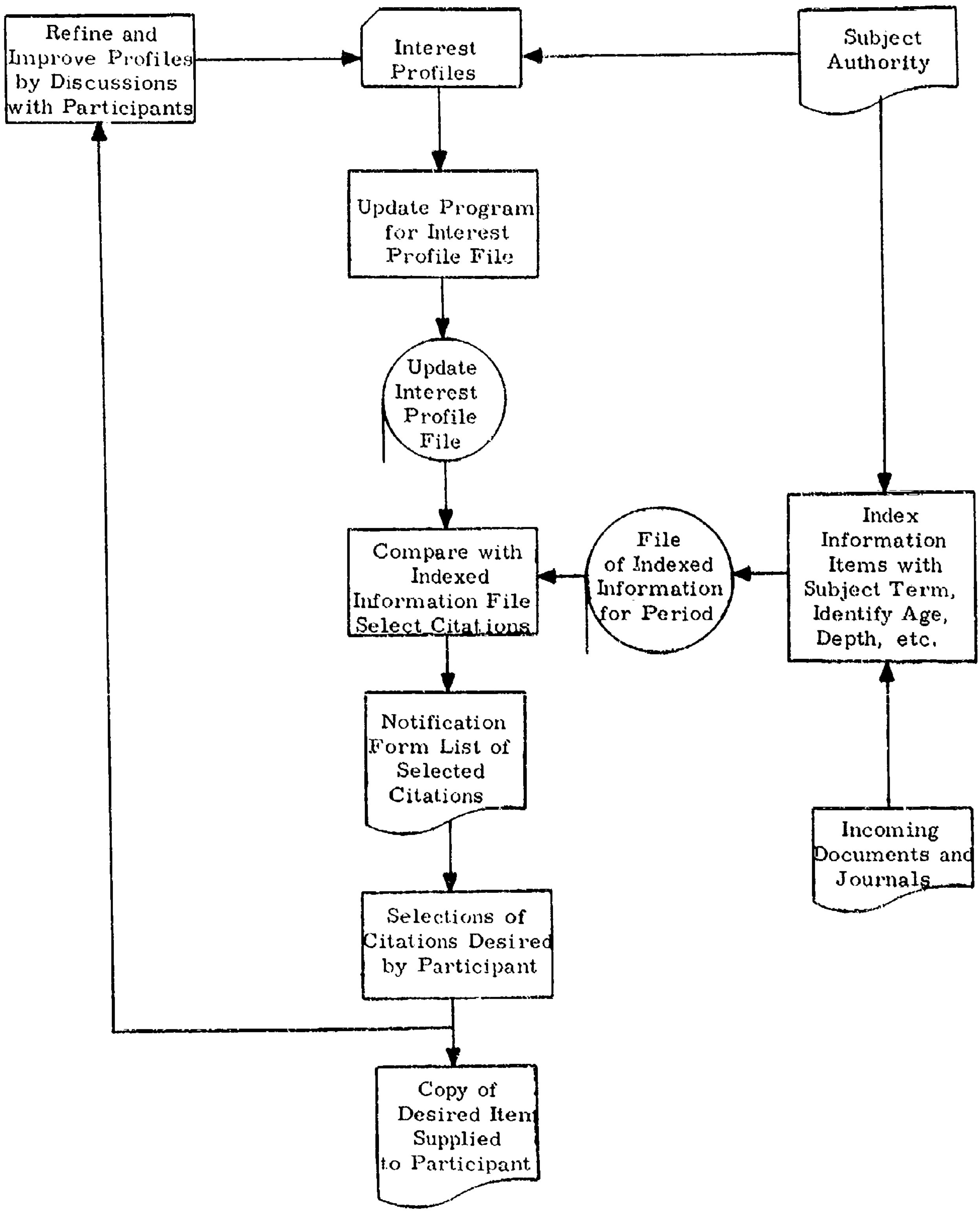
- The interest profiles
- A means for updati _ the interest profiles to keep them current and responsive
- A means of subject-indexing incoming materials compatibly with profile development
- A mechanized means for comparing profiles with the new material index terms
- A notification and/or circulation scheme
- Provision for feedback to maintain the viability of the system and the satisfaction of the user.

1. FT. DETRICK SDI SYSTEM

At Ft. Detrick, each participant develops and submits his own interest profile. The profile consists of the participant's name and address, up to 10 languages of interest, and any number of subject interests, using up to 400 medical subject tags to describe an interest. This profile may be updated at any time with additions, changes or deletions. In order to refine the participant's interest profile so that a useful selection of citations can result from it, the Information Division spends a considerable amount of time in personal conference with the individual and in keeping records of what notifications he

FIGURE 22

Selective Dissemination of Information System



received, what he wanted, and why. The success of the SDI system as measured by the satisfaction of the user appears to depend heavily upon such personal treatment.

The profile interest tags of all users are run against a tape of medical citations specially prepared for Ft. Detrick by the National Library of Medicine. The result is a printout on 3 x 5 cards of selected citations for each user.

The selection of citations employs a system of "weights" in which "weighted" numbers are assigned to each of the user's profile interest tags. In the descriptor tag versus profile interest tag match in a citation, the preassigned weights of the matched tags are summed. If the sum equals or exceeds 10 (a program constant), then the citation is listed for the individual's attention. Certain tags may be listed as MUST OR NOT, and, in this case, the indicated action is taken without regard for weight. If a match is found and the tag is a MUST, the citation will be selected regardless of weights or percent of matches. If a match is found and the tag is a NOT, the citation will be bypassed. The NOT operation overrides all other considerations, including the MUST.

Formerly, the MAY method was also a selection option, but it is no longer used because of its relatively poor discrimination. The MAY method determines the citation descriptor tag versus profile interest tag match as a percent of either the total number of descriptor tags per document or profile tags per individual, whichever is less, and compares this percentage to a percentage factor that has been predetermined by the participant. If a percent figure higher than this factor results, then the citation is listed for the participant's attention.

Once a citation has been selected on the basis of a particular interest, it will not be matched against any other interests for the same participant. Thus, the notification cannot be selected twice. (If a participant's entire profile contains more than 400 tags, it is possible to make more than one selection of a citation, since in this case the program would make a second search of the citation file and would not keep track of citations selected during the first search.) Should a citation meet the selection criteria for only one interest of a participant, only the tags of the interest causing selection will appear on the notification card.

2. FTD SDI SYSTEM

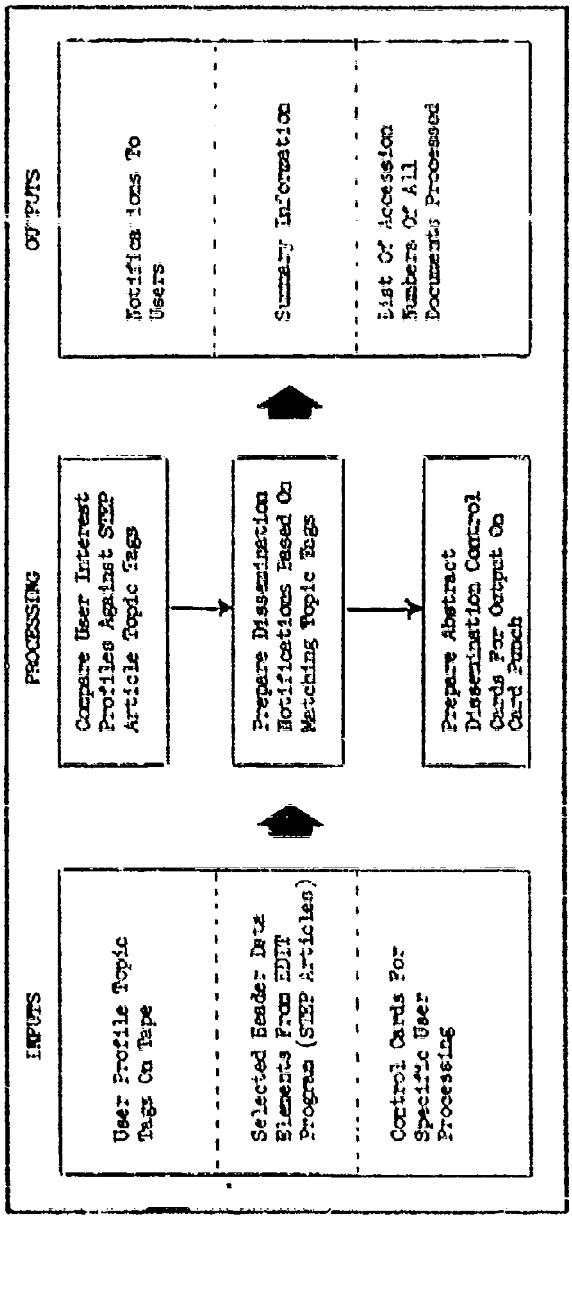
Selective dissemination of information at FTD is performed by two methods. In the first method, a group of accessions lists supplied monthly make up the notifications. Separate accessions lists are produced for each subject area, and the user is sent those lists for the subject areas indicated in his profile. In the accessions list, the data under each subject are grouped by input type, which enables the user to rapidly select and use only the information that is of value to his present work. The level of information contained in the accessions list includes accession number, title, author, source, descriptors, and references.

The second method shown in Figure 23 is concerned with the dissemination of information by the FTD system, better known as the Central Information Reference and Control (CIRC) System. All of CIRC's dissemination is semiautomatic (i.e., it is computer supported) and depends upon the existence of very specific and very detailed user profiles. The user profile is a list of topic tags, or descriptors, that describes the scope of a user group's interest. All dissemination is based upon unit profiles. It was discovered that individual profiles contained duplication and that it was more economical to have a profile serve a unit rather than an individual. Such a unit may be comprised of from two to ten individuals working on closely associated subject areas. From experience, it was found that a unit profile averaged approximately 1,000 precoordinated topic tags. The system has been running for about one year and is currently serving approximately 70 user groups throughout the United States.

Semiautomatic dissemination at FTD is accomplished in several ways. One is profile-controlled notification. This method is used for

FIGURE 23

FTD SDI System

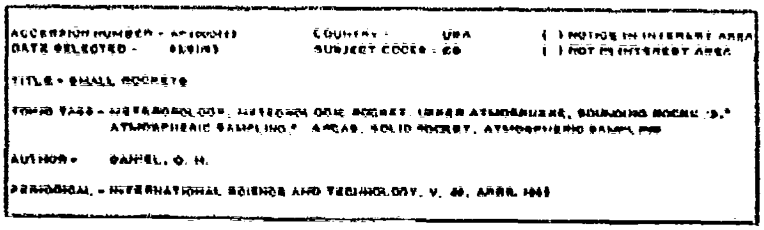


users who prefer to be kept aware of information that is responsive to their areas of interest but do not wish to have the actual materials automatically sent to them. These people receive a notification once a week that consists of the bibliographic level of information on each article that came into CIRC which fits their use pattern and which is responsive to their profile.

Other users prefer proxy dissemination, in which case they receive the abstract or extract of each document responsive to their profile. Some users prefer to receive both, because the notification is easy to screen and the proxies are useful as references.

It was found necessary to provide each user group with a control for volume and specificity. These user groups vary from just a few people to dozens of people, so that the capability to assimilate raw data varies considerably. The machine criteria that determine what shall be sent to a specific user can be varied by a clip level in the program, and a different setting can be applied for each user group. With respect to specificity, there is a feedback program, primarily automatic, which makes small demands on the users on a routine basis.

Figure 24 presents an excerpt from a weekly notification. Note that an asterisk appears after some of the topic tags. This informs the user that the article was called to his attention because these topic tags occurred in his profile ("sounding rockets" and "atmospheric sampling"). If the user so desires, these topic tags may be deleted from his profile, or other topic tags may be added.


ACCESSION NUMBER - [illegible] COUNTRY - USA ( ) NOTICE IN INTEREST AREA
DATE SELECTED - [illegible] SUBJECT CODES - [illegible] ( ) NOT IN INTEREST AREA

TITLE - SMALL ROCKETS

TOPIC TAGS - METEOROLOGY, METEOROLOGIC ROCKET, UPPER ATMOSPHERE, SOUNDING ROCKETS,* ATMOSPHERIC SAMPLING,* ARCAS, SOLID ROCKET, ATMOSPHERIC SAMPLING

AUTHOR - [illegible]

PERIODICAL - INTERNATIONAL SCIENCE AND TECHNOLOGY, V. [illegible], APRIL [illegible]

FIGURE 24
Weekly Notification

Before June 1965, notifications were prepared on standard print-out paper. However, since that time a change has been made to card stock (one card per notification) which provides the recipient with notifications that can be filed in a standard, manual file box under the indicated subject headings. This new method facilitates retrospective searching of materials selected for the user by the semiautomatic dissemination program.

There is a quarterly, automatic review of a user's profile. The machine prints out the user's profile, and next to each word a number is printed that indicates how many times that word was useful in obtaining an article for the user.

Although accurate data could not be acquired, the cost of SDI systems is obviously high. Whether this can be justified in terms of reduced effort on the part of the user and higher relevance and increased quantity of material disseminated is highly questionable. User satisfaction with SDI systems appeared to vary widely.

IX. EQUIPMENT

This section discusses several mechanical aids, other than computers, encountered during the field surveys that are used for retrospective searching and information materials processing. This is not, however, a comprehensive review of available equipments. Such general reviews may be found in the sources listed in the bibliography section.

Included in the discussion of each equipment is a detailed description of its application and some of the special advantages and disadvantages experienced. In addition, a summary of computer equipments employed by each facility in their mechanized processes is given in Figure 25.

Since the devices relate primarily to either retrospective search functions or materials processing functions (e.g., catalog card production), the following section organization has been established:

Equipment for Information Storage and Retrieval

Termatrex and Keydex
ACCESS
Filesearch

FIGURE 25

Summary of Computer Equipments
Used by Surveyed Facilities

Facility	Computer Type
AFCRL	IBM 7044, PDP-1
AFIT	IBM 1401
Army Map	Univac 1004, Honeywell H-800
ASDIRS	IBM 1401, 7090
APL	IBM 7094, 7040
BATTELLE	CDC 3400
BuSHIPS	IBM 7094, LARC
Defense Logistics	RCA 501
DISC	Univac 1004
Edgewood	Honeywell 200
EPIC	Honeywell 200, G. E. 635
FTD	IBM 7094, 1401
Fort Detrick	Univac SS II-90
Harry Diamond	IBM 7094
Materials	NCR 301
Mechanical Properties Data Center	IBM 1440
MEL	IBM 1401
NAFI	Burroughs 280, G. E. 225
NATICK	G. E. 225
Naval Missile Center	IBM 7094, 1401
Naval Post Craduate School	CDC 1604
NOL	IBM 7090
NOTS	IBM 7094
NSMSES	IBM 705, 1401
NWL	IBM 7090, 1401
Picatinny	IBM 7090, 1401
PLASTEC	Honeywell 1401
Redstone	IBM 7010, 1401, 1460
SEG	IBM 7094, 7044
TPRC	IBM 7094
Un. of Mich. Info. Center	IBM 1401

Equipment for Materials Processing

Crossfiler
EDITOR-I
IBM 870 Document Writing System

1. EQUIPMENT FOR INFORMATION STORAGE AND RETRIEVAL

(1) Termatrex and Keydex

1. General Description

The Termatrex[1] and Keydex[2] systems belong to a class of equipment that utilizes coordinate indexing techniques via the "peek-a-boo" method of visual term coordination. In the visual coordination method, one vocabulary term is assigned to each of any number of term cards. These cards are made of tough flexible plastic material about 9-5/8 x 11-1/2 in size. On each card, holes are drilled in identifiable positions to represent information references (e.g., accession numbers) that relate to the specific term. A term

1 Jonker Business Machines, Inc., Gaithersburg, Md.

2 McBee Systems
a Division of Litton Industries, Athens, Ohio

card has space for 10,000 references, each of which may be uniquely identified by using a grid overlay to determine the vertical and horizontal coordinates. Thus, one such system has a capacity of 10,000 information sources, although this limit can be increased simply by adding more independent card files.

To retrieve information from the system, the user selects cards corresponding to his desired index vocabulary terms and superimposes them all together over a card-sized light source. If a reference contains all of the selected terms, its representative holes on the term cards will coincide, permitting light to shine through. Coordinates of the lighted holes, then, identify the retrieved references. A search might proceed as in the following example:

> Assume a search is to be made for information concerning the utlrasonic testing of welds in missiles. Three cards are selected: "Ultrasonics," "Welds," and "Missiles." The "Ultrasonics" card contains holes representing all of the information sources dealing with ultrasonics in the system; "Welds," all the information concerning welds; and

"Missiles," all information concerning missiles. By overlapping "Ultrasonics" and "Welds," the light shines through only at those locations that identify documents which contain information on both ultrasonics and welds--probably in the relationship of ultrasonic testing of welds. Note that references dealing with only one of the terms are excluded. By overlapping "Missiles" on top of the preceding two cards, only those references pertaining to ultrasonic testing of welds in missiles coincide and are therefore selected. Further refinements are possible. Steel welds in missiles can be selected by simply adding the card for "Steel." "Ultrasonics" can be replaced by "X-Ray" for search in another direction, and so forth.

Two or three minutes are said to represent a typical time for conducting a search.

Both the Termatrex and the Keydex equipments consist of a precision drill and a file of plastic cards containing special identifying features such as tabs, colors, and edge notches. Holes are made in the cards with the precision drill, which is movable on two axes to the appropriate coordinates. Coordinates are determined by a 100 x 100 grid. Accession number 1427, for example, corresponds to a hole in the 15th row and the 28th column. A warning device may be included with the drill to reduce errors resulting from out-of-sequence drills. Color filters may be used to indicate, for example, abstracts (green) and classified documents (red) by drilling holes in the filter card corresponding to all documents that do not apply. Thus, if a document is classified, no hole exists for it in the filter; light shining through coincident term card holes and the filter card appears red.

The Termatrex and Keydex systems differ in one significant feature. Termatrex term cards are filed in some pattern and located in the file by means of the tab on each card. Keydex term cards, on the other hand, do not have tabs, are usually filed randomly, and are located in the file by means of passing a needle through the margin holes in the fashion of the well-known McBee Keysort process. With both Termatrex and Keydex equipments, it is possible to obtain peripheral equipment such as optical readers that will automatically punch EAM cards or paper tape, automatic term card punches that operate from EAM card readers and thus copy EAM punched cards, gang punches for reproducing several identical term cards simultaneously, etc.

As stated earlier, the capacity of a complete system is 10,000 information source references corresponding to an equal number of hole positions on each term card. In order to accommodate a larger number of references, as many card file systems are necessary as there are multiples of 10,000 references. Term cards belonging to up to 10 different systems may be identified by a scheme of punching the edge of the card in a specified position. This, however, does not relieve the user of the necessity of conducting separate searches in each system; that is, cards from one system cannot be intermingled with cards from another system for a common search.

The chief advantage of the visual coordination system derives from its characteristic of immediate visual identification of holes belonging to references containing coinciding terms. However, the drilling process and the later determination of the coordinates of drilled holes have been reported to be tedious and error-prone processes if many holes are involved and if the only aid is the grid overlay.

2. Application

A Termatrex system is used by the Nondestructive Testing Information Analysis Center.

Recon Central has developed a retrieval system based upon the Keydex equipment with two files of term cards. The information sources are usually in the form of document abstracts which are stored on un-punched aperture cards. The system provides a search requester with lists of retrieved abstract accession numbers with corresponding document titles, and, if desired, enlarged copies of the selected micro-film chips. The system consists of the Keydex equipment and peripheral equipment including an automatic term card reader and an EAM card reader, both of which are capable of operating a Programmatic Flexo-writer for printouts. The EAM cards are used to provide title infor-mation corresponding to the retrieved information source code numbers from the term cards.

3. Cost

Termatrex System: The Nondestructive Testing Information Analysis Center purchased their Termatrex equipment in 1961 for $3, 600.

Keydex System: Recon Central purchased their Keydex equip-ment and the peripheral equipment in 1961 and reported the costs as follows:

Friden Programmatic Flexowriter Automatic Keydex Card Reader EAM Card Reader	\$20,000
Keydex System Miscellaneous Copiers and Viewers	\$ 9,500

4. Comments

Recon Central is generally pleased with the operation of its system and has pointed out that it represents about one-tenth the investment of a fully computerized system giving the same performance. The Central has further commented that the system as presently constructed meets the main requirements of getting information into the hands of the requester in time to be useful; i.e., full response time is less than one week.

Other forms of the "peek-a-boo" system have been developed using different term card formats (including EAM card formats), but a discussion of these is beyond the scope of this report.

(2) The ACCESS System*

1. General Description

Recon Central is currently considering an alternative system that can be used in coordinate index applications,

* ACCESS Corp., 4632 Paddock Road, Cincinnati, Ohio

called the ACCESS System. This system utilizes cards that are edge-notch-coded and provided with magnetic tabs. In the selection process, an operator presses keys on the system's calculator-size console corresponding to a set of terms to be coordinated. When all of the term codes have been entered, the system's selector automatically raises a tray of cards to contact an energized electromagnet and then lowers the tray, leaving all of the cards attached to the electromagnet. The previously selected keys then cause rods to press down on the cards, pushing away all cards not having corresponding notches (i.e., coordinated terms). The rejected cards fall back into the tray, and the selected cards may be removed for identification.

The ACCESS System has three basic units: a keyboard console, a card notching device which is controlled from the keyboard, and a selector unit. The selector holds a tray of about 1,350 cards; up to 100 selectors may be operated simultaneously from the console. There is no limit to the number of trays and therefore no limit to the number of cards. The searching of one tray takes only about as long as it takes to press the selection keys.

The cards have 65 coding sites on each of two edges. Only one edge may be searched at a time. The sites may be arranged in fields, and up to 13 decades (0.9 for each decade) of digits may be encoded on an edge.

To use the system for coordinate index searches, one card is prepared for each document. Since only the edge is used in the system, the body of the card could also contain, for example, a film chip or an abstract plus bibliographic information. The coding of terms on the card can be done by using the console keyboard to automatically notch the cards, with the notching pattern for each term dependent upon the number of terms in the thesaurus.

The maximum number of terms assignable to each document determines the term capacity of the term thesaurus. This is because of the limited number of position sites on the card for coding terms. For example, if a maximum of 65 terms per document were to be assigned, then each term would have to correspond to each site, yielding a thesaurus maximum of 65 terms. If, however, only four terms were to be assigned to each source, then 1,000 terms would make up the thesaurus. This is apparent from the earlier statement that 13 coded decades were available on an edge. These can be divided into four groups (for the four terms assigned) of three decades each. Since a three-decade group will permit numbers from 000 to 999, 1,000 term variations are possible. A typical application of this system would probably not require as many as 65 term assignments but would probably need more than four.

2. Cost

The price for the ACCESS System has been quoted at less than $1,800. Many variations of system use besides coordinate index searches are possible. Using the system for coordinate index searches is one of the less flexible arrangements. If only one code per card were required, for example, a trillion code permutations would be possible.

3. Comments

The chief advantages of the system are the random filing of cards, the simple techniques of preparing the cards, and the unlimited file capacity. Since the cards are searched on the basis of notches, no order is required, and refiling time is nearly eliminated. The card notching is a simple mechanical operation compared to the drilling of visual coordination cards, and it can be done automatically from the keyboard. The file capacity does not have a limit, the maximum being only whatever the user is willing to store. Furthermore, the trays do not have to be kept separate, and cards from different trays can be intermingled.

The chief limitation of the system with regard to coordinate index searches is the inverse dependency of term thesaurus capacity upon the maximum number of terms to be assigned to an information source.

(3) Filesearch*

1. General Description

The Filesearch is a system that stores documentary information on 35-mm film, along with indexing codes, and that has the capability for later retrieval of the information based on a single term query or a query composed

* The descriptive material in this section is largely composed of extracts from The Filesearch System, a general information manual by FMA, Inc., Washington, D. C.

of terms related by AND, OR, and NOT connectives. The system consists of three elements, as follows:

- A Recording Unit that photographs documents and their indexing information adjacent to one another on reels of photographic film.
- A Retrieval Unit that searches the Index codes on the file with an optical scanner and locates the desired information via comparison registers.
- A Flexowriter that is used to prepare the input forms with indexing information.

Figure 26 illustrates the operation of the system. The operational functions are identified as follows:

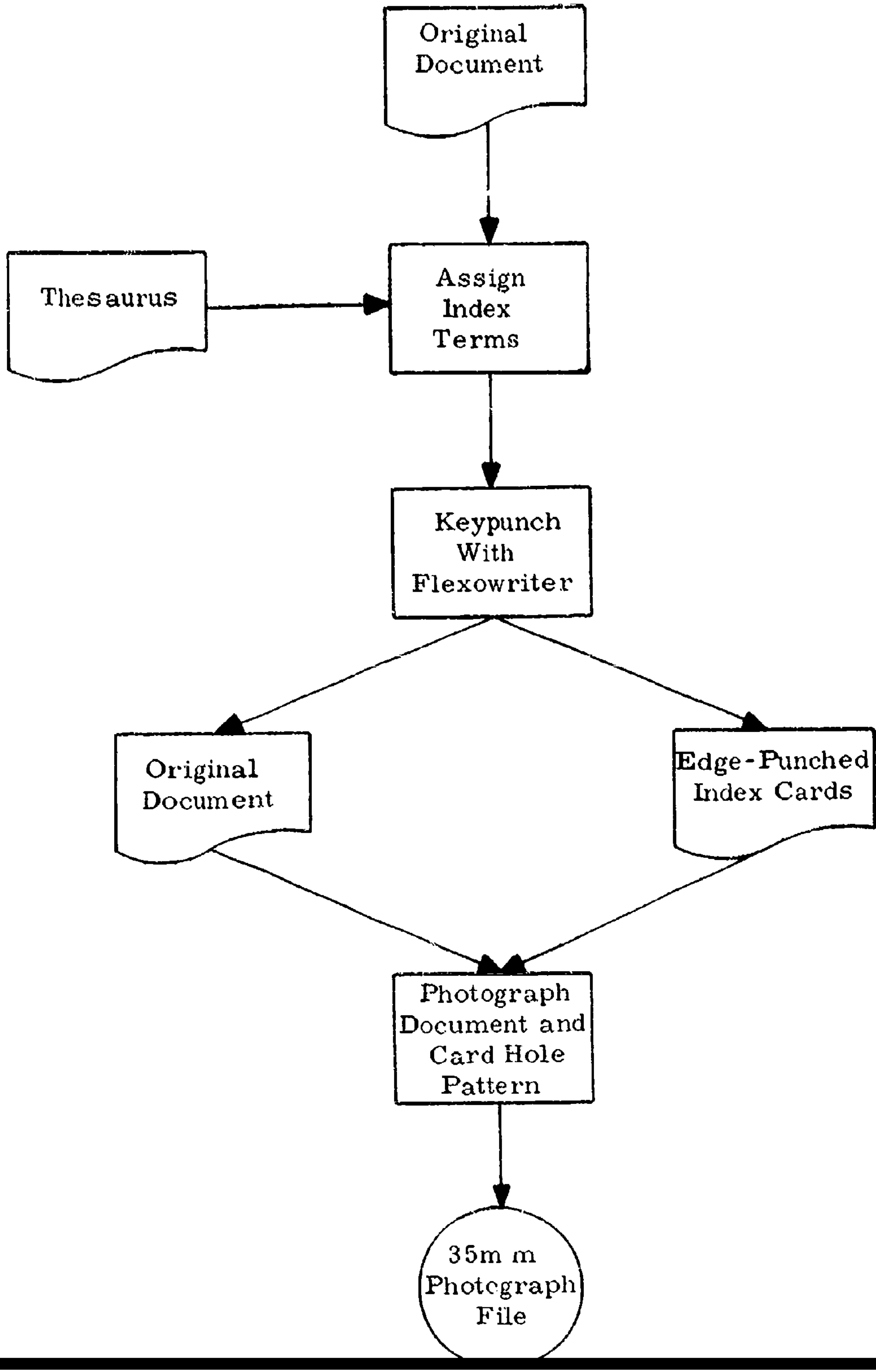
- Indexing
- Keypunching
- Recording
- Retrieval
- File Structuring.

(1) Indexing

The indexing process consists of reviewing the document and assigning a set of descriptive words or numbers to it. These may vary from a single accession number to an assortment of terms giving

FIGURE 26

Storage Process -- Filesearch System



information about such things as the document's date, classification, and subject. The indexing terms may be numeric (e.g., Part No. A72-4521B). Indexing terms may be of varying length, may be assigned in random order, and may be used in any quantity.

Index terms are entered on a coding form, each preceded by a special letter that identifies the type of term (e.g., date or contract number). Thus, the date January 24, 1927, might be written D12427, while a contract number appears as C12427.

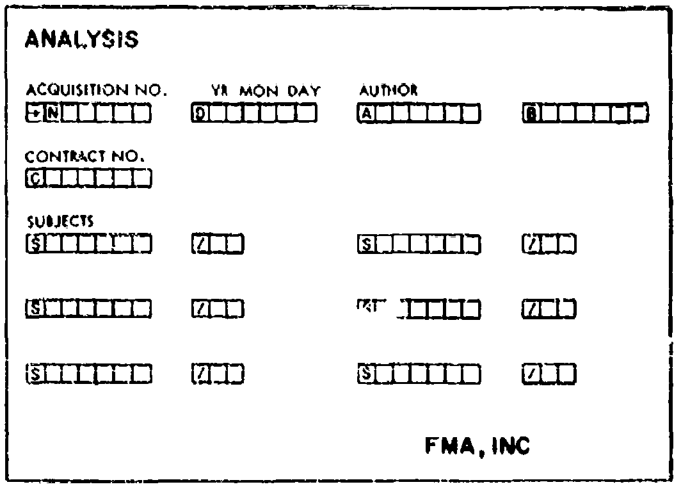
These characters may be preprinted on the coding form as in the example in Figure 27. Some other special characters used are the parenthesis sign, which indicates the beginning of indexing information for one document, and the slash or virgule, which is used for descriptors exceeding six characters in length.

(2) Keypunching

Indexing information from the worksheet is punched on an edge-punched card using a Flexowriter.

FIGURE 27

Coding Form - File Search System



An illustration of one of these cards is given in Figure 28. Six bits on the card represent each alphanumeric character, and a seventh bit is used for checking for odd parity.

(3) Recording

The document to be recorded is placed below the Recording Unit viewer, and the edge-punched card is inserted into a slot in the unit's control panel. The document is then photographed page by page simultaneously with the hole pattern appearing on the edge-punched card. Figure 29 is an illustration of the resulting format on 35-mm film. The viewer holds up to 200 feet of film which will record up to 6,400 pages on one reel.

(4) Retrieval

A request for information is indexed using the same format as for documents. The request index terms are keypunched on an edge-punched card and inserted in a slot in the retrieval unit. The holes in

FIGURE 28
Index Card - File Search System

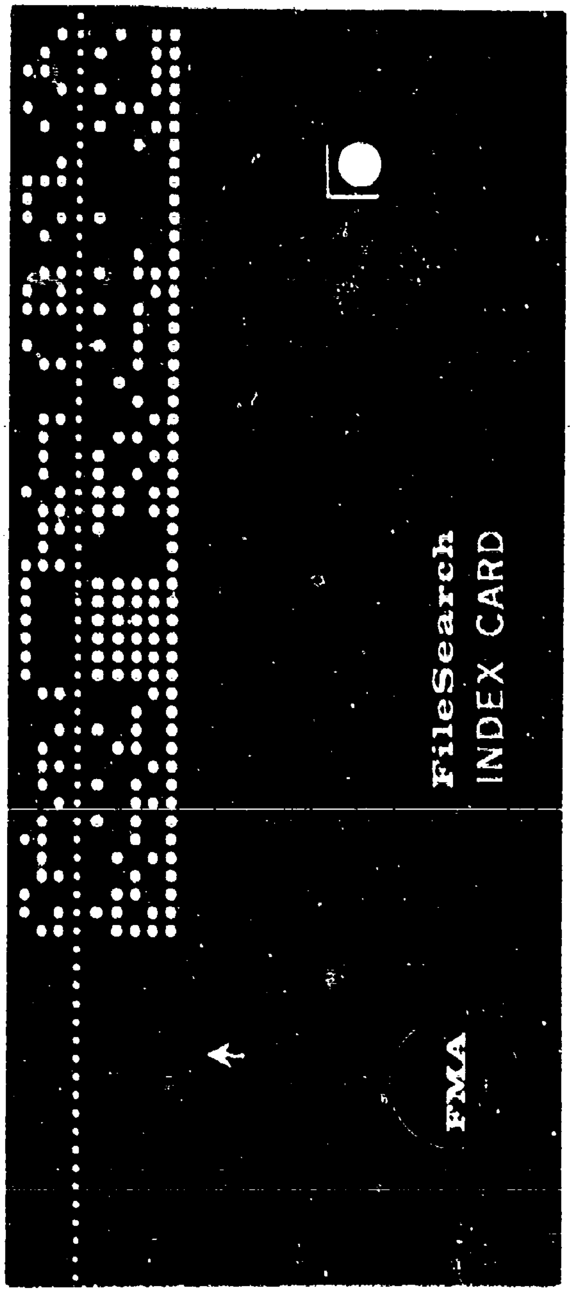
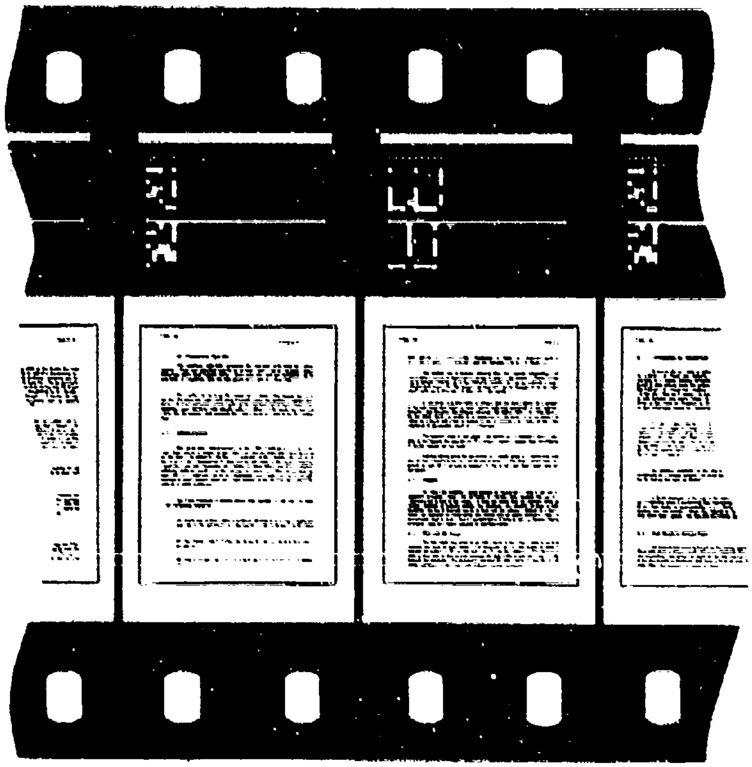


FIGURE 29
Document Recording Format
- File Search System



the card are optically read and converted to electrical pulses, which are stored in a set of comparison registers.

A film reel is mounted on the Retrieval Unit, and the film is optically read. The pulses from the reading process are compared with the request criteria in the comparison register, and the reel is stopped each time a correspondence occurs. The comparison registers may be associated with one another by AND, OR, and NOT connectives and may be required to function in the following three different ways:

- To match the code on the film exactly with that of the request
- To accept code on the film that falls between limits (e.g., all documents after June 1, 1963 and before June 1, 1964)
- To function in continuity with one another so that a descriptor that begins in one register can be continued into the next (for terms larger than seven characters).

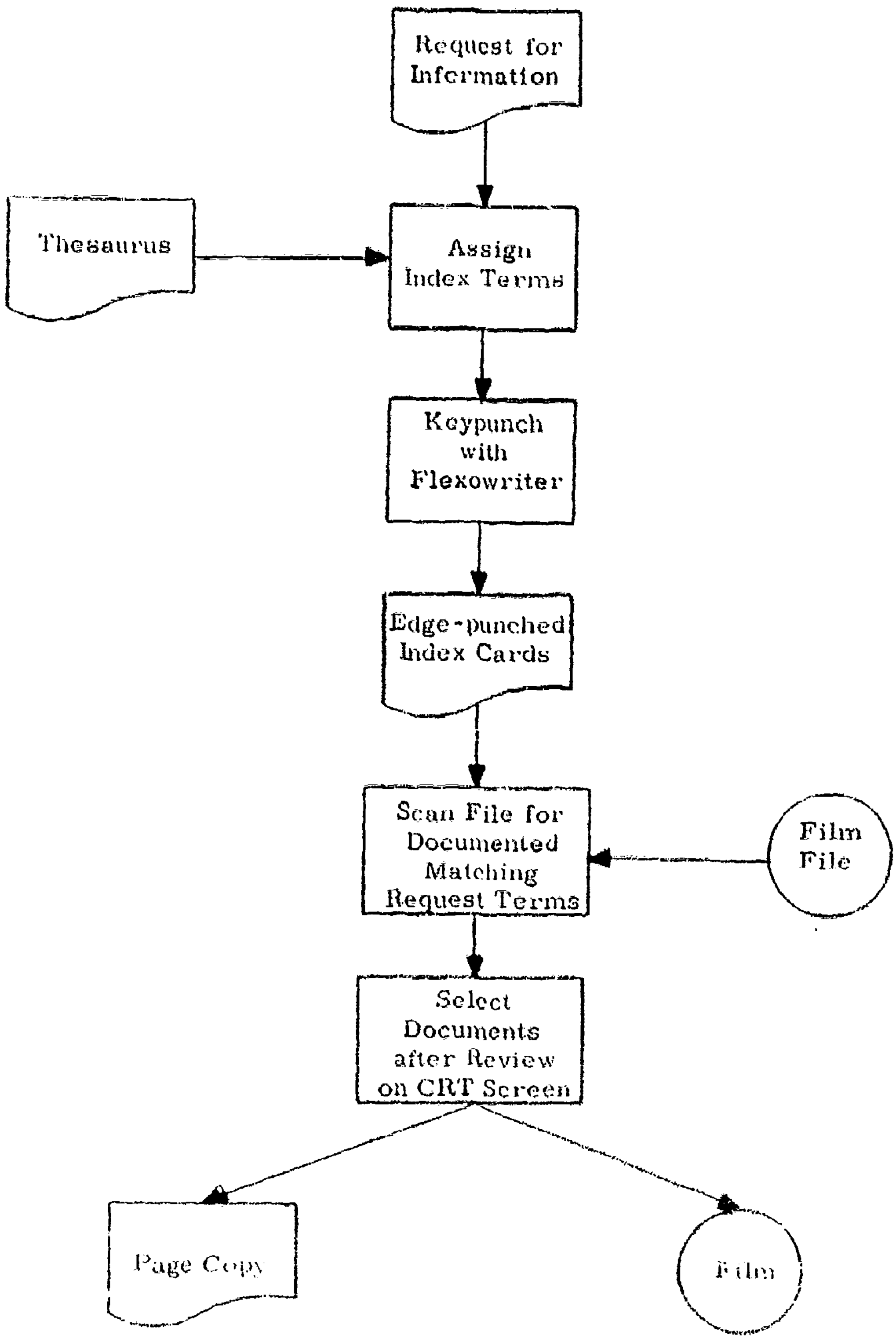
A simple request that illustrates these operations is one for all documents dealing with electro-optical companies that make lasers, excluding pulsed lasers, described in documents published between January 1, 1960 and January 1, 1964. The association indicates how the request terms are to be logically connected with one another; the functions indicate how the registers are to compare the code from the film with that of the request. Figure 30 illustrates this process.

Any of the search descriptors can be dropped from the search by turning off the corresponding register switches. Thus, if a search does not produce a hit, it can be made more general by cancelling one or more descriptors.

The system provides for categorical searches by coding a "superdigit" character (typed as an asterisk). This will preclude a comparison with corresponding characters read from the film. Thus, all documents on physics can be retrieved by searching on QC***** or all on Optical Instruments by searching on QC 373**. Another example is the ease of searching when using an author's name where the spelling is questionable, such as Millar, Muller, or

FIGURE 30

<u>Retrieval Process--Filesearch System</u>



Moller. Such a request would be coded M*LL*R and AND-ed with other descriptors.

(5) File Structuring

The system has the capability of searching a reel of randomly sorted material by any element of their index code, thereby producing a new structured file from the old. In this fashion, the results of a search can be recorded on a reel of tape automatically.

2. EQUIPMENT FOR MATERIALS PROCESSING

(1) Crossfiler

1. General Description

The crossfiler is a solid-state digital processor capable of performing the following functions: (1) catalog card record multiplication on punched paper tape which can be used to produce a set of catalog cards with segregated entry headings, and (2) tape duplication.

The first function is completed by detecting headings that will be used for each card in a set from a punched paper tape record of a catalog card. After each heading is punched out on a secondary tape, it is followed by a reproduction of the complete card record. Thus, for one card record input, the Crossfiler punches out the representation of a complete set of cards with appropriate headings formatted at the top of each card in the set.

To perform the second function, the Crossfiler simply reads the input tape and simultaneously punches out a duplicate.

The Crossfiler consists of the following:

- An optical bidirectional paper tape reader, which has a reading speed of 110 characters per second
- A mechanical paper tape punch with a punching speed of 110 characters per second.
- Processor digital logic.

There is no memory in the Crossfiler. It generates by scanning, detecting, and punching the detected information; it then reverses the input tape to the beginning of the record, and reads the record again and punches out the complete record information.

2. Application

The Crossfiler was designed and built by the Itek Corporation for the Technical Library of the Air Force Cambridge Research Laboratory. Rather than purchase a computer, the Library had the Crossfiler developed because of its relatively cheaper cost ($25,000 compared to $100,000) at the time of development. However, this large cost difference no longer exists, and the Library will phase out the Crossfiler after the necessary computer programs are developed.

The Library applies the Crossfiler output tape to a Programmatic Flexowriter to produce catalog cards, charge cards, card pockets, and an accessions list and then stores the paper tape record for a future book catalog to be produced by computer. A significant feature of the system is its use of a natural language format with nontyping characters rather than codes to define information fields.

3. Cost

The following chart presents a cost analysis of the use of the Crossfiler at the Cambridge Library.

COST ANALYSIS OF CROSSFILER-PRODUCED CARD SETS*

Percentage of total Crossfiler processing capacity	100%	50%	25%
Total number cards produced in 1 year	806,400	403,200	201,600
Total number of card sets produced in 1 year	115,200	57,600	28,800
Machine cost per card	.3	.6¢	1.2¢
Final cost of machine-produced cards	12.3	12.6¢	13.2¢
Final cost of machine-produced card sets	82.7¢	86.7¢	90.9¢

Percentage of total Crossfiler processing capacity	12.5%	6.25%
Total number cards produced in 1 year	100,800	50,400
Total number of card sets produced in 1 year	14,400	7,200
Machine cost per card	2.4¢	4.8¢
Final cost of machine-produced cards	14.4¢	16.8¢
Final cost of machine-produced card sets	99.3¢	$1.16

* Figured on using a Crossfiler exclusively for card set production. Based on a $25,000 machine cost and 10-year depreciation. Extracted from: Automating Cataloging Functions in Conventional Libraries, Paul J. Fasana, Itek Corporation published in Library Resources and Technical Services, Volume 7, Number 14, Fall 1963.

(2) EDITOR-I

The EDITOR-I is a small digital data processor that has a two-character memory buffer, a character counter, and a high-speed tape reader and punch. It has two significant capabilities, as follows:

- A Flexowriter may be connected through the buffer, permitting a two-character delay between the pressing of the key and the punching of the character. Thus, if the word data was to be punched on the tape, the d and a would be keyed but would be stored in the Editor without any corresponding action to the tape. When the t is keyed, the d would then be taken out of storage and punched on the tape. This delay permits an operator to correct character errors that are immediately detected.

- For editing, a paper tape may be mounted on the high-speed reader, and the location of a previously noted error may be typed in the unit's console. The Editor will then advance at 500 words per minute to the error position, meanwhile copying the correct material on a new tape. When it reaches the error, it will stop and permit the operator to enter the correct information from the Flexowriter keyboard. It can then be instructed to proceed to the next error.

The control console has the following three sets of keys on it:

Set 1 - Copy, Insert, Delete, Justify

Set 2 - Line, Word, Character, Sentence, Paragraph, Record

Set 3 - 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30

The selection Copy 9 Lines would cause, for example lines of the old tape to be reproduced followed by a stop for the operator to insert new or corrected information.

(3) IBM 870 Document Writing System

1. General Description

The IBM 870 Document Writing System is a wired program, punched-card-oriented system which permits the printing of several programmed outputs simultaneously with card-punching or card-reading. It also has provision for punched tape input. Possible outputs for library applications are as follows:

- Orders
- Order status reports
- Claim notices
- Receipt and checkin
- Cataloging forms

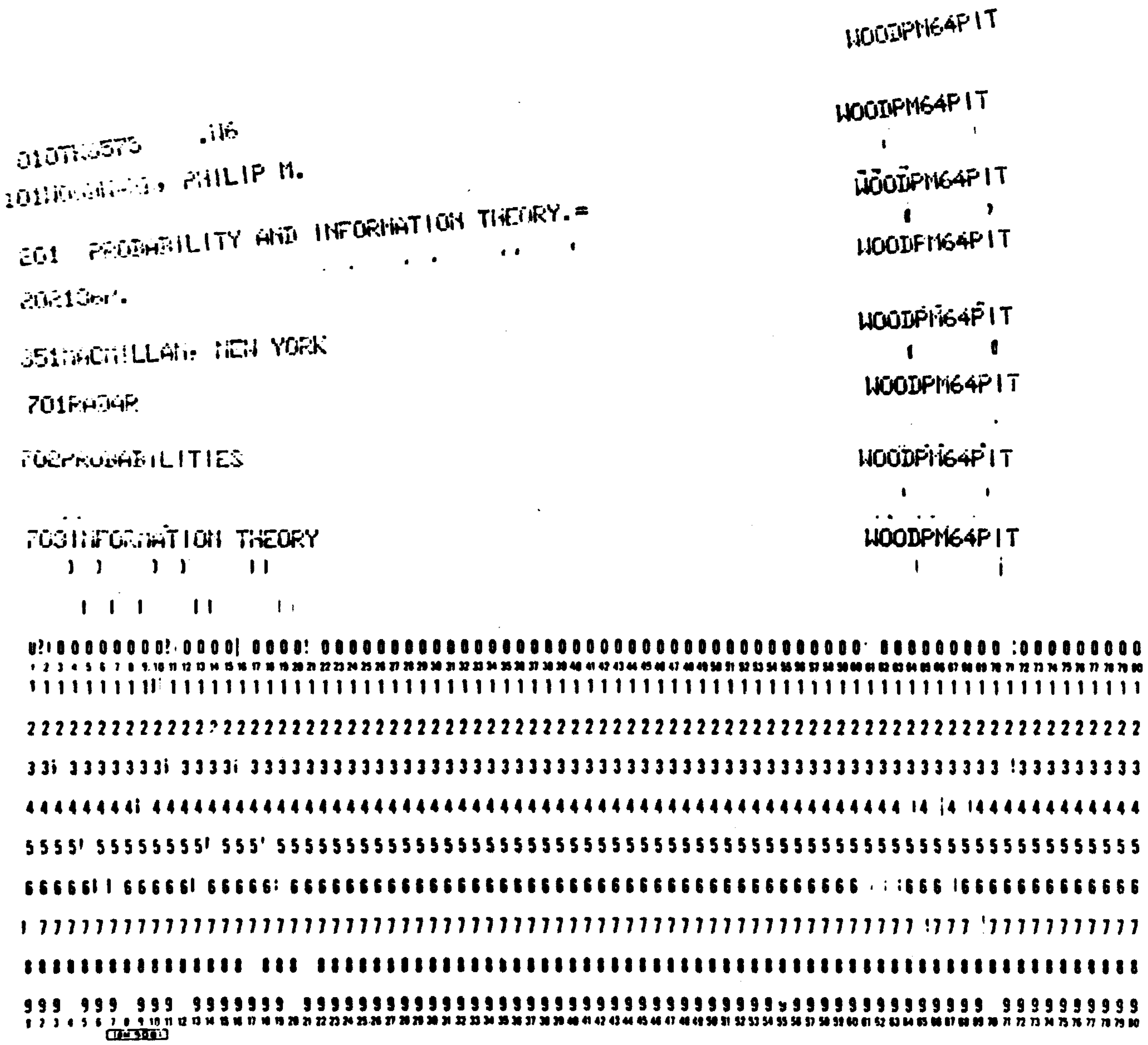
- Book pockets and labels
- Shelf list cards
- Announcements and notifications
- Circulation control forms
- Statistics.

The system consists of an IBM 836 Control Unit and an IBM 866 nontransmitting typewriter. A second typewriter may be connected to the Control Unit for simultaneously typing in a different format. The Control Unit contains a card reader/punch and a tape reader and will produce an output from any combination of keyboard, punched cards, and punched tape inputs. A second card punch may also be connected to the Control Unit. Auxiliary equipment often used with the 870 System are the 082 Sorter and/or the 085 collator.

Figures 31 through 33 illustrate three output forms that are produced simultaneously on the 870 System using keyboard input. These outputs consist of a set of punched cards, an order record, and a purchase order. Figures 34 through 36 illustrate

FIGURE 31

IBM 870 System Outputs Punched Cards



```
SEPTEMBER 29, 1965

LOWDERMILK BOOK STORE                                  20077

715 12TH ST.,N W                                       15

WASHINGTON, DC                                         508886

                                                       W
010TK6575     .W6                                      WOODPM64PIT
101         WOODWARD, PHILIP M.                        WOODPM64PIT
201
042    1      PROBABILITY AND INFORMATION THEORY.      WOODPM64PIT          $  5.00

202136P.                                               WOODPM64PIT
351MACMILLAN, NEW YORK                                 WOODPM64PIT
701RADAR                                               WOODPM64PIT
702PROBABILITIES                                       WOODPM64PIT
703INFORMATION THEORY                                  WOODPM64PIT
```

FIGURE 32
IBM 870 System Outputs
Printout

IBM Federal Systems Division

International Business Machines Corporation, Bethesda, Md.

Blanket Purchase Order Release

TO

LOWDERMILK BOOK STORE
715 12TH ST.,N W
WASHINGTON, DC

DATE SEPTEMBER 29, 1965
ORDER NO. 20077
RELEASE NO. 15
VENDOR NO. 508836

	QUANTITY	DESCRIPTION	ITEM	PRICE
042	1	WOODWARD, PHILIP M. PROBABILITY AND INFORMATION THEORY.		$ 5.00

LOCATION	ORD BY	DEL TO	ORDER OR REFERENCE NO	JOB NO	ACCOUNT NO	DEPT CHG	APPRO NO	MAT CODE

FORM NO 953-0135-0

AUTHORIZED SIGNATURE

VENDOR'S COPY

FIGURE 33
IBM 870 System Outputs
Purchase Order

three other outputs--a typed letter, punched cards, and a request record. The cards and request records were produced at the particular stage in the typing of the letter when the information requested was specified.

Figure 37 illustrates a system flow for an application of the 870 System. This system may be characterized by the following general procedure:

(1) After processing a request, the order clerk selects the prepunched cards pertaining to the vendor to be used from a file of vendors' cards.

(2) The clerk next selects an order card, order memo card, author card, title card, shelf list card, and source card. These are placed in the order given behind the vendor card. All of these latter cards are blank except for a card identification code prepunched in column 75 of each card.

(3) All of these are sent to the keypunch operator, who punches each of the cards with information taken from the original request form. (Some of the information is automatically duplicated from one card to the next.)

(4) The order memo card is then filed, and the shelf list card is removed to be held until after the purchase order is written.

7220 Wisconsin Avenue
Bethesda, Maryland 20014
Oliver 6-2800 (Code 301)

[illegible] Machines Corporation

September 29, 19 5

Rand Corporation
1700 Main St.
Santa Monica, California

Gentlemen,

The IBM Washington Systems Center is interested in obtaining a copy of the following publication which we believe you may be able to supply. The publication is

BELLMAN, R. E.
KALABA, R. E.
A NOTE ON NONLINEAR SUMMABILITY
TECHNIQUES IN INVARIANT IMBEDDING.
RAND RM3397PR FEB 63

This item is needed by our Systems Engineers in connection with their current projects. We would appreciate your assistance in sending us this publication, invoicing us for any charges due or suggesting another source for this material.

Thank you for your consideration.

Sincerely yours,

IBM Washington Systems Center
Library

DCE,esz

FIGURE 34
IBM 870 System Outputs
Letter

FIGURE 35
IBM 870 System Outputs
Punched Cards

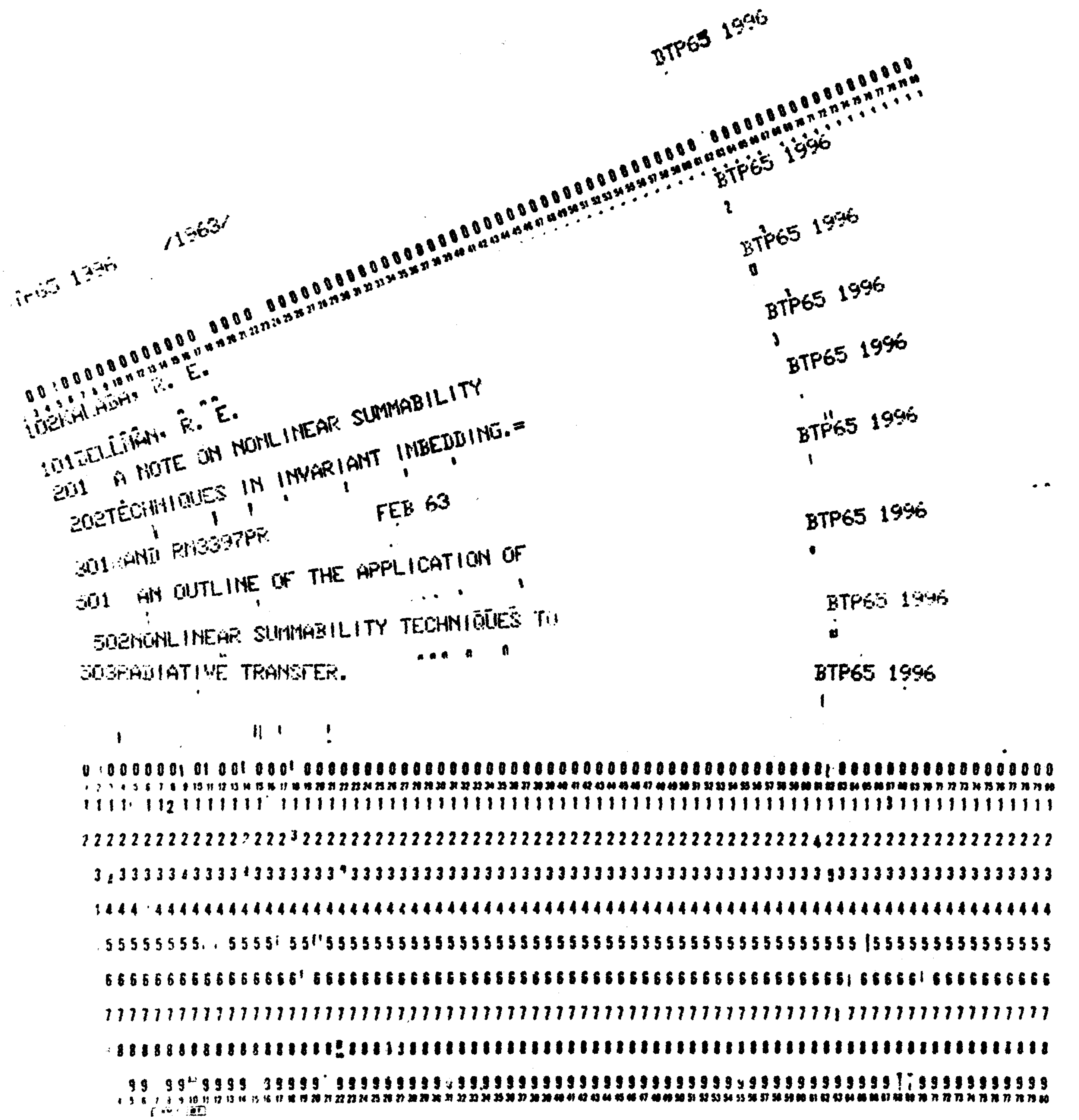


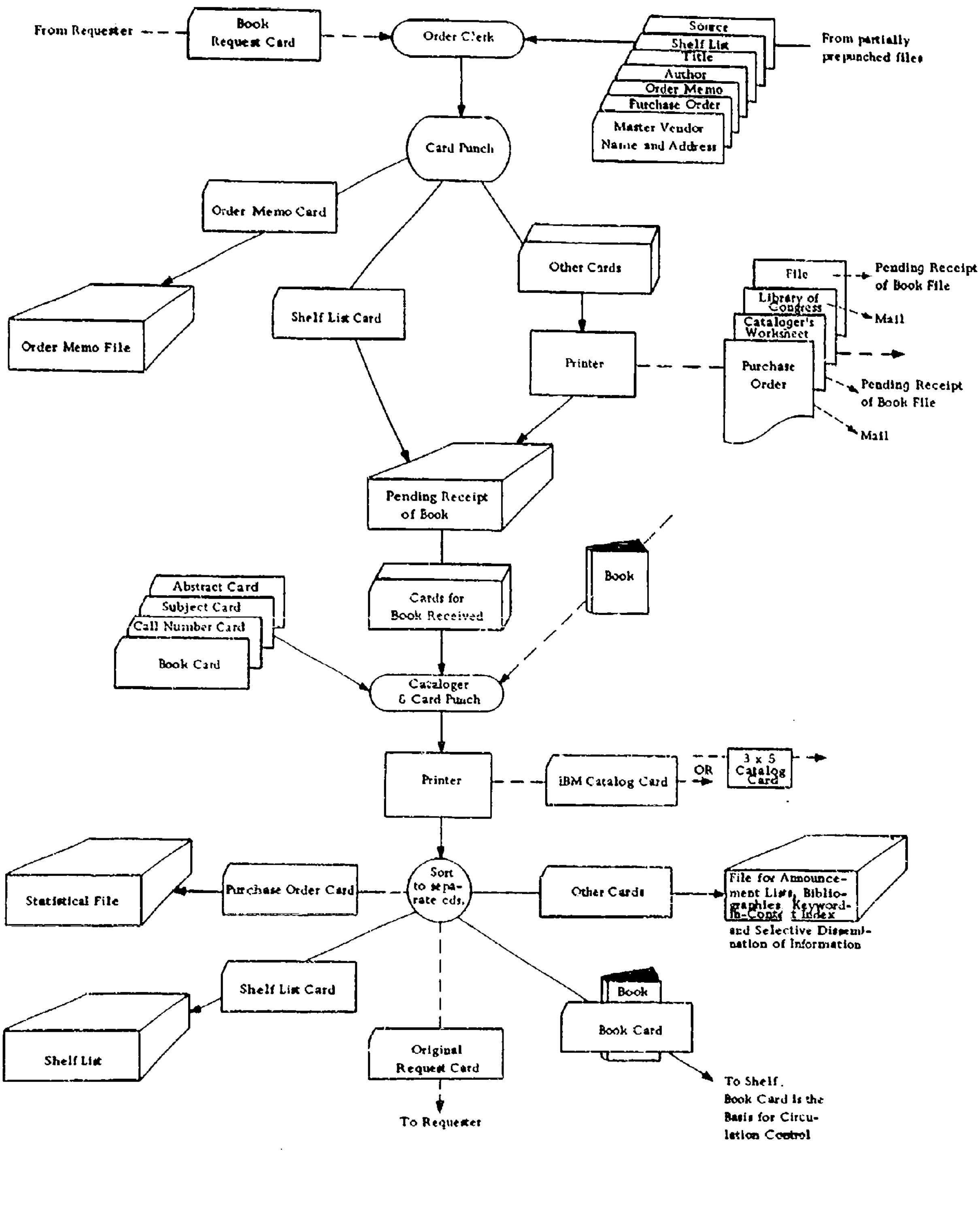
FIGURE 36
IBM 870 System Outputs
System Request Record

```
          September 29, 1965

  rand
Rand Corporation
1700 Main St.
Santa Monica, California

001   btp65 1996    1963                              btp65 1996
101
      BELLMAN, R. E.                                  BTP65 1996
102
      KALABA, R. E.                                   BTP65 1996
201
        A NOTE ON NONLINEAR SUMMABILITY               BTP65 1996
202
      TECHNIQUES IN INVARIANT IMBEDDING.              BTP65 1996
301
      RAND RM3397PR         FEB 63                    BTP65 1996
501     AN OUTLINE OF THE APPLICATION OF              BTP65 1996
502   NONLINEAR SUMMABILITY TECHNIQUES TO             BTP65 1996
503   RADIATIVE TRANSFER.                             BTP65 1996
```

FIGURE 37
IBM 870 System
Flow Diagram



(5) The remaining cards are read by the 870 Control Unit to produce the purchase order and other desired formats as indicated. Cards are then filed by vendor and order date.

(6) When an order is received, the cards are pulled from the vendor file. The order is checked in against the purchase order card.

(7) The received orders are then sent to the cataloger, who prepares a worksheet of usual cataloging information. The worksheet, blank book, call number, subject heading, abstract cards, and the cards of step 6 are all sent to the keypunch operator.

(8) Call number, number of copies received, and cost are added to the purchase order card and are automatically duplicated on the shelf list card. From the shelf list card, the title, call number, author, and accession number are duplicated onto the book card. Call number and accession number are duplicated into the call number card, which is also manually punched with the number of subject headings assigned and the number of catalog cards to be printed. The subject heading cards and abstract cards are manually punched with the necessary information.

(9) Catalog cards are then printed using a programmed format for 3 x 5 cards. (LC cards are not to be used.) For this printing, the subject, author, title, source, call number, and abstract cards are used. These cards are then used for special output listings such as SDI notification and KWIC indexes.

(10) The various cards are filed, completing the process.

A detailed description of the IBM 870 Document Writing System may be found in the following publication:

> The IBM 870
> Library Administrative Processing System for Federal Government Libraries and Special Information Repositories, published by IBM, Technical Publications Department, White Plains, N.Y. 10601.

2. Application

The Mechanical Properties Data Center employed the IBM 870 System prior to the installation of its present computer system.

3. Cost

The Center experienced the following monthly rental charges for its 870 System and some of its auxiliary equipment:

834	Control Unit	$ 124
866	Typewriter	35
101	Electronics statistical machine	275
026	Keypunch	60
083	Sorter	112

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The following bibliography is divided into six sections. The first section covers DoD information systems other than the Defense Documentation Center (DDC). The second has references concerning or published by DDC. The third section lists references concerning Government information systems other than those of DoD.

The remaining three sections list additional bibliographies, directories of libraries and information centers, and general references to mechanization processes in libraries.

Bibliographies of publications relating specifically to the facilities studied may be found in the individual facility reports.

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Distribution

by COSATI Sub

COSATI SUBJECT CATEGORIES	NUMBER OF FACILITIES AND RE					
	Books			Periodicals		
	Major	Medium	Minor	Major	Medium	Minor
Aeronautics	14	9	17	13	6	17
Agriculture	3	0	11	3	0	7
Astronomy/Astrophysics	7	11	9	6	10	9
Atmospheric Sciences	6	15	13	7	9	15
Behavioral/Social Science	9	10	13	7	13	10
Biological/Medical Science	11	7	19	10	6	18
Chemistry	22	15	10	20	17	8
Earth Sci. /Oceanography	8	14	16	9	9	16
Electronics/Electr. Engr.	29	12	9	30	11	6
Energy Conversion (non-propulsive)	2	8	13	2	6	13
Materials	14	17	11	16	16	10
Mathematical Sciences	21	21	4	16	22	5
Mech., Indus., Civil and Marine Engineering	13	17	11	12	17	11
Methods and Equipment	9	18	13	8	18	30
Military Sciences	9	15	16	9	11	16
Missile Technology	19	10	11	20	9	9
Navigation, Comm., Detection/Countermeasures	13	12	11	9	13	10
Nuclear Sci. /Technology	14	18	12	13	18	16
Ordnance	9	11	14	9	11	14
Physics	27	13	6	25	15	5
Propulsion/Fuels	9	11	14	9	11	14
Space Technology	13	14	15	11	13	15

Appendix A-1

Distribution of Facilities
by COSATI Subject Category

MBER OF FACILITIES AND RELATIVE SIZE OF COLLECTION								
Periodicals			Technical Reports					
			Unclassified			Classified		
Major	Medium	Minor	Major	Medium	Minor	Major	Medium	Minor
13	6	17	13	8	17	11	6	17
3	0	7	3	0	9	3	0	10
6	10	9	6	3	10	5	5	13
7	9	15	6	12	15	5	12	12
7	13	10	3	12	10	2	9	8
10	6	18	9	8	17	7	9	11
20	17	8	19	15	11	17	13	8
9	9	16	7	10	15	7	9	15
30	11	6	29	13	6	25	14	5
2	6	13	6	6	16	6	4	15
16	16	10	18	17	9	13	18	5
16	22	5	16	18	9	11	14	9
12	17	11	9	17	16	7	16	12
8	18	30	12	18	11	11	14	8
9	11	16	15	7	15	17	7	11
20	9	9	21	13	6	23	11	6
9	13	10	15	10	10	19	11	5
13	18	16	14	18	12	12	19	10
9	11	14	16	14	7	16	12	8
25	15	5	23	19	5	21	16	4
9	11	14	9	18	12	9	16	10
11	13	15	14	14	13	11	15	12

Appendix A-2

This section contains the COSATI Subject Category breakdowns of the collections of most of the facilities visited. Breadkdowns are not incleded for those facilities whose collections consist primarily of specialized data.

COLLECTION OF THE
DASA INFORMATION AND ANALYSIS CENTER
816 STATE STREET
SANTA BARBARA, CALIFORNIA

BOOKS ____________ REPORTS, Uncl. ____________
PERIODICALS ____________ REPORTS, Class. ____________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics				
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science				
Biological/Medical Science			3	
Chemistry			3	
Earth Science/Oceanography				
Electronics/Electrical Engineering				
Energy Conversion (non-propulsive)				
Materials				
Mathematical Sciences				
Mech., Indus., Civil & Marine Eng				
Methods and Equipment				
Military Sciences				
Missile Technology				
Navigation, Comm., Detection/ Countermeasures				3
Nuclear Science/Technology			1	1
Ordnance				
Physics			3	3
Propulsion/Fuels				
Space Technology				

COLLECTION OF THE
ARNOLD ENGINEERING DEVELOPMENT CENTER
TECHNICAL LIBRARY
TULLAHOMA, TENNESSEE

BOOKS	19,470	REPORTS, Uncl.	72,000
PERIODICALS	8,069	REPORTS, Class.	

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics	1	1	1	1
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences	1	1	1	1
Behavioral/Social Science				
Biological/Medical Science				
Chemistry	3	3	3	3
Earth Science/Oceanography				
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)	2	2	2	2
Materials	2	2	2	2
Mathematical Sciences	2	2	2	2
Mech., Indus., Civil & Marine Eng	3	3	3	3
Methods and Equipment	2	2	2	2
Military Sciences				
Missile Technology	1	1	1	1
Navigation, Comm., Detection/Countermeasures				
Nuclear Science/Technology	2	2	2	2
Ordnance				
Physics	2	2	2	2
Propulsion/Fuels	1	1	1	1
Space Technology	1	1	1	1

COLLECTION OF THE

AIR FORCE FLIGHT TEST CENTER
TECHNICAL LIBRARY
EDWARDS AFB, CALIFORNIA

BOOKS ____________ REPORTS, Uncl. ____________
PERIODICALS ____________ REPORTS, Class. ____________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics	1	1	1	
Agriculture				
Astronomy/Astrophysics	3	3	3	
Atmospheric Sciences	3	3	3	
Behavioral/Social Science	1	1	3	
Biological/Medical Science	3	3	3	
Chemistry	1	2	3	
Earth Science/Oceanography	3	3		
Electronics/Electrical Engineering	1	1	3	
Energy Conversion (non-propulsive)		3	3	
Materials	3	2	3	
Mathematical Sciences	1	3	3	
Mech., Indus., Civil & Marine Eng.	1	2	3	
Methods and Equipment	3	3	3	
Military Sciences	3	3		
Missile Technology	3	3	3	
Navigation, Comm., Detection/Countermeasures	3	3	3	
Nuclear Science/Technology	3	3	3	
Ordnance	3	3	3	
Physics	1	2	3	
Propulsion/Fuels	3	3	2	
Space Technology	2	3	2	

COLLECTION OF THE

DEFENSE LOGISTICS STUDIES INFORMATION EXCHANGE
ARMY LOGISTICS MANAGEMENT CENTER
FORT LEE, VIRGINIA

BOOKS ________ REPORTS, Uncl. ________
PERIODICALS ________ REPORTS, Class. ________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics	3	3	3	3
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science	1	1	2	2
Biological/Medical Science	3	3	3	3
Chemistry				
Earth Science/Oceanography				
Electronics/Electrical Engineering	3	3	2	2
Energy Conversion (non-propulsive)				
Materials				
Mathematical Sciences	2	2	1	1
Mech., Indus., Civil & Marine Eng				
Methods and Equipment	1	1	1	1
Military Sciences	3	3	2	2
Missile Technology				
Navigation, Comm., Detection/Countermeasures				
Nuclear Science/Technology				
Ordnance	3	3	2	2
Physics				
Propulsion/Fuels	3	3	3	3
Space Technology	3	3	3	3

COLLECTION OF THE

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH
WASHINGTON, D. C.

BOOKS 10,272 REPORTS, Uncl. ______
PERIODICALS 338 REPORTS, Class. 30,000

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl	Technical Reports Class.
Aeronautics	1	1	1	1
Agriculture				
Astronomy/Astrophysics	1	1	1	1
Atmospheric Sciences	3	3	3	3
Behavioral/Social Science	2	2	2	2
Biological/Medical Science	3	3	3	3
Chemistry	2	2	2	2
Earth Science/Oceanography	3	3	3	3
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)	3	3	3	3
Materials				
Mathematical Sciences	2	2	2	2
Mech., Indus., Civil & Marine Eng.				
Methods and Equipment				
Military Sciences				
Missile Technology				
Navigation, Comm., Detection/Countermeasures				
Nuclear Science/Technology	2	2	2	2
Ordnance				
Physics	2	2	2	2
Propulsion/Fuels	2	2	2	2
Space Technology	1	1	1	1

COLLECTION OF THE

AIR FORCE MATERIALS LABORATORY
WRIGHT-PATTERSON AFB, OHIO

BOOKS ____________ REPORTS, Uncl. ____________
PERIODICALS ____________ REPORTS, Class. ____________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics				
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science				
Biological/Medical Science				
Chemistry			1	
Earth Science/Oceanography				
Electronics/Electrical Engineering				
Energy Conversion (non-propulsive)				
Materials			1	
Mathematical Sciences				
Mech., Indus., Civil & Marine Eng				
Methods and Equipment			3	
Military Sciences				
Missile Technology				
Navigation, Comm., Detection/ Countermeasures				
Nuclear Science/Technology				
Ordnance				
Physics			1	
Propulsion/Fuels				
Space Technology				

COLLECTION OF THE

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WRIGHT-PATTERSON AFB, OHIO

BOOKS 75,000 REPORTS, Uncl. 25,000
PERIODICALS 1,250 titles REPORTS, Class.

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics	1	1	1	1
Agriculture	3	3	3	
Astronomy/Astrophysics	2	2	2	
Atmospheric Sciences	2	2	2	
Behavioral/Social Science	2	2	2	2
Biological/Medical Science	3	3	3	
Chemistry	3	3	3	
Earth Science/Oceanography	3	3	3	
Electronics/Electrical Engineering	1	1	1	
Energy Conversion (non-propulsive)	2	2	2	
Materials	2	2	2	
Mathematical Sciences	1	1	1	
Mech., Indus., Civil & Marine Eng	1	1	1	
Methods and Equipment	2	2	2	
Military Sciences	3	3	3	
Missile Technology	1	1	1	
Navigation, Comm., Detection/Countermeasures	2	2	2	
Nuclear Science/Technology	1	1	1	
Ordnance	2	2	2	2
Physics	1	1	1	1
Propulsion/Fuels	1	1	1	
Space Technology	1	1	1	1

COLLECTION OF THE
AECRNAUTICAL RESEARCH LABORATORY
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BOOKS ________ REPORTS, Uncl. ________
PERIODICALS ________ REPORTS, Class. ________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics	2	2	2	
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science				
Biological/Medical Science				
Chemistry	1	1	1	
Earth Science/Oceanography				
Electronics/Electrical Engineering				
Energy Conversion (non-propulsive)				
Materials				
Mathematical Sciences	1	1	1	
Mech., Indus., Civil & Marine Eng				
Methods and Equipment				
Military Sciences				
Missile Technology				
Navigation, Comm., Detection/ Countermeasures				
Nuclear Science/Technology				
Ordnance				
Physics	1	1	1	
Propulsion/Fuels				
Space Technology	3	3	3	

COLLECTION OF THE
U. S. ARMY MAP SERVICE LIBRARY
BETHESDA, MARYLAND

BOOKS ____________ REPORTS, Uncl. ____________
PERIODICALS ____________ REPORTS, Class. ____________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports		
			Uncl.	Class.	
Aeronautics	1	1	1	1	*
Agriculture	1	1	1	1	*
Astronomy/Astrophysics	2	2			*
Atmospheric Sciences	1	1			*
Behavioral/Social Science	1	1			*
Biological/Medical Science	1	1			*
Chemistry	1	1			*
Earth Science/Oceanography	3	3	3	3	
Electronics/Electrical Engineering	1	1			*
Energy Conversion (non-propulsive)					
Materials	1	1			*
Mathematical Sciences	1	1			
Mech., Indus., Civil & Marine Eng.	1	1			*
Methods and Equipment	2	2			
Military Sciences	3	3			
Missile Technology	1	1			*
Navigation, Comm., Detection/Countermeasures	1	1			*
Nuclear Science/Technology	1	1			*
Ordnance					
Physics					
Propulsion/Fuels					
Space Technology	1				

* The Total of all these subjects represent less than 15% of our total Library holdings.

COLLECTION OF THE
U. S. ARMY COMBAT DEVELOPMENTS COMMAND LIBRARY
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ADMINISTRATIVE DIVISION
FORT SILL, OKLAHOMA

BOOKS ______ REPORTS, Uncl. ______
PERIODICALS ______ REPORTS, Class. ______

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics			3	3
Agriculture			3	3
Astronomy/Astrophysics			3	3
Atmospheric Sciences			2	2
Behavioral/Social Science				
Biological/Medical Science			2	2
Chemistry			3	3
Earth Science/Oceanography			3	3
Electronics/Electrical Engineering			2	2
Energy Conversion (non-propulsive)			3	3
Materials			2	2
Mathematical Sciences			2	2
Mech., Indus., Civil & Marine Eng			2	2
Methods and Equipment			1	1
Military Sciences			1	1
Missile Technology			1	1
Navigation, Comm., Detection/Countermeasures			1	1
Nuclear Science/Technology			2	2
Ordnance			1	1
Physics			2	2
Propulsion/Fuels			2	2
Space Technology			3	3

COLLECTION OF THE
USAF AEROSPACE MEDICAL CENTER
AEROMEDICAL LIBRARY
BROOKS AFB, TEXAS

BOOKS ________ REPORTS, Uncl. ________
PERIODICALS ________ REPORTS, Class. ________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics	2	2	2	2
Agriculture				
Astronomy/Astrophysics	1	1	1	1
Atmospheric Sciences	2	2	2	2
Behavioral/Social Science	2	2	2	2
Biological/Medical Science	1	1	1	1
Chemistry	1	1	1	1
Earth Science/Oceanography	3			
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)				
Materials				
Biometrics Mathematical Sciences	1	1.	1	1
Mech., Indus., Civil & Marine Eng				
Methods and Equipment	3			
Military Sciences				
Missile Technology				
Navigation, Comm., Detection/Countermeasures				
Nuclear Science/Technology	1	1	1	1
Ordnance				
Physics	1	1	1	1
Propulsion/Fuels				
Space Technology	1	1	1	1

COLLECTION OF THE
ARMY STUDY DOCUMENTATION AND INFORMATION RETRIEVAL SYSTEM
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BOOKS ____________ REPORTS, Uncl. ____________
PERIODICALS ____________ REPORTS, Class. ____________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics				
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science			2	
Biological/Medical Science				
Chemistry				
Earth Science/Oceanography				
Electronics/Electrical Engineering				
Energy Conversion (non-propulsive)				
Materials				
Mathematical Sciences				
Mech., Indus., Civil & Marine Eng				
Methods and Equipment				
Military Sciences			1	
Missile Technology				
Navigation, Comm., Detection/ Countermeasures				
Nuclear Science/Technology				
Ordnance			2	
Physics				
Propulsion/Fuels				
Space Technology				

COLLECTION OF THE
AERONAUTICAL CHART AND INFORMATION CENTER
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SECOND AND ARSENAL
ST. LOUIS, MISSOURI

BOOKS ________ REPORTS, Uncl. ________
PERIODICALS ________ REPORTS, Class. ________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics	3	1	3	
Agriculture				
Astronomy/Astrophysics	1	1	1	
Atmospheric Sciences	3	3	3	
Behavioral/Social Science	1	2	2	
Biological/Medical Science	3	3	3	
Chemistry				
Earth Science/Oceanography	1	1	1	
Electronics/Electrical Engineering	2	1	2	
Energy Conversion (non-propulsive)				
Materials	3	3	3	
Mathematical Sciences	2	2	2	
Mech., Indus., Civil & Marine Eng	3	2	3	
Methods and Equipment	2	2	2	
Military Sciences	2	2	2	
Missile Technology	1	1	1	
Navigation, Comm., Detection/ Countermeasures	3	3	3	
Nuclear Science/Technology	3	3	3	
Ordnance				
Physics	2	3	2	
Propulsion/Fuels	3	3	3	
Space Technology	1	1	1	

COLLECTION OF THE
HARRY DIAMOND LABORATORIES
TECHNICAL INFORMATION OFFICE
WASHINGTON, D. C.

BOOKS 20,100 REPORTS, Uncl. 340,000
PERIODICALS 700 REPORTS, Class. ______

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics	3	3	3	3
Agriculture				
Astronomy/Astrophysics	3	3	3	3
Atmospheric Sciences	3	3	3	3
Behavioral/Social Science	2	2	2	2
Biological/Medical Science	3	3	3	3
Chemistry	2	2	2	2
Earth Science/Oceanography	3	3	3	3
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)	1	1	1	1
Materials	2	2	2	2
Mathematical Sciences	1	1	1	1
Mech., Indus., Civil & Marine Eng.	2	2	2	2
Methods and Equipment	2	2	2	2
Military Sciences	1	1	1	1
Missile Technology	1	1	1	1
Navigation, Comm., Detection/ Countermeasures	1	1	1	1
Nuclear Science/Technology	1	1	1	1
Ordnance	1	1	1	1
Physics	1	1	1	1
Propulsion/Fuels	3	3	3	3
Space Technology	2	2	2	2

COLLECTION OF THE
U. S. ARMY EDGEWOOD RESEARCH & DEVELOPMENT LABORATORY
TECHNICAL LIBRARY
EDGEWOOD ARSENAL, MARYLAND

BOOKS ______ REPORTS, Uncl. ______
PERIODICALS ______ REPORTS, Class. ______

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics	3	3	3	3
Agriculture	3	3	3	3
Astronomy/Astrophysics	3	3	3	3
Atmospheric Sciences	2	2	2	2
Behavioral/Social Science	2	2	2	2
Biological/Medical Science	1	1	1	1
Chemistry	1	1	1	1
Earth Science/Oceanography				
Electronics/Electrical Engineering	2	2	2	2
Energy Conversion (non-propulsive)	2	2	2	2
Materials	1	1	1	1
Mathematical Sciences	1	1	1	1
Mech., Indus., Civil & Marine Eng	2	2	2	2
Methods and Equipment	2	2	2	2
Military Sciences	1	1	1	1
Missile Technology	2	2	2	2
Navigation, Comm., Detection/ Countermeasures	3	3	3	3
Nuclear Science/Technology	2	2	2	2
Ordnance	2	2	2	2
Physics	1	1	1	1
Propulsion/Fuels	2	2	2	2
Space Technology	3	3	3	3

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BOOKS 75,000 REPORTS, Uncl. 37,241
PERIODICALS 437 REPORTS, Class. 15,961

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics				
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science				
Biological/Medical Science	3	3	3	3
Chemistry	2	2	2	2
Earth Science/Oceanography	1	1	1	1
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)			1	1
Materials	1	1	1	1
Mathematical Sciences	3	3	3	3
Mech., Indus., Civil & Marine Eng	1	1	1	1
Methods and Equipment				
Military Sciences				
Missile Technology				
Navigation, Comm., Detection/ Countermeasures				
Nuclear Science/Technology		2	1	1
Ordnance			1	1
Physics	2	2	2	2
Propulsion/Fuels				
Space Technology			3	3

COLLECTION OF THE
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BOOKS 10,000 REPORTS, Uncl. 170,000
PERIODICALS 90,000 REPORTS, Class. 120,000

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics	1	2	2	2
Agriculture	3	3	3	3
Astronomy/Astrophysics	1	2	3	3
Atmospheric Sciences	2	2	2	2
Behavioral/Social Science	2	2	3	3
Biological/Medical Science	3	3	3	3
Chemistry	2	2	2	2
Earth Science/Oceanography	2	3	2	2
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)	2	2	1	1
Materials	2	2	2	2
Mathematical Sciences	2	2	3	3
Me[illegible], Indus., Civil & Marine Eng	1	3	3	3
Methods and Equipment	3	3	2	2
Military Sciences	2	3	1	1
Missile Technology	1	1	1	1
Navigation, Comm., Detection/ Countermeasures	2	2	1	1
Nuclear Science/Technology	2	2	1	1
Ordnance	3	3	2	2
Physics	1	1	2	2
Propulsion/Fuels	1	1	1	1
Space Technology	1	1	1	1

COLLECTION OF THE
UNITED STATES ARMY COMBAT DEVELOPMENTS COMMAND
TECHNICAL LIBRARY
FORT MCCLELLAN, ALABAMA

BOOKS ____________ REPORTS, Uncl. 1,500
PERIODICALS ____________ REPORTS, Class. ____________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics			3	3
Agriculture			3	3
Astronomy/Astrophysics			3	3
Atmospheric Sciences			2	2
Behavioral/Social Science				
Biological/Medical Science			2	2
Chemistry			3	3
Earth Science/Oceanography			3	3
Electronics/Electrical Engineering			2	2
Energy Conversion (non-propulsive)			3	3
Materials			2	2
Mathematical Sciences			2	2
Mech., Indus., Civil & Marine Eng			2	2
Methods and Equipment			1	1
Military Sciences			1	1
Missile Technology			1	1
Navigation, Comm., Detection/ Countermeasures			1	1
Nuclear Science/Technology			2	2
Ordnance			1	1
Physics			2	2
Propulsion/Fuels			2	2
Space Technology			3	3

COLLECTION OF THE
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CHEMICAL PROPULSION INFORMATION AGENCY
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BOOKS ____________ REPORTS, Uncl. 35,000
PERIODICALS ____________ REPORTS, Class. ____________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics			2	2
Agriculture				
Astronomy/Astrophysics			3	3
Atmospheric Sciences			1	1
Behavioral/Social Science				
Biological/Medical Science			2	2
Chemistry			1	1
Earth Science/Oceanography			3	3
Electronics/Electrical Engineering			3	3
Energy Conversion (non-propulsive)			1	1
Materials			1	1
Mathematical Sciences				
Mech., Indus., Civil & Marine Eng			2	2
Methods and Equipment			1	1
Military Sciences			2	2
Missile Technology			1	1
Navigation, Comm., Detection/ Countermeasures			3	3
Nuclear Science/Technology			3	3
Ordnance			1	1
Physics			2	2
Propulsion/Fuels			1	1
Space Technology			1	1

COLLECTION OF THE
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BOOKS 11,000 REPORTS, Uncl. 65,000
PERIODICALS 280 REPORTS, Class.

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics				
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science				
Biological/Medical Science				
Chemistry	1	1	1	1
Earth Science/Oceanography	2	2	2	2
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)	2	2	2	2
Materials	2	2	2	2
Mathematical Sciences	2	2	2	2
Mech., Indus., Civil & Marine Eng	1	1	1	1
Methods and Equipment	2	2	2	2
Military Sciences	3	3	3	3
Missile Technology				
Navigation, Comm., Detection/Countermeasures	2	2	2	2
Nuclear Science/Technology	3	3	3	3
Ordnance				
Physics				
~~Propulsion/~~Fuels	2	2	2	2
Space Technology				

COLLECTION OF THE
JOHNS HOPKINS UNIVERSITY
APPLIED PHYSICS LABORATORY
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SILVER SPRING, MARYLAND

BOOKS 25,000 — REPORTS, Uncl. 130,000
PERIODICALS 15,000 — REPORTS, Class. ______

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics	1	1	1	1
Agriculture				3
Astronomy/Astrophysics	1	1	2	3
Atmospheric Sciences	1	1	1	3
Behavioral/Social Science	3	3	2	3
Biological/Medical Science	3	3	3	3
Chemistry	3	3	2	3
Earth Science/Oceanography	1	1	3	3
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)	3	3	3	3
Materials	2	2	1	2
Mathematical Sciences	1	1	2	3
Mech., Indus., Civil & Marine Eng.	2	2	3	3
Methods and Equipment	3	3	3	3
Military Sciences	3	3	3	2
Missile Technology	1	1	2	1
Navigation, Comm., Detection/ Countermeasures	1	1	1	1
Nuclear Science/Technology	2	2	1	2
Ordnance	3	3	2	2
Physics	1	1	1	1
Propulsion/Fuels	1	1	2	1
Space Technology	1	1	1	2

COLLECTION OF THE
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WATERVLIET, NEW YORK

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PERIODICALS 210 REPORTS, Class. 9,500

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics				
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science	3	3	3	3
Biological/Medical Science				
Chemistry	2	2	2	2
Earth Science/Oceanography				
Electronics/Electrical Engineering	3	3	3	3
Energy Conversion (non-propulsive)	3	3	3	3
Materials	1	1	1	1
Mathematical Sciences	2	2	2	2
Mech., Indus., Civil & Marine Eng.	1	1	1	1
Methods and Equipment	1	1	1	1
Military Sciences	2	2	2	2
Missile Technology	1	1	1	1
Navigation, Comm., Detection/Countermeasures	3	3	3	3
Nuclear Science/Technology	3	3	3	3
Ordnance	1	1	1	1
Physics	2	2	2	2
Propulsion/Fuels	3	3	3	3
Space Technology	2	2	2	2

COLLECTION OF THE
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BOOKS 40,000 REPORTS, Uncl. 20,000
PERIODICALS 1,100 REPORTS, Class. 3,000

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics	3	3	3	3
Agriculture				
Astronomy/Astrophysics	2	3	3	3
Atmospheric Sciences	2	3	2	2
Behavioral/Social Science	3	3	3	3
Biological/Medical Science	3	3		
Chemistry	1	2	2	3
Earth Science/Oceanography	2	3	2	
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)	2	3	3	3
Materials	2	3	1	2
Mathematical Sciences	1	2	2	3
Mech., Indus., Civil & Marine Eng.	2	3	3	3
Methods and Equipment	3	3		
Military Sciences	3	3		2
Missile Technology	3	3		2
Navigation, Comm., Detection/ Countermeasures	3	3	3	1
Nuclear Science/Technology	3	3	3	2
Ordnance				3
Physics	1	1	1	1
Propulsion/Fuels				
Space Technology	3	3	3	3

BOOKS ____________ REPORTS, Uncl. ____________
PERIODICALS ____________ REPORTS, Class. ____________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics	2	2	2	2
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences	2	2	2	2
Behavioral/Social Science				
Biological/Medical Science	2	2	2	[illegible]
Chemistry	2	2	2	2
Earth Science/Oceanography				
Electronics/Electrical Engineering				
Energy Conversion (non-propulsive)				
Materials	2	2	2	2
Mathematical Sciences	3	3	3	3
Mech., Indus., Civil & Marine Eng				
Methods and Equipment	3	3	3	3
Military Sciences	3	3	3	3
Missile Technology	3	3	3	3
Navigation, Comm., Detection/ Countermeasures	2	2	2	2
Nuclear Science/Technology	1	1	1	1
Ordnance	3	3	3	3
Physics	1	1	1	1
Propulsion/Fuels	2	2	2	2
Space Technology	2	2	2	2

COLLECTION OF THE
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BOOKS 50,000 REPORTS, Uncl. 20,000
PERIODICALS 36,000 REPORTS, Class. 22,000

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics	3	3	3	3
Agriculture	1	1	1	1
Astronomy/Astrophysics				
Atmospheric Sciences	2	2	2	2
Behavioral/Social Science	3	3		
Biological/Medical Science	1	1	1	1
Chemistry	2	2	2	2
Earth Science/Oceanography	3	3	3	3
Electronics/Electrical Engineering	3	3	3	3
Energy Conversion (non-propulsive)				
Materials	3	3	3	3
Mathematical Sciences	2	2	3	3
Mech., Indus., Civil & Marine Eng.	2	2	3	3
Methods and Equipment	3	3	3	3
Military Sciences	3	3	1	1
Missile Technology	3	3	3	3
Navigation, Comm., Detection/ Countermeasures	2	2	2	2
Nuclear Science/Technology	3	3	3	3
Ordnance	2	2	3	3
Physics	2	2	2	2
Propulsion/Fuels	3	3	3	3
Space Technology	3	3	3	3

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COLUMBUS, OHIO

BOOKS ____________ REPORTS, Uncl. ____________
PERIODICALS ____________ REPORTS, Class. ____________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports * Uncl.	Technical Reports * Class.
Aeronautics			1	
Agriculture				
Astronomy/Astrophysics			3	
Atmospheric Sciences			2	
Behavioral/Social Science				
Biological/Medical Science				
Chemistry			3	
Earth Science/Oceanography				
Electronics/Electrical Engineering			1	
Energy Conversion (non-propulsive)				
Materials			3	
Mathematical Sciences			3	
Mech., Indus., Civil & Marine Eng.			3	
Methods and Equipment			3	
Military Sciences			1	
Missile Technology			1	
Navigation, Comm., Detection/ Countermeasures			1	
Nuclear Science/Technology				
Ordnance			3	
Physics			2	
Propulsion/Fuels			3	
Space Technology			2	

* In the form of Extract Cards.

COLLECTION OF THE
DEFENSE METALS INFORMATION CENTER
BATTELLE MEMORIAL INSTITUTE
505 KING AVENUE
COLUMBUS, OHIO

BOOKS ______ REPORTS, Uncl. ______
PERIODICALS ______ REPORTS, Class. ______

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports * Uncl.	Technical Reports * Class.
Aeronautics				
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science				
Biological/Medical Science				
Chemistry			3	
Earth Science/Oceanography				
Electronics/Electrical Engineering				
Energy Conversion (non-propulsive)				
Materials			1	
Mathematical Sciences				
Mech., Indus., Civil & Marine Eng			3	
Methods and Equipment			2	
Military Sciences				
Missile Technology			3	
Navigation, Comm., Detection/ Countermeasures				
Nuclear Science/Technology				
Ordnance				
Physics			3	
Propulsion/Fuels				
Space Technology			3	

* In the form of extract cards.

COLLECTION OF THE
AIR FORCE TECHNICAL LIBRARY 2302
WRIGHT-PATTERSON AFB, OHIO

BOOKS ________ REPORTS, Uncl. ________
PERIODICALS ________ REPORTS, Class. ________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics	1	1	1	1
Agriculture				
Astronomy/Astrophysics	2	2	2	2
Atmospheric Sciences	2	2	2	2
Behavioral/Social Science	2	2		
Biological/Medical Science	2	2	3	3
Chemistry	2	2	3	3
Earth Science/Oceanography	2	2		
Electronics/Electrical Engineering	2	2	2	2
Energy Conversion (non-propulsive)	2	2	2	2
Materials	2	2	2	2
Mathematical Sciences	2	2	3	3
Mech., Indus., Civil & Marine Eng	3	3		
Methods and Equipment	3	3	3	3
Military Sciences	2	2		
Missile Technology	1	1	1	1
Navigation, Comm., Detection/ Countermeasures	2	2	2	2
Nuclear Science/Technology	3	3	3	3
Ordnance	3	3		
Physics	2	2	2	2
Propulsion/Fuels	1	1	1	1
Space Technology	1	1	1	1

COLLECTION OF THE
AIR FORCE WEAPONS LABORATORY
TECHNICAL LIBRARY
KIRTLAND AFB, NEW MEXICO

BOOKS ____________ REPORTS, Uncl. ____________
PERIODICALS ____________ REPORTS, Class. ____________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports * Uncl.	Technical Reports * Class.
Aeronautics	3		3	
Agriculture				
Astronomy/Astrophysics	2	2	2	
Atmospheric Sciences	3	3	3	
Behavioral/Social Science				
Biological/Medical Science	3	3	3	
Chemistry	3	3	3	
Earth Science/Oceanography				
Electronics/Electrical Engineering	1	2	2	
Energy Conversion (non-propulsive)				
Materials	3	3	3	
Mathematical Sciences	1	2	3	
Mech., Indus., Civil & Marine Eng	2	2	1	
Methods and Equipment	3	3	3	
Military Sciences	3		1	
Missile Technology			1	
Navigation, Comm., Detection/ Countermeasures			2	
Nuclear Science/Technology	2	2	1	
Ordnance	3	3	2	
Physics	1	2	2	
Propulsion/Fuels	3	3	2	
Space Technology	2	2	2	

* Unclassified and classified reported together.

COLLECTION OF THE
REMOTE AREA CONFLICT INFORMATION CENTER
BATTELLE MEMORIAL INSTITUTE
505 KING AVENUE
COLUMBUS, OHIO

BOOKS ____________ REPORTS, Uncl. ____________
PERIODICALS ____________ REPORTS, Class. ____________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports*	
			Uncl.	Class.
Aeronautics			2	
Agriculture			3	
Astronomy/Astrophysics			3	
Atmospheric Sciences			2	
Behavioral/Social Science			2	
Biological/Medical Science			1	
Chemistry			1	
Earth Science/Oceanography			3	
Electronics/Electrical Engineering			1	
Energy Conversion (non-propulsive)			2	
Materials			2	
Mathematical Sciences			2	
Mech., Indus., Civil & Marine Eng			1	
Methods and Equipment			2	
Military Sciences			1	
Missile Technology			3	
Navigation, Comm., Detection/Countermeasures			1	
Nuclear Science/Technology			3	
Ordnance			1	
Physics			2	
Propulsion/Fuels			3	
Space Technology			3	

* In the form of Extract Cards.

COLLECTION OF THE
U. S. ARMY MATERIALS RESEARCH AGENCY
TECHNICAL LIBRARY BRANCH
WATERTOWN, MASSACHUSETTS

BOOKS ____________ REPORTS, Uncl. 70,000
PERIODICALS 700 REPORTS, Class. 10,000

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics				
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science				
Biological/Medical Science				
Chemistry	2	2	2	2
Earth Science/Oceanography				
Electronics/Electrical Engineering	2	2	2	2
Energy Conversion (non-propulsive)				
Materials	1	1	1	1
Mathematical Sciences				
Mech., Indus., Civil & Marine Eng				
Methods and Equipment	1	1	1	1
Military Sciences	3	3	3	3
Missile Technology				
Navigation, Comm., Detection/ Countermeasures				
Nuclear Science/Technology	2	2	2	2
Ordnance	1	1	1	1
Physics	2	2	2	2
Propulsion/Fuels	2	2	2	2
Space Technology				

COLLECTION OF THE
U. S. NAVAL SHIP MISSILES SYSTEMS ENGINEERING STATION
TECHNICAL LIBRARY DIVISION
PORT HUENEME, CALIFORNIA

BOOKS __________ REPORTS, Uncl. __________
PERIODICALS __________ REPORTS, Class. __________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics	3	3	3	3
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science	3			
Biological/Medical Science				
Chemistry				
Earth Science/Oceanography				
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)				
Materials				
Mathematical Sciences	2		2	2
Mech., Indus., Civil & Marine Eng.	2	2	2	2
Methods and Equipment				
Military Sciences	2	2	2	2
Missile Technology	1	1	1	1
Navigation, Comm., Detection/Countermeasures	1	1	1	1
Nuclear Science/Technology	2	2	2	2
Ordnance	1	1	1	1
Physics	[illegible]	2	2	2
Propulsion/Fuels				
Space Technology	2	2	2	2

COLLECTION OF THE
U. S. ARMY NATICK LABORATORIES
TECHNICAL LIBRARY
NATICK, MASSACHUSETTS

BOOKS 16,000 REPORTS, Uncl. 75,000
PERIODICALS 1,000 REPORTS, Class. 2,000

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics				
Agriculture	1	1	1	1
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science	1	1	1	1
Biological/Medical Science	1	1	1	1
Chemistry	1	1	1	1
Earth Science/Oceanography	1	1	1	1
Electronics/Electrical Engineering	3	3	3	3
Energy Conversion (non-propulsive)				
Materials	1	1	1	1
Mathematical Sciences	2	2	3	3
Mech., Indus., Civil & Marine Eng.	2	2	2	2
Methods and Equipment	3	3	3	3
Military Sciences	3	3	3	3
Missile Technology				
Navigation, Comm., Detection/Countermeasures				
Nuclear Science/Technology	1	1	1	1
Ordnance	3	3	3	3
Physics	1	1	1	1
Propulsion/Fuels	3	3	3	3
Space Technology	2	2	2	2

COLLECTION OF THE
BUREAU OF SHIPS TECHNICAL LIBRARY
18th STREET & CONSTITUTION AVENUE, N. W.
WASHINGTON, D. C.

BOOKS 30,000 REPORTS, Uncl. 120,000
PERIODICALS 760 titles REPORTS, Class. 80,000

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics				
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science	3	3		
Biological/Medical Science				
Chemistry	1	1	3	3
Earth Science/Oceanography	3	3	3	3
Electronics/Electrical Engineering	2	2	1	1
Energy Conversion (non-propulsive)				
Materials	3	3	2	
Mathematical Sciences	3	3		
Mech., Indus., Civil & Marine Eng.	1	1	1	1
Methods and Equipment				
Military Sciences	2	2	3	3
Missile Technology				
Navigation, Comm., Detection/Countermeasures	2	2	1	1
Nuclear Science/Technology	3	3	2	2
Ordnance				
Physics	3	3	3	3
Propulsion/Fuels	3	3	3	3
Space Technology				

COLLECTION OF THE
OPERATIONAL TEST & EVALUATION FORCE
TECHNICAL LIBRARY
U. S. NAVAL STATION
NORFOLK, VIRGINIA

BOOKS 500 REPORTS, Uncl. 35,000
PERIODICALS 100 REPORTS, Class. ______

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics	2	1	2	2
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science				
Biological/Medical Science				
Chemistry				
Earth Science/Oceanography		1		
Electronics/Electrical Engineering	3	3		
Energy Conversion (non-propulsive)				
Materials				
Mathematical Sciences				
Mech., Indus., Civil & Marine Eng.				
Methods and Equipment	1	1	1	1
Military Sciences				
Missile Technology	2	2	2	2
Navigation, Comm., Detection/ Countermeasures	2	2	2	2
Nuclear Science/Technology				
Ordnance	1	1	1	1
Physics				
Propulsion/Fuels				
Space Technology	2	2	2	2

COLLECTION OF THE
U. S. NAVAL WEAPONS LABORATORY
TECHNICAL LIBRARY
DAHLGREN, VIRGINIA

BOOKS 16,000 REPORTS, Uncl. 45,000
PERIODICALS 600 REPORTS, Class. 15,000

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics	1	1	1	1
Agriculture				
Astronomy/Astrophysics	1	1	1	1
Atmospheric Sciences	1	1	1	1
Behavioral/Social Science	3	3	3	3
Biological/Medical Science	1	1	1	1
Chemistry	1	1	1	1
Earth Science/Oceanography	2	2	2	2
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)	3	3	3	3
Materials	1	1	1	1
Mathematical Sciences	1	1	1	1
Mech, Indus., Civil & Marine Eng	2	2	2	2
Methods and Equipment	1	1	1	1
Military Sciences	1	1	1	1
Missile Technology	1	1	1	1
Navigation, Comm., Detection/ Countermeasures	3	3	1	1
Nuclear Science/Technology	2	2	2	1
Ordnance	3	2	1	1
Physics	1	1	1	1
Propulsion/Fuels	1	1	1	1
Space Technology	1	1	1	1

COLLECTION OF THE
PICATINNY ARSENAL
TECHNICAL INFORMATION BRANCH
DOVER, NEW JERSEY

BOOKS 20,400 REPORTS, Uncl. 50,000
PERIODICALS 1,000 REPORTS, Class. 100,000

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics	3	3	3	3
Agriculture	3			
Astronomy/Astrophysics	3	3	3	3
Atmospheric Sciences	3	3	3	3
Behavioral/Social Science	1	2	3	
Biological/Medical Science	3	3	3	
Chemistry	2	1	1	1
Earth Science/Oceanography	3	3	3	3
Electronics/Electrical Engineering	2	1	1	1
Energy Conversion (non-propulsive)	3	3	3	3
Materials	1	1	2	1
Mathematical Sciences	2	3	2	2
Mech., Indus., Civil & Marine Eng.	2	2	2	2
Methods and Equipment	2	2	2	2
Military Sciences	1	1	1	1
Missile Technology	1	1	1	1
Navigation, Comm., Detection/ Countermeasures	3	3	3	2
Nuclear Science/Technology	1	1	2	2
Ordnance	1	1	1	1
Physics	2	2	2	2
Propulsion/Fuels	3	3	2	2
Space Technology	3	3	2	2

COLLECTION OF THE
TECHNICAL INFORMATION REFERENCE BRANCH
SYSTEMS ENGINEERING GROUP
RESEARCH & TECHNOLOGY DIVISION
WRIGHT-PATTERSON AFB, OHIO

BOOKS ________ REPORTS, Uncl. 160,000
PERIODICALS ________ REPORTS, Class. 40,000

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics			1	1
Agriculture				
Astronomy/Astrophysics			1	1
Atmospheric Sciences			1	1
Behavioral/Social Science			2	2
Biological/Medical Science			2	2
Chemistry			1	1
Earth Science/Oceanography			1	1
Electronics/Electrical Engineering			1	1
Energy Conversion (non-propulsive)			1	1
Materials			1	1
Mathematical Sciences			1	1
Mech., Indus., Civil & Marine Eng			1	1
Methods and Equipment			1	1
Military Sciences			1	1
Missile Technolo			1	1
Navigation, Comm., Detection/Countermeasures			1	1
Nuclear Science/Technology			1	1
Ordnance			1	1
Physics			1	1
Propulsion/Fuels			1	1
Space Technology			1	1

COLLECTION OF THE
TACTICAL AIR RECONNAISSANCE CENTER
TECHNICAL LIBRARY
SHAW AFB, SOUTH CAROLINA

BOOKS ____________ REPORTS, Uncl. ____________
PERIODICALS ____________ REPORTS, Class. ____________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics	2			
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science				
Biological/Medical Science	2			
Chemistry	2			
Earth Science/Oceanography	2			
Electronics/Electrical Engineering	2			
Energy Conversion (non-propulsive)				
Materials				
Mathematical Sciences	2			
Mech., Indus., Civil & Marine Eng	2	2	2	2
Methods and Equipment	2			
Military Sciences	2			
Missile Technology	2	2	2	2
Navigation, Comm., Detection/ Countermeasures	2			
Nuclear Science/Technology	2			
Ordnance				
Physics	2			
Propulsion/Fuels				
Space Technology				

COLLECTION OF THE
RELIABILITY CENTRAL
ROME AIR DEVELOPMENT CENTER
TECHNICAL LIBRARY
GRIFFISS AIR FORCE BASE, NEW YORK

BOOKS ________ REPORTS, Uncl. ________
PERIODICALS ________ REPORTS, Class. ________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics				
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science				
Biological/Medical Science				
Chemistry				
Earth Science/Oceanography				
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)				
Materials				
Mathematical Sciences				
Mech., Indus., Civil & Marine Eng	3	3	3	3
Methods and Equipment	2	2	2	2
Military Sciences				
Missile Technology	2	2	2	2
Navigation, Comm., Detection/ Countermeasures	2	2	2	2
Nuclear Science/Technology				
Ordnance				
Physics				
Propulsion/Fuels				
Space Tech. ology	2	2	2	2

COLLECTION OF THE
REDSTONE SCIENTIFIC INFORMATION CENTER
TECHNICAL LIBRARY
REDSTONE ARSENAL, ALABAMA

BOOKS ________ REPORTS, Uncl. ________
PERIODICALS ________ REPORTS, Class. ________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics	2	2	2	2
Agriculture				
Astronomy/Astrophysics	2	2	2	2
Atmospheric Sciences	2	2	2	2
Behavioral/Social Science				
Biological/Medical Science				
Chemistry	2	2	2	2
Earth Science/Oceanography	2	2	2	2
Electronics/Electrical Engineering	2	2	2	3
Energy Conversion (non-propulsive)				
Materials	3	1	3	2
Mathematical Sciences	2	2	2	2
Mech., Indus., Civil & Marine Eng				
Methods and Equipment	2	2	2	2
Military Sciences	2	2	2	2
Missile Technology	2	2	2	1
Navigation, Comm., Detection/ Countermeasures	2	2	2	2
Nuclear Science/Technology	2	2	2	2
Ordnance	2	2	2	2
Physics	2	3	2	2
Propulsion/Fuels	2	2	2	2
Space Technology	1	2	1	2

COLLECTION OF THE
ARMED FORCES RADIOBIOLOGICAL RESEARCH INSTITUTE
NATIONAL NAVAL MEDICAL CENTER
BETHESDA, MARYLAND

BOOKS ________ REPORTS, Uncl. ________
PERIODICALS ________ REPORTS, Class. ________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics			3	
Agriculture	3			
Astronomy/Astrophysics	3			
Atmospheric Sciences	3	3	3	
Behavioral/Social Science	1	1		
Biological/Medical Science	1	1	1	
Chemistry	1	1	1	
Earth Science/Oceanography				
Electronics/Electrical Engineering	2	2	2	
Energy Conversion (non-propulsive)	2		2	
Materials	2	2		
Mathematical Sciences	1	1	1	
Mech., Indus., Civil & Marine Eng				
Methods and Equipment	2	2	2	
Military Sciences	3	3	3	
Missile Technology				
Navigation, Comm., Detection/Countermeasures	3		3	
Nuclear Science/Technology	1	1	1	
Ordnance				
Physics	1	1	1	
Propulsion/Fuels				
Space Technology	3		3	

COLLECTION OF THE
RADIATION EFFECTS INFORMATION CENTER
BATTELLE MEMORIAL INSTITUTE
COLUMBUS, OHIO

BOOKS ______ REPORTS, Uncl. ______
PERIODICALS ______ REPORTS, Class. ______

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports Uncl.	Technical Reports Class.
Aeronautics				
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences	3	1	2	
Behavioral/Social Science				
Biological/Medical Science				
Chemistry	3	2	2	2
Earth Science/Oceanography				
Electronics/Electrical Engineering	3	1	1	2
Energy Conversion (non-propulsive)				
Materials	3	1	1	2
Mathematical Sciences				
Mech., Indus., Civil & Marine Eng				
Methods and Equipment	3	2	2	
Military Sciences				
Missile Technology				2
Navigation, Comm., Detection/Countermeasures				
Nuclear Science/Technology	3	2	2	
Ordnance				
Physics				
Propulsion/Fuels		2	2	2
Space Technology				

COLLECTION OF THE
PLASTICS TECHNICAL EVALUATION CENTER
PICATINNY ARSENAL
TECHNICAL LIBRARY
DOVER, NEW JERSEY

BOOKS	220	REPORTS, Uncl.	7,500
PERIODICALS	215	REPORTS, Class.	700

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics	2	2	2	2
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavio../Social Science				
Biological/Medical Science	3	3	3	3
Chemistry	2	2	2	2
Earth Science/Oceanography				
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)				
Materials	1	1	1	1
Mathematical Sciences				
Mech., Indus., Civil & Marine Eng.	1	1	1	1
Methods and Equipment	2	2	2	2
Military Sciences	3	3	3	3
Missile Technology	1	1	1	1
Navigation, Comm., Detection/ Countermeasures				
Nuclear Science/Technology	2	2	2	2
Ordnance	2	2	2	2
Physics	3	3	3	3
Propulsion/Fuels				
Space Technology	2	2	2	2

COLLECTION OF THE
NONDESTRUCTIVE TESTING INFORMATION ANALYSIS CENTER
U. S. ARMY MATERIALS RESEARCH AGENCY
TECHNICAL LIBRARY
WATERTOWN, MASSACHUSETTS

BOOKS ________ REPORTS, Uncl. ________
PERIODICALS ________ REPORTS, Class. ________

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics				
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science				
Biological/Medical Science				
Chemistry	1	1	1	1
Earth Science/Oceanography				
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)				
Materials	1	1	1	1
Mathematical Sciences	1	2	3	3
Mech., Indus., Civil & Marine Eng.	3	3	3	3
Methods and Equipment	3	3	3	3
Military Sciences	2	2	2	1
Missile Technology	3	3	3	3
Navigation, Comm., Detection/ Countermeasures				
Nuclear Science/Technology	[illegible]	1	1	1
Ordnance	3	3	2	2
Physics	1	1	1	1
Propulsion/Fuels	3	3	3	3
Space Technology	3	3	3	3

COLLECTION OF THE
NAVAL UNDERWATER WEAPONS RESEARCH
AND ENGINEERING STATION
TECHNICAL LIBRARY
NEWPORT, RHODE ISLAND

BOOKS 10,000 REPORTS, Uncl. 10,000
PERIODICALS 345 REPORTS, Class. 43,000

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics				
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science				
Biological/Medical Science				
Chemistry				
Earth Science/Oceanography	2	2	2	2
Electronics/Electrical Engineering	1	2	2	2
Energy Conversion (non-propulsive)	3	3	3	3
Materials	3	3	3	3
Mathematical Sciences				
Mech., Indus., Civil & Marine Eng	2	1	3	3
Methods and Equipment				
Military Sciences	3	1	3	3
Missile Technology	2	1	2	2
Navigation, Comm., Detection/ Countermeasures	1	2	1	1
Nuclear Science/Technology	2	2	2	2
Ordnance	2	2	1	1
Physics	1	1	3	3
Propulsion/Fuels	3	3	3	3
Space Technology				

COLLECTION OF THE
NAVY UNDERWATER SOUND LABORATORY LIBRARY
NEW LONDON, CONNECTICUT

BOOKS 9,500 — REPORTS, Uncl. 44,000
PERIODICALS 467 — REPORTS, Class. ______

COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics	3	3	3	
Agriculture				
Astronomy/Astrophysics	3	3		
Atmospheric Sciences		3	3	
Behavioral/Social Science	3	3	3	
Biological/Medical Science	3		3	
Chemistry	3	3		
Earth Science/Oceanography	1	1	1	1
Electronics/Electrical Engineering	1	1	1	
Energy Conversion (non-propulsive)	3		3	
Materials	3	3	3	
Mathematical Sciences	2	2	2	
Mech., Indus., Civil & Marine Eng	1	1	1	
Methods and Equipment	3	3	3	
Military Sciences	3	3	3	3
Missile Technology	1	1	1	1
Navigation, Comm., Detection/ Countermeasures	1	1	1	1
Nuclear Science/Technology	1	1	1	
Ordnance	2	2	2	2
Physics	1	1	1	1
Propulsion/Fuels	2	2	2	
Space Technology	3	3		

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Agriculture				
Astronomy/Astrophysics	2	2	2	2
Atmospheric Sciences	2	2	2	2
Behavioral/Social Science				
Biological/Medical Science	3	3	3	3
Chemistry	2	2	2	2
Earth Science/Oceanography	2	2	2	2
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)	3	3	3	3
Materials	3	3	3	3
Mathematical Sciences	2	2	2	2
Mech., Indus., Civil & Marine Eng	2	2	2	2
Methods and Equipment				
Military Sciences				
Missile Technology	3	3	3	3
Navigation, Comm., Detection/ Countermeasures	1	1	1	1
Nuclear Science/Technology	2	2	2	2
Ordnance	3	3	3	3
Physics	1	1	1	1
Propulsion/Fuels	3	3	3	3
Space Technology	2	2	2	2

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Aeronautics	3			
Agriculture	3			
Astronomy/Astrophysics	2			
Atmospheric Sciences	2			
Behavioral/Social Science	3			
Biological/Medical Science	1			
Chemistry	1			
Earth Science/Oceanography	2			
Electronics/Electrical Engineering	3			
Energy Conversion (non-propulsive)				
Materials	3			
Mathematical Sciences	2			
Mech., Indus., Civil & Marine Eng	3			
Methods and Equipment				
Military Sciences	2			
Missile Technology	3			
Navigation, Comm., Detection/ Countermeasures	1			
Nuclear Science/Technology	1			
Ordnance				
Physics	1			
Propulsion/Fuels	3			
Space Technology	3			

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Aeronautics	1	1	1	1
Agriculture	3	3	3	3
Astronomy/Astrophysics	2	2	2	2
Atmospheric Sciences	2	2	2	2
Behavioral/Social Science	1	1	1	1
Biological/Medical Science	2	2	2	2
Chemistry	1	1	1	1
Earth Science/Oceanography	1	1	1	1
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)	1	1	1	1
Materials	1	1	1	1
Mathematical Sciences	1	1	1	1
Mech., Indus., Civil & Marine Eng	1	1	1	1
Methods and Equipment	1	1	1	1
Military Sciences	1	1	1	1
Missile Technology	1	1	1	1
Navigation, Comm., Detection/ Countermeasures	1	1	1	1
Nuclear Science/Technology	1	1	1	1
Ordnance	1	1	1	1
Physics	1	1	1	1
Propulsion/Fuels	1	1	1	1
Space Technology	1	1	1	1

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			Uncl.	Class.
Aeronautics		3		3
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science	1	1	1	
Biological/Medical Science		3	3	
Chemistry				
Earth Science/Oceanography		3		
Electronics/Electrical Engineering		3	3	
Energy Conversion (non-propulsive)				
Materials				
Mathematical Sciences	1	2	2	
Mech., Indus., Civil & Marine Eng				
Methods and Equipment			3	
Military Sciences		2		1
Missile Technology				3
Navigation, Comm., Detection/ Countermeasures		3		1
Nuclear Science/Technology		3		3
Ordnance				
Physics				
Propulsion/Fuels				
Space Technology		3		

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COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 - Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl.	Class.
Aeronautics	1	1	1	1
Agriculture				
Astronomy/Astrophysics	3	3	3	3
Atmospheric Sciences	3	3	3	3
Behavioral/Social Science	2	2	2	2
Biological/Medical Science				
Chemistry	1	1	1	1
Earth Science/Oceanography	2	2	2	2
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)				
Materials	2	2	2	2
Mathematical Sciences	1	1	1	1
Mech., Indus., Civil & Marine Eng.	2	2	2	2
Methods and Equipment				
Military Sciences	2	2	2	2
Missile Technology	1	1	1	1
Navigation, Comm., Detection/Countermeasures				1
Nuclear Science/Technology	3	3	3	3
Ordnance	1	1	1	1
Physics	1	1	1	1
Propulsion/Fuels	1	1	1	1
Space Technology	2	2	2	2

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			Uncl.	Class.
Aeronautics	2	3	3	3
Agriculture				
Astronomy/Astrophysics		3		
Atmospheric Sciences	3		3	3
Behavioral/Social Science				
Biological/Medical Science				
Chemistry	1	1	3	1
Earth Science/Oceanography	3	3	3	3
Electronics/Electrical Engineering	1	1	1	2
Energy Conversion (non-propulsive)				
Materials	2	2	2	2
Mathematical Sciences	1	2	3	
Mech., Indus., Civil & Marine Eng			3	3
Methods and Equipment			2	2
Military Sciences	2		3	3
Missile Technology	3	3	2	1
Navigation, Comm., Detection/Countermeasures	3	3	3	2
Nuclear Science/Technology	2	3	3	3
Ordnance	3	3	1	1
Physics	1	1	2	1
Propulsion/Fuels			3	2
Space Technology	3	3	3	3

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			Uncl.	Class.
Aeronautics	2	2	2	
Agriculture				
Astronomy/Astrophysics	2	3		2
Atmospheric Sciences	2	3		2
Behavioral/Social Science	3	3		
Biological/Medical Science	3	3		
Chemistry	1	1	3	1
Earth Science/Oceanography	3			3
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)	3		2	2
Materials	2	3	3	
Mathematical Sciences	1	1	1	
Mech., Indus., Civil & Marine Eng	1	1	2	2
Methods and Equipment	2		2	2
Military Sciences	3		1	1
Missile Technology	1	1	1	1
Navigation, Comm., Detection/ Countermeasures	1	2		1
Nuclear Science/Technology	2	2		2
Ordnance	2	3	2	2
Physics	1	1	1	1
Propulsion/Fuels	2		2	2
Space Technology	2	2		2

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Aeronautics	3	3		3
Agriculture	3	3		3
Astronomy/Astrophysics	3	3		3
Atmospheric Sciences	3	3		3
Behavioral/Social Science				
Biological/Medical Science	2	2		2
Chemistry				
Earth Science/Oceanography	1	1		1
Electronics/Electrical Engineering	2	2		2
Energy Conversion (non-propulsive)				
Materials				
Mathematical Sciences	2	2		2
Mech., Indus., Civil & Marine Eng				
Methods and Equipment	2	2		2
Military Sciences				
Missile Technology				
Navigation, Comm., Detection/ Countermeasures	3	3		3
Nuclear Science/Technology	3	3		3
Ordnance				
Physics	3	3		3
Propulsion/Fuels				
Space Technology	3	3		3

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			Uncl.	Class.
Aeronautics	1	1	1	1
Agriculture	3		3	3
Astronomy/Astrophysics	1	1	1	1
Atmospheric Sciences	1	1	2	2
Behavioral/Social Science	2	2	2	2
Biological/Medical Science	2	2	2	2
Chemistry	3	3	3	3
Earth Science/Oceanography	1	1	1	1
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)	3	3	3	3
Materials	2	2	2	2
Mathematical Sciences	1	1	1	1
Mech., Indus., Civil & Marine Eng	2	2	2	2
Methods and Equipment				
Military Sciences	3	3	3	3
Missile Technology	1	1	1	1
Navigation, Comm., Detection/ Countermeasures	2	2	2	2
Nuclear Science/Technology	3	3	3	3
Ordnance	3	3	3	3
Physics	1	1	1	1
Propulsion/Fuels	2	2	2	2
Space Technology	1	1	1	1

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Aeronautics				
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science				
Biological/Medical Science	2	2	2	2
Chemistry	2	2	2	2
Earth Science/Oceanography	2	2	2	2
Electronics/Electrical Engineering	2	2	2	2
Energy Conversion (non-propulsive)				
Materials	2	2	2	2
Mathematical Sciences	2	2	2	2
Mech., Indus., Civil & Marine Eng.	2	2	2	2
Methods and Equipment				
Military Sciences	2	2	2	2
Missile Technology				
Navigation, Comm., Detection/Countermeasures				
Nuclear Science/Technology	2	2	2	2
Ordnance				
Physics	2	2	2	2
Propulsion/Fuels				
Space Technology				

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			Uncl.	Class.
Aeronautics	1	1	1	1
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences	3		3	3
Behavioral/Social Science				
Biological/Medical Science				
Chemistry	3	3		
Earth Science/Oceanography	3	3	3	3
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)				
Materials	2	2	2	2
Mathematical Sciences	1	1	1	1
Mech., Indus., Civil & Marine Eng				
Methods and Equipment	2	2	2	2
Military Sciences	3	3	3	3
Missile Technology	1	1	1	1
Navigation, Comm., Detection/ Countermeasures	2	2	2	2
Nuclear Science/Technology		3		
Ordnance	3	3	3	3
Physics		2	2	
Propulsion/Fuels				
Space Technology	2	2	2	2

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			Uncl.	Class.
Aeronautics	3	3	3	3
Agriculture				
Astronomy/Astrophysics	2	2	2	2
Atmospheric Sciences	2	2	2	2
Behavioral/Social Science				
Biological/Medical Science	3	3	3	3
Chemistry	2	2	2	2
Earth Science/Oceanography	2	2	2	2
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)	3	3	3	3
Materials	1	1	1	1
Mathematical Sciences	2	2	2	2
Mech., Indus., Civil & Marine Eng.	2	2	2	2
Methods and Equipment	3	3	3	3
Military Sciences				
Missile Technology	2	2	2	2
Navigation, Comm., Detection/ Countermeasures	1	1	1	1
Nuclear Science/Technology	2	2	2	2
Ordnance				
Physics	1	1	1	1
Propulsion/Fuels	2	2	2	2
Space Technology	2	2	2	2

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			Uncl.	~~Class.~~ Data
Aeronautics				
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science				
Biological/Medical Science	3	3	3	2
Chemistry	3	3	3	2
Earth Science/Oceanography	2	2	2	1
Electronics/Electrical Engineering				
Energy Conversion (non-propulsive)				
Materials				
Mathematical Sciences				
Mech., Indus., Civil & Marine Eng.	3	3	3	2
Methods and Equipment	3	3	3	3
Military Sciences				
Missile Technology				
Navigation, Comm., Detection/ Countermeasures				
Nuclear Science/Technology				
Ordnance				
Physics	3	3	3	2
Propulsion/Fuels				
Space Technology				

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			Uncl.	Class.
Aeronautics	3	3	3	3
Agriculture	3	3	3	3
Astronomy/Astrophysics	3	3	3	3
Atmospheric Sciences	2	2	2	2
Behavioral/Social Science	3	3	3	3
Biological/Medical Science	1	1	1	1
Chemistry	1	1	1	1
Earth Science/Oceanography	3	3	3	3
Electronics/Electrical Engineering	2	2	2	2
Energy Conversion (non-propulsive)	3	3	3	3
Materials	3	3	3	3
Mathematical Sciences	2	2	2	2
Mech., Indus., Civil & Marine Eng.	3	3	3	3
Methods and Equipment	2	2	2	2
Military Sciences	1	1	1	1
Missile Technology	2	2	2	2
Navigation, Comm., Detection/Countermeasures	3	3	3	3
Nuclear Science/Technology	2	2	2	2
Ordnance	2	2	2	2
Physics	2	2	2	2
Propulsion/Fuels	3	3	3	3
Space Technology	3	3	3	3

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Aeronautics	3	3	3	3
Agriculture	3	3	3	3
Astronomy/Astrophysics				
Atmospheric Sciences	3	3	3	3
Behavioral/Social Science	3	3	3	3
Biological/Medical Science	1	1	1	1
Chemistry	1	1	1	1
Earth Science/Oceanography	3	3	3	3
Electronics/Electrical Engineering	2	2	2	2
Energy Conversion (non-propulsive)				
Materials	3	3	3	3
Mathematical Sciences	2	2	2	2
Mech., Indus., Civil & Marine Eng	3	3	3	3
Methods and Equipment	1	1	1	1
Military Sciences	1	1	1	1
Missile Technology	2	2	2	2
Navigation, Comm., Detection/ Countermeasures	1	1	1	1
Nuclear Science/Technology	1	1	1	1
Ordnance	2	2	2	2
Physics	1	1	1	1
Propulsion/Fuels	2	2	2	2
Space Technology				

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Aeronautics				
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science	3	3	3	3
Biological/Medical Science				
Chemistry	1	1	1	1
Earth Science/Oceanography				
Electronics/Electrical Engineering	1	1	1	1
Energy Conversion (non-propulsive)				
Materials	2	2	2	2
Mathematical Sciences	1	1	1	1
Mech., Indus., Civil & Marine Eng	3	3	3	3
Methods and Equipment	2	2	2	2
Military Sciences				
Missile Technology	3	3	3	3
Navigation, Comm., Detection/Countermeasures				
Nuclear Science/Technology	3	3	2	2
Ordnance	2	2	2	2
Physics	1	1	1	1
Propulsion/Fuels	2	2	2	2
Space Technology	3	3	3	3

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Aeronautics	3	3	3	
Agriculture				
Astronomy/Astrophysics				
Atmospheric Sciences				
Behavioral/Social Science				
Biological/Medical Science				
Chemistry				
Earth Science/Oceanography				
Electronics/Electrical Engineering				
Energy Conversion (non-propulsive)				
Materials	1	1	2	
Mathematical Sciences				
Mech., indus., Civil & Marine Eng	1	1	3	
Methods and Equipment	1	2	1	
Military Sciences	2	2	2	
Missile Technology	3	3	3	
Navigation, Comm., Detection/Countermeasures				
Nuclear Science/Technology				
Ordnance	3	3	3	
Physics				
Propulsion/Fuels				
Space Technology				

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COSATI SUBJECT CATEGORIES 1 - Largest Aspect 2 - Middle Aspect 3 Smallest Aspect	Books	Periodicals	Technical Reports	
			Uncl	Class
Aeronautics	3	3		3
Agriculture				
Astronomy/Astrophysics				3
Atmospheric Sciences	3	3		1*
Behavioral/Social Science	2	2		
Biological/Medical Science	3	3		3*
Chemistry	3	3		
Earth Science/Oceanography	3	3		2*
Electronics/Electrical Engineering	1	1		2*
Energy Conversion (non-propulsive)	3	3		3
Materials				2*
Mathematical Sciences	1	1		
Mech., Indus., Civil & Marine Eng	3	3		
Methods and Equipment	3	3		3*
Military Sciences	2	2		1
Missile Technology	3	3		1
Navigation, Comm., Detection/ Countermeasures				2*
Nuclear Science/Technology	1	1		1
Ordnance	2	2		3
Physics	1	1		2
Propulsion/Fuels	3	3		2
Space Technology	3	3		2

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5. AUTHORS

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13. ABSTRACT

Mechanized library functions are performed on the IBM 7094 and 1410 computers using the Approach-By-Concept (ABC) storage and retrieval system. At present, mechanization is applied only to technical reports. The four outputs are accessions lists with supplementary KWIC Index, catalog cards, the ABC Dictionary, and current-awareness notifications. These notifications are provided as a result of the Martin Company contract for analyses of current open-source publications in selected subject areas. Because of file organization problems encountered in the first-generation model of the ABC system, a second-generation model was developed which will become operational in the near future. Periodicals are presently controlled with the aid of EAM techniques with a view to computerization in the near future. The Library staff states that the program has developed smoothly, with problem areas being worked out before they became serious.

DD FORM 1473

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Security Classification

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
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5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year, or month, year. If more than one date appears on the report, use date of publication.

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8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

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(3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through ________________."

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Security Classification

Unclassified

Security Classification

DOCUMENT CONTROL DATA R&D

BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	Unclassified

Mechanization Study of the Foreign Technology Division, Wright-Patterson Air Force Base, Ohio.

Final Report of ... survey

G. A. Kershaw, D. Crowder, T. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

REPORT DATE	TOTAL NO. OF PAGES	NO. OF REFS
September, 1966	143	15

CONTRACT OR GRANT NO.	ORIGINATOR'S REPORT NUMBER(S)
DSA-7-15489	914-1.3
	OTHER REPORT NO(S): AD 489 966

AVAILABILITY LIMITATION NOTICES U.S. military agencies may obtain copies of this report directly from D. D. C. Other qualified users shall request through: T. W. Blasius, Technical Information Director (TDBT), Foreign Technology Division, AFSC, Wright-Patterson AFB, Ohio

SUPPLEMENTARY NOTES	SPONSORING MILITARY ACTIVITY
None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

ABSTRACT

Central Information Reference and Control (CIRC) is used at the Foreign Technology Division (FTD) to provide computer-controlled dissemination, production of accessions lists, selective listings, and retrospective searches of a data base of foreign technical documents and publications. CIRC is a large-scale, semi-automatic system designed and implemented through the combined efforts of FTD, the System Development Corporation, and other DoD agencies. The system is expected to provide improved service to the user; literature searches are faster and much more comprehensive than they were before.

DD FORM 1473

Unclassified

Security Classification

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computers Information Retrieval						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (corporate author) issuing the report.

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Security Classification

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R&D

BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	Unclassified

Mechanization Survey of the Army Biological Laboratories, Technical Library, Fort Detrick, Maryland

Final Report of on-site survey

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

September, 1966	117	6
DSA-7-15489	914-1-4	
	AD 640 102	

10. AVAILABILITY LIMITATION NOTICES

Distribution of this Document is unlimited

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

13. ABSTRACT

The Technical Information Division of the U.S. Army Biological Laboratories has three mechanized programs: Selective Dissemination of Information (SDI), Serials Processing System, and Retrospective Search File. The SDI Program uses magnetic tapes from the National Library of Medicine to generate monthly lists of journals and monographs that match the interest profiles of participating scientists. The Serials Processing System provides a list of the journal holdings for periodical control. The Retrospective Search File of about 8,000 document records is used for bibliographic searches, for inventory control, and to produce book catalogs and accession lists. Input to this file is confined to Fort Detrick and contractor reports. All three program systems are run on the UNIVAC SS-II computer. A new unit record, comparable to DDC's record, is planned for the Retrospective Search File. The SDI Program is expected to grow to about 350 participants, and information from Biological Abstracts and similar publications will be added to the input citation files.

DD FORM 1473

Unclassified
Security Classification

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computers Libraries Indexes Information Retrieval						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization [illegible] issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: [illegible]

3. REPORT TITLE: Enter the complete report title in all capital letters. [illegible] should be unclassified. [illegible] cannot be selected without classification, show [illegible] in all capitals in parenthesis [illegible] the title.

4. DESCRIPTIVE NOTES: [illegible]

5. AUTHOR(S): [illegible]

6. REPORT DATE: Enter the date of the report as day, [illegible] year. If more than one date appears [illegible] of publication.

7a. TOTAL NUMBER OF PAGES: [illegible] pagination procedures, [illegible] information.

7b. NUMBER OF REFERENCES: [illegible] the report.

8a. CONTRACT OR GRANT NUMBER: If appropriate, enter [illegible] of the contract or grant under which [illegible] was written.

8b, 8c, & 8d. PROJECT NUMBER: [illegible]

9a. ORIGINATOR'S REPORT NUMBER(S): [illegible]

9b. [illegible] REPORT NUMBER(S): [illegible]

10. AVAILABILITY/LIMITATION NOTICES: [illegible] other than those imposed by security classification, using standard statements such as:

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[illegible]."

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Security Classification

Best Available Copy

Security Classification

DOCUMENT CONTROL DATA - R&D

BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	Unclassified

Mechanization Study of the Technical Library, Bureau of Ships,* Navy Department, Washington, D.C.

Final Report of on-site survey

C. A. Kershaw, D. Crowder, J. F. Davis, E. C. Loges, E. Merendini, S. M. Thomas

September, 1966	267	7
DSA-7-15489	914-1-5	
	AD 640 103	

Distribution of this Document is unlimited

None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

The mechanized system used in the Technical Library at the Bureau of Ships (BUSHIPS) is called the SHips Analysis and Retrieval Project (SHARP). SHARP is a computer-oriented information storage and retrieval system developed to resolve some of the problems inherent in the handling, storage and retrieval of scientific and technical literature at the BUSHIPS Technical Library. The IBM 7090 computer was used during the development and early operational stages of the SHARP system; conversion to the Livermore Atomic Research Computer (LARC) at David Taylor Model Basin has been completed. The computer is being used to automate bibliographic searches; subject matter searches; coordinated searches; issuance of library catalog cards and accessions bulletins; control of periodicals and journals; and other aspects under development, such as complete automatic generic computer searching, automatic posting of descriptive terms by the computer in the indexing procedure, and user interest registers. Both the Library and the users appear to be satisfied with the results of the system programs that are operational.

* Bureau of Ships is now known as Ship's Systems Command.

DD FORM 1473

Unclassified
Security Classification

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computers						
Libraries						
Information Retrieval						
Bibliographies						

INSTRUCTIONS

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Security Classification

DOCUMENT CONTROL DATA - R&D

BOOZ ALLEN APPLIED RESEARCH, INC.
4733 Bethesda Avenue
Bethesda, Maryland 20014

Unclassified

Mechanization Study of the U. S. Naval Underwater Weapons Research and Engineering Station Technical Library, Newport, R. I.

Final Report of [illegible]

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

Report date	Total no. of pages	No. of refs
September, 1966	24	0

DSA-7-15489

914-1-6

AD 489 997

U. S. Military agencies may obtain copies of this report directly from D.D.C. Other qualified users shall request through: U. S. Naval Underwater Weapons Research & Engineering Station, Newport R. I. Attention: Central Staff

Supplementary notes: None

Sponsoring military activity: Defense Supply Agency, Defense Documentation Center, Cameron Station, Virginia

At present, mechanization of the Library at the Naval Underwater Ordnance Station (NUOS)* is limited to the use of a Flexowriter which prepares accessions lists and catalog cards for books and reports. Queries for information concerning NUOS's documented fields of interest are handled by the Technical Information Division which maintains a file of all NUOS reports and lists their reports by category on EAM punched cards. It is anticipated that the Library will expand rapidly in the future as the result of the Station's developing preeminence in the field of underwater ordnance research. Future plans call for the development of a computer program for the control of classified documents and for the production of a book catalog.

* The Station has recently been renamed "U. S. Naval Underwater Weapons Research and Engineering Station".

DD FORM 1473

Unclassified
Security Classification

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Libraries						
Electronic Accounting Machines						
Information Systems						

INSTRUCTIONS

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Security Classification

DOCUMENT CONTROL DATA R&D

BOOZ ALLEN APPLIED RESEARCH, INC.
4733 Bethesda Avenue
Bethesda, Maryland 20014

Unclassified

Mechanization Study of the U. S. Army Natick Laboratories Technical Library, Natick, Mass.

Final Report of on-site survey

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

September, 1966	30	0
DSA-7-15489	914-1-7	
	AD 640 104	

Distribution of this Document is unlimited

None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

The Library at the Natick Laboratories uses EAM punched card sorting techniques in circulation control and in the generation of master holdings lists of periodicals and journals, subscription renewal, binding lists, and a current titles checklist. The EAM punched cards are also being applied to a survey of title usage. A Flexowriter tape is used to produce catalog cards. Also in process is the subject indexing of the Laboratories' notebooks on EAM cards. Under the Army Technical Library Improvement Study, the Natick Library has been assigned responsibility for a pilot SDI study, matching new acquisitions against user profiles. This program will probably use the Laboratories' GE 225 computer. Future plans call for the introduction of the Southern Illinois University system of circulation. Consideration is also being given to the introduction of a computer and the IBM 870 system which will greatly diminish the Library's dependence on Natick's central computer section. Realization of these plans will depend upon the growth of the Library's responsibilities, the addition of professionals to the Library's staff, and available space within the Library for the necessary equipment.

DD FORM 1473

Unclassified

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Electronic Accounting Machines						
Libraries						
Information Systems						

INSTRUCTIONS

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13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

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Unclassified
Security Classification

DOCUMENT CONTROL DATA - R&D

1. ORIGINATING ACTIVITY: BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	2a. Unclassified
	2b.
3. REPORT TITLE: Mechanization Study of the Nondestructive Testing Information Center, Army Materials Research Agency, Watertown, Mass.	
4. DESCRIPTIVE NOTES: Final Report of on-site survey	
5. AUTHORS: G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas	
6. REPORT DATE: September, 1966	7a. TOTAL NO. OF PAGES: 20 / 7b. NO. OF REFS: 0
8a. CONTRACT OR GRANT NO.: DSA-7-15489	9a. ORIGINATOR'S REPORT NUMBER(S): 914-1-8
b. PROJECT NO.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report): AD 640 105
10. AVAILABILITY LIMITATION NOTICES: Distribution of this Document is unlimited	
11. SUPPLEMENTARY NOTES: None	12. SPONSORING MILITARY ACTIVITY: Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

13. ABSTRACT

The Nondestructive Testing Information Center uses the Termatrex system of coordinate indexing to identify and retrieve desired abstract cards and documents in their collection. The system uses visual coincidence ("peek-a-boo") term cards in which holes are drilled in specific locations to represent documents possessing a particular term. Documents identified by a group of desired terms may be retrieved by superimposing the term cards and observing the resulting coincident holes. The present set of cards is capable of handling up to 10,000 documents. Expansion beyond this capacity requires an additional deck of term cards that must be processed and searched separately. Since the Termatrex system is an economical, rapid retrieval system that fills the Center's needs, no plans have been made for the application of computer techniques.

DD FORM 1473

Unclassified
Security Classification

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Information Retrieval						
Data						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the [illegible] contractor, [illegible] grantee, Department of Defense activity or other organization [illegible] author) issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year, or month, year. If more than one date appears on the report, use date of publication.

7a. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

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8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9a. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers (either by the originator or by the sponsor), also enter this number(s).

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(3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through

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(5) "All distribution of this report is controlled. Qualified DDC users shall request through

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If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

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Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) BOOZ · ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP
3. REPORT TITLE Mechanization Study of the Mechanical Properties Data Center Traverse City, Michigan	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final Report of on-site survey	
5. AUTHOR(S) (Last name, first name, initial) G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas	
6. REPORT DATE September, 1966	7a. TOTAL NO. OF PAGES 48 / 7b. NO. OF REFS 6
8a. CONTRACT OR GRANT NO. DSA-7-15489	9a. ORIGINATOR'S REPORT NUMBER(S) 914-1-9
b. PROJECT NO. c. d.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD 489 998
10. AVAILABILITY LIMITATION NOTICES Foreign announcement and dissemination of this report is not authorized without prior approval of Air Force Material Lab (MAAM-R. F. Klinger), Wright-Patterson Air Force Base, Ohio.	
11. SUPPLEMENTARY NOTES None	12. SPONSORING MILITARY ACTIVITY Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

13. ABSTRACT

The Data Center employs the IBM 1440 in the search and retrieval of its data files. The files are maintained on EAM cards but are to be converted to disk during a search. The Center formerly utilized the IBM 101 Statistical Machine and the IBM 870 Document Writing System. The Center has data relating to more than 1/2 million material tests of metals and plastics. Use of the computer has permitted the Center to cope with the increasing demand on its services without increasing its budget by the same order of magnitude.

DD FORM 1473

Unclassified

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computers						
Data						
Analysis						
Information Retrieval						
Documentation						

INSTRUCTIONS

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Unclassified
Security Classification

DOCUMENT CONTROL DATA - R&D

1. ORIGINATING ACTIVITY: BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	2a. REPORT SECURITY CLASSIFICATION: Unclassified 2b. GROUP
3. REPORT TITLE: Mechanization Study of the Technical Information Reference Branch of the Systems Engineering Group, Wright-Patterson AFB, Ohio	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates): Final Report of on-site survey	
5. AUTHOR(S) (Last name, first name, initial): G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas	
6. REPORT DATE: September, 1966	7a. TOTAL NO. OF PAGES: 27 7b. NO. OF REFS: 4
8a. CONTRACT OR GRANT NO.: DSA-7-15489 b. PROJECT NO.	9a. ORIGINATOR'S REPORT NUMBER(S): 914-1-10 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report): AD 489 999
10. AVAILABILITY LIMITATION NOTICES: U. S. military agencies may obtain copies of this report directly from D.D.C. Other qualified users shall request through: Systems Engineering Group/SEPIR, Research & Technology Division, Wright-Patterson Air Force Base, Ohio	
11. SUPPLEMENTARY NOTES: None	12. SPONSORING MILITARY ACTIVITY: Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

13. ABSTRACT

By use of the IBM 7094-7044 computer system, the Technical Information Reference Branch of the Systems Engineering Group produces catalog cards, Selective Dissemination of Information notification cards, and a noncumulative semimonthly accessions list with a KWIC index. The computer program that produces these outputs utilizes information from document unit records entered on EAM punched cards. Since the introduction of mechanized processing, the accessions list with KWIC index has been produced on a regular semimonthly schedule with no increase in effort or manpower on the part of the Branch. Prior to mechanization, the Branch found it impossible to produce a list for distribution even on a monthly basis.

DD FORM 1473

Unclassified
Security Classification

Security Classification

KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computers						
Indexes						

INSTRUCTIONS

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2b. GROUP: [illegible]

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Security Classification

Best Available Copy

Unclassified

Security Classification

DOCUMENT CONTROL DATA R&D

BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	Unclassified

Mechanization Study of the U.S. Army Picatinny Arsenal Technical Library, Dover, New Jersey

Final Report of on-site survey

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

Report date	Total no. of pages	No. of refs
September, 1966	47	1

DSA-7-15489	914-1-11
	AD 640 106

Distribution of this Document is unlimited

Supplementary notes	Sponsoring military activity
None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

The circulation of books and technical reports (both classified and unclassified) at Picatinny Arsenal's Library is mechanized by the IBM 7090 and 1401 computers, producing seven outputs. At present, mechanized preparation of catalog cards, maintenance of catalog authorities, preparation of bibliographies and accessions lists, routing of periodicals, and control of classified reports are under development. Routing of periodicals should be operational early in 1966. An SDI system is under consideration. Work measurement and standard time data studies on the efficiency of the system indicate that the mechanized circulation system is much more efficient than the previous manual one.

DD FORM 1473

Unclassified

Security Classification

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computers						
Electronic Data Processing						
Libraries						

INSTRUCTIONS

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2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

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Security Classification

Unclassified
Security Classification

DOCUMENT CONTROL DATA R&D

BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	Unclassified

Mechanization Study of the Plastics Technical Evaluation Center, U. S. Army Picatinny Arsenal, Dover, N. J.

Final Report of on-site survey

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

September, 1966	35	0

DSA-7-15489	914-1 - 12
	AD 640 107

Distribution of this Document is unlimited

SUPPLEMENTARY NOTES	SPONSORING MILITARY ACTIVITY
None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

ABSTRACT

Under contract to the Center, Franklin Institute processes R&D reports for input to the Honeywell 140 computer. The major output is the PLASTEC Document Index; four other outputs are used for control purposes. The computer program is limited to alphabetization and arrangement functions. No machine retrieval has been attempted. The index contains document numbers which refer to a storage location at PLASTEC. Without a companion volume of citations related to these numbers (which does not exist at present), the Index is of no value to an outside reader and is therefore not distributed.

DD FORM 1473

Unclassified
Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Data Digital Computer Indexes Information Systems						

INSTRUCTIONS

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Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	Unclassified

Mechanization Study of the Defense Industrial Supply Center Technical Library, Philadelphia, Pa

Final Report of on-site survey

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

September, 1966	54	0

DSA-7-15489	914-1-13
	AD 640 108

Distribution of this Document is unlimited

None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

Mechanization at the Defense Industrial Supply Center (DISC) Technical Library consists of EAM cataloging of books, specifications and standards, engineering drawings on microfilm aperture cards, and manufacturer's catalogs. All four systems have been developed, but only the engineering drawing and book systems are operational. The output from the engineering drawing system, the Engineering Drawing Index, is printed out in four listings, each arranged with pertinent numbers in a different order. The output from the book system, the Book Index, is prepared in three volumes: an alphabetical author list, an alphabetical title list, and a Dewey Decimal classification number arranged list.

DD FORM 1473

Unclassified

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Electronic Accounting Machines						
Information Systems						
Libraries						
Photographic Recording Systems						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (corporate author) issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

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7a. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

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8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

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9b. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers (either by the originator or by the sponsor), also enter this number(s).

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Security Classification

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

1. ORIGINATING ACTIVITY: BOOZ ALLEN APPLIED RESEARCH, INC., 4733 Bethesda Avenue, Bethesda, Maryland 20014	2a. Unclassified
	2b. GROUP

3. REPORT TITLE

Mechanization Study of the Technical Library, Air Force Cambridge Research Laboratory, L. G. Hanscom Field, Mass.

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final Report of on-site survey

5. AUTHOR(S) (Last name, first name, initial)

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
September, 1966	60	5

8a. CONTRACT OR GRANT NO. DSA-7-15489	9a. ORIGINATOR'S REPORT NUMBER(S) 914-1-14
b. PROJECT NO.	
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD 640 109
d.	

10. AVAILABILITY/LIMITATION NOTICES

Distribution of this Document is unlimited

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
None	Defense Supply Agency, Defense Documentation Center, Cameron Station, Virginia

13. ABSTRACT

The Technical Library has developed a unique semimechanized process for the production of catalog cards, charge cards, card pockets, and accessions lists, and a machine-readable punched paper tape record for a future computer-produced book catalog. This system was originally based on a special purpose digital processor, called the Crossfiler, which multiplies catalog card records, inputed on punched paper tape and supplies entry headings for each of the copies. Actual printing is done on a Flexowriter. The Library recently began employing the PDP-1 computer to perform this task and has phased out the Crossfiler. A periodical control system is being developed utilizing the Laboratory's IBM 7044 computer. The library plans to convert its paper tape records to magnetic tape for computer production of a book catalog and computer-run retrospective searches.

DD FORM 1473

Security Classification

KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computer						
Digital Systems						
Information Systems						
Libraries						

INSTRUCTIONS

[illegible] ACTIVITY: Enter the name and address [illegible] contractor, grantee, Department of De- [illegible] corporate author) issuing [illegible]

[illegible] CLASSIFICATION: Enter the over [illegible] of the report. Indicate whether [illegible] is included. Marking is to be in accord [illegible] regulations.

[illegible] downgrading is specified in DoD Di[illegible] Armed Forces Industrial Manual. Enter [illegible] that optional [illegible] Group 4 as author[illegible]

[illegible] Enter the complete report title in all [illegible] in all cases should be unclassified. [illegible] be selected without classifica- [illegible] in all capitals in parenthesis [illegible] the title.

[illegible] If appropriate, enter the type of [illegible] progress, summary, annual, or final. [illegible] the reporting period is [illegible]

[illegible] name(s) of author(s) as shown on [illegible] last name, first name, middle initial. [illegible] branch of service. The name of [illegible] an absolute minimum requirement.

[illegible] DATE: Enter the date of the report as day, [illegible] year. If more than one date appears [illegible] of publication.

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Unclassified

Security Classification

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	2b. GROUP

3. REPORT TITLE

Mechanization Study of the Library, U.S. Naval Postgraduate School, Monterey, California

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final Report of on-site survey

5. AUTHOR(S) (Last name, first name, initial)

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
September, 1966	36	2

8a. CONTRACT OR GRANT NO. DSA-7-15489	9a. ORIGINATOR'S REPORT NUMBER(S) 914-1-15
b. PROJECT NO.	
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD 640 110
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10. AVAILABILITY/LIMITATION NOTICES

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

13. ABSTRACT

A mechanized system is used by the Naval Postgraduate School Library for bibliographic control of its technical documents collection. Descriptive and subject cataloging information is stored on magnetic tape, and literature searches are made. The program used, called SABIR2, is written in assembly language for the CDC 1604 computer. Automatic data processing equipment is also used to produce title and subject lists of the Library's holdings of periodicals. The Library is satisfied with the mechanized system with regard to retrieval relevancy, recall, and usefulness of the end product.

Security Classification

KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computers						
Electronic Accounting Machines						
Information Retrieval						
Libraries						

INSTRUCTIONS

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Security Classification

Unclassified

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DOCUMENT CONTROL DATA - R&D

BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	Unclassified

Mechanization Study of the Technical Library, U.S. Naval Missile Center, Point Mugu, California

Final Report of on-site survey

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

6. REPORT DATE		
September, 1966	30	0

DSA-7-15489	914-1-16
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10. AVAILABILITY LIMITATION NOTICES

Distribution of this Document is unlimited

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

13. ABSTRACT

The Naval Missile Center Library uses the IBM 7094 and IBM 1401 to produce a cumulative monthly and annual catalog of the technical document collection. This catalog is printed out in two parts: source and subject. The mechanized system used at the Center is the Technical Library Program Series. A mechanized system for circulation control will be introduced in the near future. If demands on the Library intensify, the computer will be used for literature searches in the document collection. This could be initiated easily, as the subject descriptors for each document are already on the tapes. Efficiency of the Documents Branch is considerably enhanced by the system because the catalog is produced very quickly after the monthly input is completed.

DD FORM 1473

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computers						
Libraries						
Catalogs						

INSTRUCTIONS

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Security Classification

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	2b. GROUP

3. REPORT TITLE

Mechanization Study of the Technical Library, U.S. Naval Ship Missile Systems Engineering Station, Port Hueneme, California

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final Report of on-site survey

5. AUTHOR(S) (Last name, first name, initial)

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6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
September, 1966	41	0

8a. CONTRACT OR GRANT NO. DSA-7-15489	9a. ORIGINATOR'S REPORT NUMBER(S) 914-1-17
b. PROJECT NO.	
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD 640 112
d.	

10. AVAILABILITY LIMITATION NOTICES

Distribution of this Document is unlimited

11. SUPPLEMENTARY NOTES: None	12. SPONSORING MILITARY ACTIVITY: Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

13. ABSTRACT

The Technical Library at the U.S. Naval Ship Missiles Systems Engineering Station (NSMSES) employs data processing equipment in the indexing of all materials regardless of subject or format. The indexes are printed out in book form by computer. A statistical inventory of the collection is maintained automatically, and inventory of a collection of microfilm cards is also maintained by computer. IBM 705 and 1401 computers are employed in the mechanized system. Although the costs of file conversion to the system were high, the large volume of data being processed appears, in the Library's opinion, to justify the use of computers.

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Libraries						
Digital Computers						
Indexes						
Information Systems						

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Unclassified

Security Classification

DOCUMENT CONTROL DATA R&D

BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	Unclassified

Mechanization Study of the DMIC, BDIC, RACIC and REIC Information Centers of the Battelle Memorial Institute, Columbus, Ohio.

Final Report of on-site survey

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

September, 1966	47	4
DSA-7-15489	914-1-18	
	AD 640 113	

Distribution of this Document is unlimited

None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

Four of the information centers operated by the Battelle Memorial Institute were included in the library mechanization study. The CDC 3400 computer is used for any mechanization although this was not extensive at the time of the survey. A Flexowriter is used by BDIC to produce a monthly list of documents for security classification downgrading and by REIC to produce a monthly accessions list with abstracts and coordinate index, and a semiannual compilation of government-sponsored contracts relative to radiation-effects research. RACIC uses Flexowriter edge-punched cards to produce a security log of secret cards in the file. DMIC uses a Termatrex coordinate index system to store and retrieve references to government-sponsored contracts of interest to the Center. REIC uses a mechanized process to punch EAM cards which are used to produce a listing of clue words and a listing of reports with accession numbers. REIC has also initiated the development of a thesaurus. RACIC has mechanized its listing of clue words and is experimenting with a computer program to produce a clue-word coordinate index from a file of EAM punched cards. All four centers consider that their manually produced and searched files of extracts are preferable to a computerized system. However, they feel that additional mechanization of their printed outputs would be desirable as a time-saving feature wherever it would prove economical.

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Information Retrieval						
Digital Computers						
Indexes						
Dictionary						
Electronic Accounting Machines						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (corporate author) issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year; or month, year. If more than one date appears on the report, use date of publication.

7a. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

8a. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9a. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers (either by the originator or by the sponsor), also enter this number(s).

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Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	Unclassified
Mechanization Study of the Air Force Institute of Technology Library, Wright-Patterson AFB, Ohio.	
Final Report of on-site survey	
G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas	

6 REPORT DATE	7a TOTAL NO. OF PAGES	7b NO. OF REFS
September, 1966	24	0

8a CONTRACT OR GRANT NO.	9a ORIGINATOR'S REPORT NUMBER(S)
DSA-7-15489	914-1-19
b PROJECT NO.	9b OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
	AD 640 114

10 AVAILABILITY/LIMITATION NOTICES

Distribution of this Document is unlimited

11 SUPPLEMENTARY NOTES	12 SPONSORING MILITARY ACTIVITY
None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

13 ABSTRACT

The Air Force Institute of Technology(AFIT) Library uses an IBM 1401 computer to produce a list of journal holdings, alphabetically arranged and provided with an abbreviation glossary. At present, one list has been produced and circulated. Input to the system is EAM cards with journal data. Because of difficulties in obtaining use of the computer--which is not owned by the Library--within a reasonable time, the Library has decided to abandon computer mechanization and to use instead Library-owned Flexowriter equipments interfaced with supplemental EAM card punch, sorter, and reader.

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Electronic Accounting Machines						
Libraries						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization [illegible] issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: [illegible] is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. [illegible]

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

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7a. TOTAL NUMBER OF PAGES: The total page count should [illegible] pagination procedures, i.e., enter the number of pages containing information.

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[illegible]"

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[illegible]"

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[illegible]"

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11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring (paying for) the research and development. Include address.

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Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

1. ORIGINATING ACTIVITY: BOOZ · ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	2a. Unclassified
3. REPORT TITLE: Mechanization Study of the Recon Central Reconnaissance Division, Air Force Avionics Lab., Wright-Pat. AFB, Ohio	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates): Final Report of on-site survey	
5. AUTHORS (Last name, first name, initial): G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas	
6. REPORT DATE: September, 1966	7a. TOTAL NO. OF PAGES: 37 / 7b. NO. OF REFS: 3
8a. CONTRACT OR GRANT NO: DSA-7-15489	9a. ORIGINATOR'S REPORT NUMBER(S): 914-1-20
b. PROJECT NO	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report): AD 640 115
10. AVAILABILITY LIMITATION NOTICES: Distribution of this Document is unlimited	
11. SUPPLEMENTARY NOTES: None	12. SPONSORING MILITARY ACTIVITY: Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

13. ABSTRACT

Information storage and retrieval functions at the Recon Central are partially mechanized by a system composed of "peek-a-boo" coordinate index cards, a Flexowriter automatic typewriter with an EAM punched card reader input and an automatic "peek-a-boo" card reader, and various types of copying devices. The stored information is primarily in document abstract form on microfilm chips that are on unpunched aperture cards. The system produces for a search requester lists of retrieved abstract accession numbers with corresponding document titles, and, if desired, enlarged copies of the selected microfilm chips. Recon Central estimates that cost investment in this semiautomated system is about one-tenth that of a fully computerized system giving the same performance in their application.

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Data						
Documentation						
Electronic Accounting Machines						
Information Retrieval						

INSTRUCTIONS

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2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

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4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year, or month, year. If more than one date appears on the report, use date of publication.

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8a. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9a. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

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Security Classification

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R&D

1. ORIGINATING ACTIVITY: BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	2a. Unclassified
3. REPORT TITLE: Mechanization Study of the Reliability Central, Rome Air Development Center, Griffiss Air Force Base, New York	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates): Final Report of on-site survey	
5. AUTHOR(S) (Last name, first name, initial): G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas	
6. REPORT DATE: September, 1966	7a. TOTAL NO. OF PAGES: 35 / 7b. NO. OF REFS: 4
8a. CONTRACT OR GRANT NO.: DSA-7-15489 b. PROJECT NO. c. d.	9a. ORIGINATOR'S REPORT NUMBER(S): 914-1-21 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report): AD 640 116
10. AVAILABILITY/LIMITATION NOTICES: Distribution of this Document is unlimited	
11. SUPPLEMENTARY NOTES: None	12. SPONSORING MILITARY ACTIVITY: Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

13. ABSTRACT Computer mechanization of the Reliability Central (RC) at Rome Air Development Center (RADC) is currently being designed and partially implemented, by contractors. RC will be an information center but will not ordinarily distribute source documents. It will retain hard copy from which raw data on electronic parts have been obtained, and it will maintain the raw data in computer files and will manipulate and interpret these data to produce handbooks in various summary forms to be widely distributed throughout the scientific community. It will also entertain queries for information obtainable from the data base but not found in the handbooks. The program will be operated on the RC computer complex following the test operation planned for March 1967.

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computers						
Data						
Analysis						
Information Retrieval						

INSTRUCTIONS

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Security Classification

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

1. ORIGINATING ACTIVITY (Corporate author)

BOOZ ALLEN APPLIED RESEARCH, INC.
4733 Bethesda Avenue
Bethesda, Maryland 20014

2a. REPORT SECURITY CLASSIFICATION: Unclassified

2b. GROUP

3. REPORT TITLE

Mechanization Study of the U.S. Navy Marine Engineering Laboratory Library, Annapolis, Maryland

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final Report of on-site survey

5. AUTHOR(S) (Last name, first name, initial)

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
September, 1966	22	0

8a. CONTRACT OR GRANT NO.

DSA-7-15489

b. PROJECT NO.

c.

d.

9a. ORIGINATOR'S REPORT NUMBER(S)

914-1-22

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

AD 640 117

10. AVAILABILITY LIMITATION NOTICES

Distribution of this Document is unlimited

11. SUPPLEMENTARY NOTES

None

12. SPONSORING MILITARY ACTIVITY

Defense Supply Agency
Defense Documentation Center
Cameron Station, Virginia

13. ABSTRACT

Computer mechanization at the U.S. Navy Marine Engineering Laboratory (MEL) Library presently consists of production of a journal listing on an IBM 1401 computer from punched cards. When the computer file of information on reports is expanded, it will be the data base for bibliographic searches and retrieval of information. This data base will be maintained and processed by the Information Storage Package, a series of computer programs developed by the Applied Physics Laboratory of Johns Hopkins University. The MEL Library feels that, while the Information Storage Package is useful, a universally accepted information system would be more beneficial for all aspects of library mechanization; with such a system, centralized cataloging might become feasible.

Security Classification

KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computers						
Information Systems						
Libraries						

INSTRUCTIONS

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Best Available Copy

Security Classification

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

1. ORIGINATING ACTIVITY: BOOZ · ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	2a. REPORT SECURITY CLASSIFICATION: Unclassified 2b. GROUP
3. REPORT TITLE: Mechanization Study of the Defense Logistics Studies Information Exchange, Fort Lee, Virginia	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates): Final Report of on-site survey	
5. AUTHOR(S) (Last name, first name, initial): G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas	
6. REPORT DATE: September, 1966	7a. TOTAL NO. OF PAGES: 39 / 7b. NO. OF REFS: 0
8a. CONTRACT OR GRANT NO.: DSA-7-15489 b. PROJECT NO. c. d.	9a. ORIGINATOR'S REPORT NUMBER(S): 914-1-23 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report): AD 640 118
10. AVAILABILITY LIMITATION NOTICES: Distribution of this Document is unlimited	
11. SUPPLEMENTARY NOTES: None	12. SPONSORING MILITARY ACTIVITY: Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

13. ABSTRACT

An RCA 501 computer is used by the Defense Logistics Studies Information Exchange to produce a thesaurus, demand bibliographies, code listings, and the Annual Department of Defense Bibliography of Logistics Studies and Related Documents. A card catalog file is maintained but will probably be discarded within 5 to 10 years. The Exchange has applied for status as a DoD Information Analysis Center; it has also been assigned an additional mission of maintaining a DoD Inventory of Technical Data and Related Efforts. Development of the thesaurus will continue, and the Annual Bibliographies and Quarterly Supplements will be printed by GPO from data on magnetic tape as soon as equipment becomes available at GPO. A survey conducted in 1963 indicated that patrons were satisfied with the services provided by the Exchange.

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computers						
Information Retrieval						
Bibliographies						
Data						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (*corporate author*) issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year, or month, year. If more than one date appears on the report, use date of publication.

7a. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

8a. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9a. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers (*either by the originator or by the sponsor*), also enter this number(s).

10. AVAILABILITY LIMITATION NOTICES: Enter any limitations on further dissemination of the report, other than those imposed by security classification, using standard statements such as:

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(2) "Foreign announcement and dissemination of this report by DDC is not authorized."

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If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring (*paying for*) the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as (TS), (S), (C), or (U).

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Security Classification

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	Unclassified

Mechanization Study of the Technical Library, U.S. Naval Weapons Laboratory, Dahlgren, Virginia

Final Report of on-site survey

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

Report Date	Total No. of Pages	No. of Refs
September, 1966	66	0

Contract or Grant No.	Originator's Report Number
DSA-7-15489	914-1-24
	Other Report No(s): AD 640 119

Distribution of this Document is unlimited

Supplementary Notes	Sponsoring Military Activity
None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

The Naval Weapons Laboratory (NWL) Technical Library is redeveloping a mechanized system that uses the IBM 7090 and 1401 computers for the IBM 870 Document Writing System and the IBM 7030 computer (STRETCH). Mechanized processes in the IBM 7090 System provide for the establishment and maintenance of a master file for reports and the search of this file to satisfy requests from Library users. The 870, 7030 System is expected to increase the timeliness of accession bulletins and catalog cards, increase the efficiency of Library procedures (Descriptive cataloging, Typing, and keypunch are combined into one step), and give the Library more control over procedures(e.g., punched cards instead of worksheets will be sent to computer operations, and generation of accessions bulletins and catalog cards will no longer involve computer operations).

Security Classification

KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Automation						
Digital Computers						
Electronic Accounting Machines						
Libraries						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the [illegible] Department of Defense [illegible] the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: [illegible] is specified in DoD Directive [illegible] Armed Forces Industrial Manual. Enter the group number. [illegible]

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. [illegible] cannot be selected without classification, [illegible] in all capitals in parenthesis [illegible] the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., [illegible] summary, annual, or final. [illegible] reporting period is [illegible]

5. AUTHOR(S): Enter the name(s) of author(s) as shown on [illegible] the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year, or month, year. If more than one date appears on the report, use date of publication.

7a. TOTAL NUMBER OF PAGES: The total page count [illegible] pagination procedures, i.e., enter the number of pages containing information.

7b. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

8a. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9a. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers (either by the originator or by the sponsor), also enter this number(s).

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(5) "All distribution of this report is controlled. Qualified DDC users shall request through

___________."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring (paying for) the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as (TS), (S), (C), or (U).

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Unclassified

Security Classification

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	Unclassified
Mechanization Study of the Reference Library, Johns Hopkins University Applied Physics Laboratory.	
Final Report of on-site survey	
G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas	
September, 1966	116 / 7
DSA-7-15489	914-1-25
	AD 640 120
Distribution of this Document is unlimited	
None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

The Applied Physics Laboratory (APL) Reference Library uses IBM 7094 and 7040 computers to produce a quarterly list of serials holdings and a quarterly union list of serials, including APL's holdings and those of other participating libraries. The APL Document Library uses these computers to produce an accession list, selective bibliographies in accordance with its SDI program, and reference or demand bibliographies as a result of search requests. The repertoire of programs used has been designated the Information Processing System.

Security Classification

KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computers						
Information Retrieval						
Bibliographies						
Libraries						
Research and Development						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization [illegible] the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: [illegible] Armed Forces Industrial Manual. Enter [illegible] Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. [illegible] in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. [illegible] reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

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12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring (paying for) the research and development. Include address.

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Security Classification

Best Available Copy

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

1. ORIGINATING ACTIVITY: BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	2a. REPORT SECURITY CLASSIFICATION: Unclassified 2b. GROUP

3. REPORT TITLE

Mechanization Study of the Technical Library, U.S. Army Map Service, Washington, D. C. 20315

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final Rep[illegible] of on-site survey

5. AUTHOR(S) (Last name, first name, initial)

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
September, 1966	66	0

8a. CONTRACT OR GRANT NO. DSA-7-15489	9a. ORIGINATOR'S REPORT NUMBER(S) 914-1-26
b. PROJECT NO. c d	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD 640 121

10. AVAILABILITY LIMITATION NOTICES

Distribution of this Document is unlimited

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

13. ABSTRACT

The Army Map Service (AMS) Library uses a Univac 1004 computer to produce map accessions lists and bibliographies from punched cards containing printed text. Also data on a Map Reproduction (Repromat) File are punched onto cards and transferred to magnetic tape on a Honeywell H-800 computer. This tape is used to produce a high-speed printout of the Repromat Tabulation semiannually and a monthly listing to update the semiannual tabulation. It is felt that the mechanized Repromat File system should be modified in a number of ways for greater efficiency.

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Information Retrieval						
Digital Computers						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (corporate author) issuing the report.

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2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

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4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

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Security Classification

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

1. ORIGINATING ACTIVITY: BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	2a. REPORT SECURITY CLASSIFICATION: Unclassified
	2b. GROUP:

3. REPORT TITLE

Mechanization Study of the Technical Library, Naval Ordnance Laboratory, White Oak, Maryland

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final Report of on-site survey

5. AUTHOR(S) (Last name, first name, initial)

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
September, 1966	117	5

8a. CONTRACT OR GRANT NO. DSA-7-15489	9a. ORIGINATOR'S REPORT NUMBER(S): 914-1-27
b. PROJECT NO.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report): AD 640 122

10. AVAILABILITY/LIMITATION NOTICES

Distribution of this Document is unlimited

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

13. ABSTRACT

The Library at the Naval Ordnance Laboratory (NOL) uses the IBM 7090 computer for information storage and retrieval of its technical reports collection. All technical reports are eventually entered on microfilm, with the present collection totaling about 150,000. However, only documents received from 1958 to the present are available for computer searches. Plans call for an annual listing by EAM techniques. of periodicals received at NOL. During fiscal 1966, punched card preparation will be completed. In addition, NOL and the Applied Physics Laboratory at Johns Hopkins are considering the possibility of cooperatively producing an annual listing of periodicals available in technical libraries in the Washington Maryland area. There is also a study being conducted at present to determine the feasibility of a printed book catalog. The computer program has provided more exhaustive searches and more detailed subject analysis of reports and has eliminated the time lag in processing subject information.

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computer						
Electronic Accounting Machines						
Information Retrieval						
Libraries						

INSTRUCTIONS

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7b. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

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12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring (paying for) the research and development. Include address.

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It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as (TS), (S), (C), or (U).

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Security Classification

Best Available Copy

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R&D

1. ORIGINATING ACTIVITY: BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	2a. Unclassified
3. REPORT TITLE: Mechanization Study of the Technical Library, U. S. Army Edgewood Arsenal, Edgewood, Maryland	
4. DESCRIPTIVE NOTES: Final Report of on-site survey	
5. AUTHORS: G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas	
6. REPORT DATE: September, 1966	7a. TOTAL NO. OF PAGES: 39 / 7b. NO. OF REFS: 1
8a. CONTRACT OR GRANT NO.: DSA-7-15489	9a. ORIGINATOR'S REPORT NUMBER(S): 914-1-28
b. PROJECT NO.	9b. OTHER REPORT NO(S): AD 640 123
10. AVAILABILITY LIMITATION NOTICES: Distribution of this Document is unlimited	
11. SUPPLEMENTARY NOTES: None	12. SPONSORING MILITARY ACTIVITY: Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

13. ABSTRACT

The Edgewood Arsenal Technical Library uses a retrieval system designed and developed for the Library by a contractor. The contractor indexes and processes documents on punched cards, and tapes generated on the Contractor's IBM 1401 are converted to Honeywell 200/400 tapes for use on EA's Honeywell computer by National Institutes of Health and Army Map Service. Search outputs enable the user to obtain desired items from the Library by use of the pertinent call numbers. The addition of an alphabetic printout capability of the existing system is now in the operational testing stage. The hopes of the designers of the system to provide half-day response to user questions have thus far been frustrated by several factors, including the high cost of operating the system and its low speed.

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Digital Computers						
Information Retrieval						

INSTRUCTIONS

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Security Classification

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R&D

1. Originating activity: BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	2a. Unclassified
3. Report title: Mechanization Study of the Aerospace Materials Information Center (Including the Ceramics & Graphites Technical Info Center), Wright-Patterson Air Force Base, Ohio	
4. Descriptive notes: Final Report of on-site survey	
5. Authors: G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas	
6. Report date: September, 1966	7a. Total no. of pages: 55 — 7b. No. of refs: 2
8a. Contract or grant no.: DSA-7-15489	9a. Originator's report number(s): 914-1-29
b. Project no.	9b. Other report no(s): AD 640 124
10. Availability/limitation notices: Distribution of this Document is unlimited	
11. Supplementary notes: None	12. Sponsoring military activity: Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

13. Abstract

By use of the IBM 7094, the Materials Laboratory performs searches and produces the KWIC index section of the "Materials Information Bulletin." Under contract to the Materials Laboratory, thesaurus maintenance, keyword index printing, and data-base updating are performed on the NCR 304 computer at the University of Dayton. The use of deep indexing with links and roles formed the basis of the system; after evaluating the value of links and roles, however, roles were eliminated. A Miracode system just recently purchased will be used to store Materials Laboratory information. Several studies covering specific areas of this system have been conducted. Currently, the Center is sending questionnaires to certain groups after running searches for them to determine the value of each search.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Digital Computers						
Indexes						
Information Retrieval						
Data						
Analysis						

INSTRUCTIONS

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Unclassified

Security Classification

DOCUMENT CONTROL DATA R&D

BOOZ ALLEN APPLIED RESEARCH, INC. Unclassified
4733 Bethesda Avenue
Bethesda, Maryland 20014

Mechanization Study of the Army Study Documentation and Information Retrieval System, U.S. Army Library, Washington, D. C.

Final Report of on-site survey

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

6 REPORT DATE: September, 1966 | 29 | 1

8a CONTRACT OR GRANT NO: DSA-7-15489

9a ORIGINATOR'S REPORT NUMBER: 914-1-30

9b OTHER REPORT NO: AD 640 125

10 AVAILABILITY/LIMITATION NOTICES

Distribution of this Document is unlimited

11 SUPPLEMENTARY NOTES: None

12 SPONSORING MILITARY ACTIVITY:
Defense Supply Agency
Defense Documentation Center
Cameron Station, Virginia

13 ABSTRACT

The objectives of the Army Study Documentation and Information Retrieval System(ASDIRS) are to provide a central library of Army studies readily accessible in the Pentagon. At the present time, a bibliographic quarterly catalog of Army studies and a permuted descriptor/title index are provided. The catalog of Army studies is produced using an IBM 1401 computer, and the permuted descriptor title index to the catalog is produced using an IBM 7090 computer. The central library of Army studies will provide a reference card file and the Termatrex retrieval system for easy subject access to the collection. The bibliographic catalog is distributed Army-wide and has been favorably received.

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computer						
Information Retrieval						
Libraries						
Documentation						

INSTRUCTIONS

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Unclassified

Security Classification

DOCUMENT CONTROL DATA R&D

BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	Unclassified
Mechanization Study of the Technical Library, U.S. Naval Avionics Facility, Indianapolis, Indiana	
Final Report of on-site survey	
G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas	
September, 1966	40 / 0
DSA-7-15489	914-1-31
	AD 640 126
Distribution of this Document is unlimited	
None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

The Naval Avionics Facility, Indianapolis (NAFI) Technical Library is planning a mechanized system to produce a permuted index of pertinent periodical references and proceedings, with books and documents to be added later. Input to the system is punched paper tape prepared from the source material, and the primary program is a "canned" General Electric permuted index program for NAFI's GE 225 computer. NAFI's Burroughs 280 computer is used to obtain special listings of EAM card information. The Library feels that the permuted index system is a relatively simple and inexpensive way to mechanize Library files.

Security Classification

KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Digital Computers						
Electronic Accounting Machines						
Electronic Equipment						
Indexes						
Information Systems						
Libraries						

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Security Classification

Unclassified

Security Classification

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BOOZ ALLEN APPLIED RESEARCH, INC.
4733 Bethesda Avenue
Bethesda, Maryland 20014

Unclassified

Mechanization Study of the U.S. Naval Ordnance Test Station Library, China Lake, California

Final Report of on-site survey

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

September, 1966	41	4

DSA-7-15489

914-1-32

AD 489 995

Foreign announcement and dissemination of this report is not authorized without prior approval of the U. S. Naval Ordnance Test Station China Lake, California

SUPPLEMENTARY NOTES: None

SPONSORING MILITARY ACTIVITY: Defense Supply Agency, Defense Documentation Center, Cameron Station, Virginia

ABSTRACT

The Naval Ordnance Test Station Library uses the IBM 7094 in the handling of its document collection to produce catalog cards, bibliographies, accessions lists, and coordinate index cards. Bibliographic data on Flexowriter tape punched by the Library staff and converted to punched cards by the IBM 047 tape-to-card converter serves as the major input to the system. Descriptors are keypunched directly onto cards. Inclusion of abstracts and annotations on the contents of reports is planned. Eventually certain specific terms will be posted automatically to more general terms. In addition, efforts are being made to control the vocabulary and structure it under large subject areas. All programs may be written in FORTRAN IV for possible use with other computer systems. Although the mechanized searching is useful for some questions, the Library staff states that manual searches of the computer prepared coordinate index cards and browsing through the card catalog are still more effective in a large portion (75%) of the work.

DD FORM 1473

Unclassified

Security Classification

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computers						
Electronic Accounting Machines						
Information Retrieval						
Libraries						

INSTRUCTIONS

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Security Classification

Unclassified
Security Classification

DOCUMENT CONTROL DATA R&D

BOOZ ALLEN APPLIED RESEARCH, INC.
4733 Bethesda Avenue
Bethesda, Maryland 20014

Unclassified

Mechanization Study of the Thermophysical Properties Research Center, Purdue University

Final Report of on-site survey

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

6. REPORT DATE September, 1966	33	5
DSA-7-15489	914-1-33	
	AD 640 127	

10. AVAILABILITY LIMITATION NOTICES

Distribution of this Document is unlimited

11. SUPPLEMENTARY NOTES
None

12. SPONSORING MILITARY ACTIVITY
Defense Supply Agency
Defense Documentation Center
Cameron Station, Virginia

13. ABSTRACT

The data files at the Thermophysical Properties Research Center (TPRC) are stored on magnetic tape and are used for mechanized retrospective searches and to produce the original copy for the Center's "Retrieval Guide to Thermophysical Properties Research Literature" publication. In the near future, the Center will be connected directly to Purdue's computer center via a UHF radio circuit. Partly because of the relatively frequent changes in computer equipment, the Center has limited its use of mechanized processes. The Director believes that at present his staff can perform most searches faster by manual reference than by machine.

Security Classification

KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computers Experimental Data Information Retrieval						

INSTRUCTIONS

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Security Classification

Unclassified
Security Classification

DOCUMENT CONTROL DATA R&D

BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014	Unclassified

Mechanization Study of the Electronic Properties Information Center, Hughes Aircraft Company, Culver City, California

Final Report of on-site survey

G. A. Kershaw, D. Crowder, J. E. Davis, E. C. Loges, E. Merendini, S. M. Thomas

September, 1966	51	0
DSA-7-15489	914-1-34	
	AD 640 128	

Distribution of this Document is unlimited

Supplementary Notes	Sponsoring Military Activity
None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

The Electronic Properties Information Center (EPIC) at Hughes Aircraft Company utilizes mechanized processes for storage and retrieval of information. Outputs of the mechanized system, which is designed for the Honeywell 200 computer, are a printed file of materials with related properties, an accessions list, and a search printout of retrieved bibliographic citations with abstracts. A new system being developed for EPIC's mechanized activities is being designed for the General Electric 635 computer; this is part of a generalized information retrieval system being developed for several related activities at Hughes. EPIC is very satisfied with the results of its mechanization programs.

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computers						
Data						
Information Retrieval						
Subject Analysis						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (corporate author) issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

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8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

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Unclassified

DOCUMENT CONTROL DATA - R&D

BOOZ ALLEN APPLIED RESEARCH, INC.
4733 Bethesda Avenue
Bethesda, Maryland 20014

Unclassified

Mechanization Study of the Redstone Scientific Information Center, Redstone Arsenal, Alabama

Final Report of on-site survey

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

September 1966	58	2

DSA-7-15489

914-1-35

AD 640 129

Distribution of this Document is unlimited

None

Defense Supply Agency
Defense Documentation Center
Cameron Station, Virginia

The Redstone Scientific Information Center (RSIC) is engaged in a major effort to mechanize its Library operations using IBM 7010, 1460, and 1401 computers. The total integrated effort is known as ALPHA (Automated Literature Processing, Handling and Analysis System), which is a serial system operating on a batched transaction basis. The system is in first-generation stage of development. Mechanization of RSIC is being developed under contract by General Electric. At present, the mechanized routines for the acquisition and circulation of books, periodical control, and the Patron File are fully operational. RSIC also receives NASA tapes and utilizes them in literature searches. In addition, NASA headquarters is sponsoring an information automation project in which RSIC is participating. This is a prototype test of the current selective dissemination of information based on IBM's SDI programs. Several programs are being planned or developed for mechanization in addition to the above.

DD FORM 1473

Unclassified

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computers						
Libraries						
Information Retrieval						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (corporate author) issuing the report.

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2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

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8a. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

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Security Classification

Unclassified

DOCUMENT CONTROL DATA - R&D

BOOZ ALLEN APPLIED RESEARCH, INC.
4733 Bethesda Avenue
Bethesda, Maryland 20014

Unclassified

Mechanization Study of the VESIAC, BAMIRAC and IRIA Information Centers, University of Michigan

Final Report of on-site survey

G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loyes, E. Merendini, S. M. Thomas

September, 1966	103	2
DSA-7-15489	914-1-36	
	AD 640 130	

Distribution of this Document is unlimited

None	Defense Supply Agency Defense Documentation Center Cameron Station, Virginia

Three information and analysis centers of the Institute of Science and Technology, University of Michigan, utilize the computer and EAM facilities of the Institute's Computation Department for retrieval of bibliographic references based upon the Computation Department's generalized retrieval system. The three centers are Infrared Information Analysis Center (IRIA), VELA Seismic Information Analysis Center (VESIAC), and Ballistic Missile Radiation Analysis Center (BAMIRAC). IRIA utilizes the mechanized retrieval program, which uses an IBM 1401 computer, to produce two listings. VESIAC is in the pilot stage of producing demand bibliographies using the mechanized information retrieval program. BAMIRAC utilizes an optional arrangement of manual, EAM, and mechanized techniques to provide demand bibliographies including abstracts. The development of a generalized retrieval program for all three centers has eliminated the need for the more costly process of maintaining a specialized program for each center. Because of center similarities, this general program fits each center's requirements without significant difficulty.

DD FORM 1473

Unclassified

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computers						
Data						
Analysis						
Electronic Accounting Machines						
Information Retrieval						

INSTRUCTIONS

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Security Classification

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

1. ORIGINATING ACTIVITY: BOOZ ALLEN APPLIED RESEARCH, INC.
4733 Bethesda Avenue
Bethesda, Maryland 20014

2a. REPORT SECURITY CLASSIFICATION: Unclassified

3. REPORT TITLE: Study of Mechanization in DoD Libraries and Information Centers

4. DESCRIPTIVE NOTES (Type of report and inclusive dates): Final Report of on-site survey

5. AUTHOR(S) (Last name, first name, initial): G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
September, 1966	304	167

8a. CONTRACT OR GRANT NO.: DSA-7-15489

b. PROJECT NO.

c.

d.

9a. ORIGINATOR'S REPORT NUMBER(S): 914-1-1

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report): AD 640 100

10. AVAILABILITY/LIMITATION NOTICES: Distribution of this Document is unlimited

11. SUPPLEMENTARY NOTES: None

12. SPONSORING MILITARY ACTIVITY: Defense Supply Agency
Defense Documentation Center
Cameron Station, Virginia

13. ABSTRACT

This report summarizes the on-site study of mechanization in DoD libraries and information centers. Included are presentations and evaluations on thesaurus building, file structure, input processing, serial control, selective dissemination of information, circulation control, equipments being used, recommendations on information retrieval systems, observations on organization, operation and application, and summaries on mechanization status, scope and size of collections, and COSATI subject area breakdowns. 76 facilities were visited; individual reports were generated for 35. Abstracts for the 35 reports and their DDC AD numbers are included

DD FORM 1473

Unclassified

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Digital Computer						
Electronic Accounting Machines						
Libraries						
Information Retrieval						
Information System						
Research and Development						
Recording Systems						
Documentation						
Dictionaries						
Data Storage Systems						

INSTRUCTIONS

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ABBREVIATION	FACILITY
NSMSES	Naval Ship Missiles Systems Engineering Station Technical Library Deivision Port Hueneme, California
NUWS	Naval Underwater Weapons Research and Engineering Station Library & Technical Information Division Newport, Rhode Island
NWL	Naval Weapons Laboratory Technical Library Dahlgren, Virginia
OPTEVFOR	Operational Test & Evaluation Force Technical Library U. S. Naval Station Norfolk, Virginia
Picatinny	Picatinny Arsenal Technical Library Dover, New Jersey
RACIC	Remote Area Conflict Information Center Battelle Memorial Institue Columbus, Ohio
RADC	Rome Air Development Center Library Griffiss Air Force Base, New York
RC	Reliability Central Rome Air Development Center Griffiss Air Force Base, New Yrok
Recon Central	Reconnaissance Applications Branch Reconnaissance Division Air Force Avionics Laboratory Wright-Patterson AFB, Ohio

Key

O = Operational
P = Planned
U = Under development or in testing
* = Discontinued

Facility	Facility Report Ad#	Classified Inventory Control	Input Processing Cards	Input Processing Paper Tape	Retrieval	Serial Control	Circulation Control	SDI	Catalog Cards	Catalog Book Form	Accession List Comp.	Accession List L.P.
AFIT	640-114		O								O	
AMS	640-121		O		U						O	
APL	640-120		O		O			O	O		O	
ASDIRS	640-125		O		Manual					O		
BAMIRAC, IRIA, VESIAC	640-130		O		O							
BDIC, DMIC, RACIC, REIC	640-113	O	O	O	Manual							O
BUSHIPS	640-103		O		O	O		O	O		O	
AFCRL	640-109	P		O	U	U			O	U	U	O
DELSIE	640-118		O		O					O		
DISC	640-108		O						EAM		EAM	
EA	640-123		O		U	P	P	P			P	
EPIC	640-128		O		O						O	
FTD	489-996		O	O	O		P	O	O		O	
FORT DETRICK	640-102			O	O	O		O			O	
HDL	640-101		O		Manual			O	O		O	
MPDC	489-998		O		O							
MEL	640-117		U		U							
NAFI	640-126		O	O								
NATICK	640-104		O	O		O	O	P	O			O
NMC	640-111	P		O	P					O	O	
NOL	640-122		O	O	O	P	P		O			O
NOTS	489-995		O	O	O	P			O		O	
NPS	640-116	P		O	O				O		P	
NSMSES	640-132		O							O	O	
NUWS	489-997	P	O							P		
NWL	640-119		O		O		U		U		O	
PICATINNY	640-105	U	O		U	P	O	P			U	
PLASTEC	640-107		O									
RECON CENTRAL	640-115		O		O							
RSIC	640-129	U	O		U	O	O	P	O	P	P	
SEG	489-999		O					O	O		O	
TPRC	640-12[illegible]		O		O							
Reliability Central	640-116		P		P						O	

Seven of the facilities stored their thesauri in computer memory and used them for automatic error control and/or code conversion for natural language input. Only three found links and roles to be worth the added programming complexity.

Eighteen facilities stored their search files in an inverted form (e.g., a file ordered by descriptors) and four in the direct form (e.g., a file ordered by accession numbers). Searching a direct file can be a long procedure since the file must include a record for each acquisition in the library. Each of these records must be searched in serial sequence to determine if it has the desired combination of descriptors. An inverted file, on the other hand, has one record for each descriptor and, therefore, is only as long as the descriptor thesaurus. Furthermore, a search can be confined to only those descriptors of interest. Searching this latter type of file, however, requires a more sophisticated program (see Section VI, "File Structure"), but the total search time can be much shorter. For this reason, the use of direct files in mechanized searching is unusual, although direct files are often used after an inverted file search in order to obtain bibliographic information relative to the retrieved accession numbers.

Two kinds of retrieval system philosophies which employ a direct file search were encountered. One (e.g., NPS) is a programs that serve a multitude of facilities. (These generalized programs represent a considerable cost economy, since a single program development can be used by several facilities. The generalized program approach can make the difference between being able to justify and afford a mechanized search process, and having none at all.)

Almost all of the libraries complained of a poor understanding of library problems on the part of the programmers, and, in general, the programmers criticized the librarians for not understanding the potentials and limitations of computer applications. Poor communications between librarian and programmer can be blamed for many of the system development problems experienced. Some of these problems manifested themselves only after the system was operating and improvements more difficult to undertake. For example, Boolean search capabilities were sometimes designed into the retrieval program with severe, although unintentional, limitations. One such limitation was the inability of the program to relate both the AND and the OR operators. Also, the capability for search complexity often seemed far more sophisticated than necessary to satisfy the actual user's needs.

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)

BOOZ - ALLEN APPLIED RESEARCH, INC.
4733 Bethesda Avenue
Bethesda, Maryland 20014

2a. REPORT SECURITY CLASSIFICATION

Unclassified

2b. GROUP

3. REPORT TITLE

Mechanization Study of the Foreign Technology Division, Wright-Patterson Air Force Base, Ohio.

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