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Technical Report

AD 640 124

MECHANIZATION STUDY
OF THE
AEROSPACE MATERIALS
INFORMATION CENTER
(INCLUDING CERAMICS AND
GRAPHITES TECHNICAL INFO CENTER),
WRIGHT-PATTERSON AFB, OHIO

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I. SUMMARY

Under contract to the Air Force Materials Laboratory, Wright-Patterson Air Force Base (W-PAFB), Ohio, the University of Dayton has indexed and processed some 30,000 documents for the Aerospace Materials Information Center. Index terms have been added to computer tapes for retrieval and printing of the keyword index.

The final choice of an information retrieval system was an inverted file system using deep indexing, links, and roles; all material was processed on the University NCR 304 computer. The initial purpose of the computer operations was the tabulation of a thesaurus of the system's vocabulary and the generation of a keyword index that could be used by individuals in performing manual literature searches. The magnetic tape from which the thesaurus and dictionary were generated also provided the opportunity to perform mechanized searches as the need arose.

Within the past year, all data in the system have been added in sequential format and without roles to the IBM 7094 at W-PAFB, which is now used for searching, though the capability still exists at the

University of Dayton. In addition to searches, the IBM 7094 produces the KWIC index section of the "Materials Information Bulletin."

Currently all documentation received at, or issued by, the Ceramics & Graphites Technical Information Center is included in the overall program developed and operated by the University of Dayton.

All of the 30,000 documents on file at the Aerospace Materials Information Center are unclassified. The collection is growing at the rate of 400 per month. Reference use of the collection and abstracts has averaged about 300 per month, with loans (approximately 600 to 700 annually beside use in the library) being made to Materials Laboratory personnel and in a few instances to people located outside Wright-Patterson AFB.

A weekly "Materials Information Bulletin" announces to potential users all new additions to the collection; the "Abstracts of Active Contracts" announces current projects of the Laboratories. Bibliographies are prepared as requested. The majority of requests are by telephone, though requests by memo or letter are received quite frequently. Fifty percent of all requests are made by DoD contractors; the remaining 50 percent cover requests from various government activities.

II. MECHANIZATION

1. CHRONOLOGY

In early 1960, the Materials Information Branch was established as a centralized technical information service for the Air Force Materials Laboratory. A processing group was organized to assist in the problem of storage, retrieval, and use of information dealing with the materials R&D area. From this original group, the Air Force Materials Information Centers (AFMIC) have evolved. The Aerospace Materials Information Center and the Ceramics and Graphites Technical Information Center are two of the eight information centers. (Appendix A illustrates the eight centers.)

Contract with the University of Dayton was let December 1, 1960, to perform indexing and develop a computer-assisted information system.

Actual work on the contract with the University of Dayton began in September 1961. The system was developed and input began.

In mid-1963, the retrieval program became operational. The program until this time consisted only of input. The thesaurus was revised to retain as much specificity as practical while using a fragmentation system for organic chemicals and applying a modified but similar approach to other areas where an uncontrolled increase in vocabulary appeared detrimental. The established controls have provided a fairly stable vocabulary and eliminated the need for continued revision of the computer tapes.

In 1964, the retrieval program was rewritten for the IBM 7094 at W-PAFB. In this transition, the inverted file was changed to sequential. The data base was added in September although the University of Dayton still formulates the search questions. Thesaurus maintenance, keyword index printing, and data-base updating are still being performed on the NCR 304 at the University of Dayton.

After a year of setting up the program on the IBM 7094, the retrieval program became operational in late 1965.

2. MAJOR PROBLEMS IN DEVELOPMENT

Problems with the free vocabulary began developing within a couple of years, initiating a redevelopment of terms within the system and the establishment of vocabulary controls.

Indexing is usually a chore, although some relief is given when the indexer formulates search questions as well as indexing. Plans call for indexers to supervise students in the indexing and spend part of their time doing more interesting and varied work.

The University's experience has shown negative aspects to the system such as the difficulty encountered in applying role indicators to the terms. After a thorough evaluation, the assigning of role indicators was dropped. It was also discovered that a large amount of time could be saved in the editing operation by letting the computer, rather than the editors, do the cross-relating of terms.

Another problem developed is the indexing of progress reports, which increased the number of overall entries to the system. This procedure was changed; currently, if a progress report is received in the Center and it is the first to be received on the contract, it is assigned a new accession number and processed for indexing. If it is not the first, the document is assigned the same accession number affixed to the first report and filed. Because of this method of handling progress reports, the exact size of the system is indeterminate.

3. THESAURUS DEVELOPMENT

The use of deep indexing with links and roles formulated the basis of this system. The role indicators used were a slightly modified version of those used by the DuPont Company. The first 500 documents that were indexed averaged over 80 link-to-role-term combinations per report. As the information analysts gained experience, the average number of entries per document was reduced to slightly over 40. The elimination of roles from the system reduced the average to about 27 entries per document.

In 1963, when controls were established for the naming of materials, the 18,000 items in the system were reduced to about 10,000. Within the past year, some 6,000 documents being added to the system have generated very few new terms.

Twelve to thirteen terms are assigned for each document, but because of the hierarchial relationships, a document may then be posted to about 20 to 25 terms automatically.

Maintenance of the thesaurus is described in Appendix B.

4. DESCRIPTION OF PROCESSES

Until 1960, a collection of Materials Laboratory's and its contractors' reports had been maintained manually. Reports were logged in, and a report number index card maintained. No subject cross-referencing was available.

Since the beginning of the University of Dayton contract, material added to the computer also has had abstract cards prepared for it. Currently, these abstract cards are maintained at the Materials Laboratory by contractor, contract number, agency, title, and accession number. Card sets are also maintained at the University of Dayton and some of the divisions within the Laboratory.

The computer programs developed and operated by the University of Dayton permit computer searches and also produce a thesaurus and a printed index of the entire collection (see Figure 1 for input flow). Searches and printing of the KWIC index are performed from the same data base using the IBM 7094 at the Materials Laboratory. In order to provide information required to produce the outputs just mentioned, the following procedures are followed:

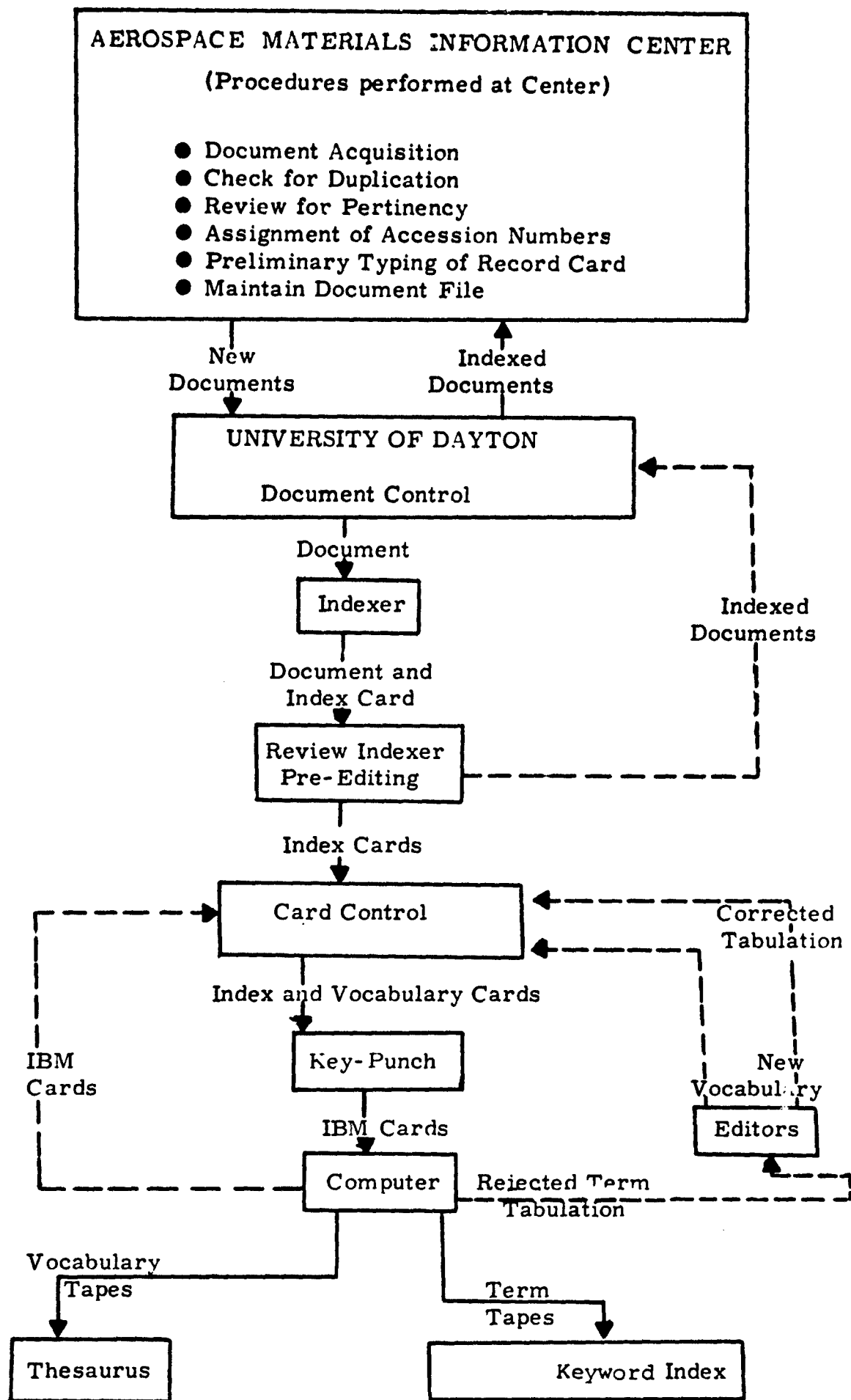


FIGURE 1
Input Flow of Information

(1) Input Procedures

1. Document is received, checked for duplication, and reviewed for pertinency to the collection.
2. Accession numbers (six digits) are assigned by the University of Dayton staff located at the Materials Laboratory.
3. Preliminary record card is typed showing accession number, title, date, and contractor.
4. Documents are forwarded to the University of Dayton for indexing and processing.
5. Final abstract card is typed including complete bibliographic information.
6. Indexer indexes the document using an indexing worksheet (referred to as index card; see Figure 2). This index card includes the accession number (access number), title of the report, author or authors, indexer's name and date, and the terms and appropriate links assigned. A link is a unique alphabetic suffix added to the accession number. Terms are selected from the thesaurus by following certain ground rules. See Appendix C for a further explanation of these rules.

Access No. 22446 Title CHARACTERISTICS OF

PHOTON-COUPLED SYSTEMS

Author (s) I. WUNDERMAN

Indexer RAS

Date 1 MAR 65

L L L

Terms

Z			D- 0465
---	--	--	---------

2			STANFORD UNIVERSITY
---	--	--	---------------------

A THEORETICAL ANALYSIS

A			SEMICONDUCTORS
---	--	--	----------------

A ELECTRONIC COMPONENTS

A			GALLIUM ARSENIDE
---	--	--	------------------

A			DIODES
---	--	--	--------

A			PHOTONS
---	--	--	---------

A		EMISSION
---	--	----------

A		DETECTORS
---	--	-----------

FIGURE 2
Index Card

7. Document and index card go to the review indexer for pre-editing.
8. Indexed documents are returned to the Materials Laboratory.
9. Index and vocabulary cards are keypunched.
10. Cards are processed on the computer; terms not already on tape are rejected.
11. Rejected terms are sent to editors for review. Terms are held for further review or added, if usage has shown need for the term. Modifications to the various sections of the valid vocabulary are made as described in Appendix B. Figure 3 shows the various card formats.
12. Final abstract cards are returned to the Materials Laboratory and filed.
13. Final record cards are filed by the University of Dayton staff, including abstract and index cards.

(2) Outputs

1. Thesaurus

The thesaurus contains some 10,000 terms, printed in numeric sequence by numeric code (see Appendix D-1 for sample). Generic Terms (GT), Related Terms (RT),

D	Numeric	Blank	Alpha
C	Numeric	Blank	Alpha
F	Numeric	Numeric	Alpha
F	Numeric	0000000	Blank
<u>THESAURUS</u>			
<u>1-7</u>	<u>9-10</u>	<u>12-18</u>	<u>21-80</u>
Numeric	SA, PO, GT, RT	Numeric	Alpha (May be ERASE)
Numeric	OO (Numeric)	Blank	Alpha (May be ERASE)
<u>GENERIC TAPE</u>			
<u>1</u>	<u>4-10</u>	<u>14-20</u>	
A	Numeric	Numeric	
D	Numeric	Numeric	
<u>POSTING INDEX</u>			
<u>ADDITIONS</u>			
<u>1-6</u>	<u>7-8</u>	<u>11-70</u>	
Numeric	Link (Alpha)	Alpha (Punch as briefs)	
<u>DELETIONS</u>			
<u>1-7</u>	<u>12-19</u>	<u>21-27</u>	
Numeric	Numeric & Alpha (Access # & Link)	Blank	
<u>ACCESS NUMBER FLIPS</u>			
<u>1-7</u>	<u>12-19</u>	<u>21-27</u>	
Numeric	Numeric & Alpha (Access # & Link)	Numeric	

FIGURE 3
Card Formats

and Posted On (PO) terms are listed immediately below the main term entries with the code GT, RT, or PO. "See" terms and "see also" (SA) terms are included in the thesaurus.

2. Keyword Index

Published annually, with supplements as 4,000 or 5,000 entries are accumulated, this index (Appendix D-2) provides a manual searching tool of all items in the collection. Each term is shown with all the accession numbers posted to it. The accession numbers may then be used to locate the abstract card with full bibliographic data or the document itself. To simplify this manual search, accession numbers are printed in 10 columns corresponding to the terminal digit of the number. The index is kept at the laboratory for quick ready reference-type searches not requiring computer processing.

The index as well as the thesaurus is produced on the NCR 304 at the University of Dayton. Frequency of use can be determined from the index printout but not from the thesaurus.

Search requests are received by the Materials Laboratory and sent to the University of Dayton for processing. The search writer formulates the question and writes up the search in English (Figure 4). The word numbers are usually looked up by one of the student employees. The codes

PAGE ____ OF ____

[illegible]

are transferred to a keypunch form (Figure 5) used in punching cards for the retrieval program on the IBM 7094 at the Materials Laboratory.

INFORMATION RETRIEVAL - SEARCH INPUT

PAGE ____ OF ____

SEARCH			
1	2	3	4

SEARCH TITLE																																							
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40										

NAME OF REQUESTOR																																							
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60																				

CUTOFF
64, 65

MAX #
68, 69, 70
A, L, L

H
80
H

After adding search criteria, delete words

ORDER	CONNECTOR			WORD NUMBER	ROLE
	AND	OR	NOT		
6 7	8	9	10	11 12 13 14 15 16 17 18 19	
01-41					
02-42					
03-43					
04-44					
05-45					
06-46					
07-47					
08-48					
09-49					
10-50					
11-51					
12-52					
13-53					
14-54					
15-55					
16-56					
17-57					
18-58					
19-59					
20-60					

ORDER	CONNECTOR			WORD NUMBER	ROLE
	AND	OR	NOT		
6 7	8	9	10	11 12 13 14 15 16 17 18 19	
21-61					
22-62					
23-63					
24-64					
25-65					
26-66					
27-67					
28-68					
29-69					
30-70					
31-71					
32-72					
33-73					
34-74					
35-75					
36-76					
37-77					
38-78					
39-79					
40-80					

FIGURE 5

Resultant printouts (Appendix D-3) indicate the search number, search title, requester's name and extension, special instructions on the search, order of terms, corrections, term numbers, and terms to be searched. Results are in the form of accession numbers for documents containing all or some of the terms specified in the search question. Accession numbers are printed in 10 columns.

Printouts are reviewed by analysts at the Center before the requester receives a copy. The analyst may indicate items which seem to be best suited to the requester's needs, ones which look doubtful, or ones which are ruled out immediately. Local users will receive a printout of terms; outside requesters will receive a list of references or the actual information they required.

4. KWIC Index to "Materials Information Bulletin"

Weekly, the IBM 7094 prints a KWIC Index of new documents added to the collection (See Appendix D-4 for sample). Permuted titles refer to the accession number (found at the right-hand side of the page for each title). This accession number may be used to locate either the abstract or document. A request form (added two months ago) is provided at the back of the bulletin, allowing the user to

circle any accession numbers pertaining to documents for which he wishes to see an abstract. This form is returned to the Materials Laboratory, and abstracts are furnished as soon as possible.

5. Other

A number of printouts are made to assist in system management. The vocabulary may be printed in alphabetic or numeric sequence. The Generic File may be printed, creating a listing in the same format as the thesaurus, differing only in that all terms at all levels appear. Also, lists of errors are printed by each of the updating runs for correction.

5. ACTIVITIES BEING PLANNED OR DEVELOPED
FOR MECHANIZATION

It is hoped that the "Abstracts of Active Contracts," now being produced manually, can be printed from the DD Form 1498 file at DDC, directly from the computer to reproducible mats.

A Miracode system just purchased will be used to store Materials Laboratory information as well as the "Commerce Business Daily" entries and some AEC materials information being purchased on film from the AEC.

Microfilm will be obtained on all other older documents, microfiche on the more current.

III. PROGRAM SYSTEM DATA

I. FILES

(1) Vocabulary File (Master Word List)

This is the basic file of valid descriptor terms and their numeric code equivalents and also contains "see" terms. Two versions of the file are kept, one in numeric sequence which is nearly alphabetic because of the code assignment technique, and another in computer alphabetic sequence which is a slightly different sequence. These and the Thesaurus File are the only tapes in the system that contain English.

(2) Generic File

This file contains records that reflect the hierarchical relationships of the vocabulary. It consists of pairs of term code numbers, the first being posted on or generically lower than the second.

(3) Thesaurus File

This is the complete dictionary for the system. The thesaurus is not required by the computer system except as an indexing aid and a search writing aid. It contains the codes, first-order generic terms (both higher and lower), "see" terms, "see also" terms, and related terms. Bombardment and irradiation are examples of "see also" terms; each is a good term but there is overlap in meaning.

(4) Posting Index (Search File)

This inverted index contains term code and accession number pairs in 32-word records. When it is transferred to the 7094 system, it is reinverted to document sequence.

2. PROGRAMS

(1) Input

Data cards containing an English descriptor and the document accession number are read. The English descriptor is compared to the Vocabulary File. If the term is valid, the code number and accession number pair is written on a work tape.

The Generic File is examined, and all higher order terms are selected for automatic posting. These are also written on the work tape. Contents of invalid cards are printed for reassessment.

(2) Post

The work tape resulting from the Input program is sorted by code numbers and posted in proper sequence in the Posting Index.

(3) Search

Batches of four to six questions (maximum of 92 words per question) from one or more users are read and stored. The term codes of the questions are compared to the Posting Index, and their Boolean relationships are evaluated. Evaluation takes place serially from first term to last and on two levels. AND or NOT terms are on the higher level and OR terms are on the lower level. Thus the truth of a single OR term in a string makes true that section of the AND statement in which it appears.

Provision is made for limiting the total number of document retrievals desired and for selecting the number of true phrases to constitute a hit.

Accession numbers of retrieval documents are printed in numeric order within groups showing the number of hit terms.

Two versions of this program have been written, one for the NCR 304 and one for the IBM 7094.

(4) Print Thesaurus

The preparation of the Print Thesaurus tape involves matching input time with the Master Word List tape. A special subroutine is required to add new terms to these tapes. A cross-match is made to establish that the same terms are included on both tapes. The Print Thesaurus tape is used to produce multiple copies of the thesaurus off-line.

The thesaurus is printed in numeric sequence. All first-order generic terms, related terms, "see" terms, and "see also" terms are printed.

(5) Print Keyword Index

English terms are extracted from the Vocabulary File and merged with data from the Posting Index onto a work tape. The tape is sorted into sequence by the English term and accession numbers, and printed off-line. A supplement to the Posting Index

is printed when 4,000 or 5,000 entries are accumulated. Once each year, all the supplements are merged and a complete version is printed.

(6) Print Vocabulary-Numeric
Print Vocabulary-Alphabetic

The Vocabulary file of codes and English is printed in the sequence indicated. To date, the alphabetic sequence has not been printed.

(7) Print Generic

The Generic File is printed in numeric sequence.

(8) Vocabulary Update

This program makes additions and deletions to the Vocabulary File. An addition is a new term and an unused code number. Code numbers are assigned so that a nearly alphabetic sequence is maintained. Unnecessary terms are deleted from the file. Those terms are also deleted from the Posting Index.

(9) Flip

This program performs interchange of one term for another. It deletes the first term from the Vocabulary File and inserts the

second. It then moves the postings from the first to this second term in the Posting Index. If the second term number is zero, all entries in the Posting Index are simply deleted.

(10) Change

The English portion of an entry in the Vocabulary File is replaced by the contents of the change card.

(11) Access Number Flip

A single accession number may be removed from posting under one term and inserted under another term in the Posting Index to correct mispostings.

(12) Delete Generic

This program deletes single entries from the Generic File.

(13) Add Generic

This program adds single entries to the Generic File.

(14) Thesaurus Update

This program is used to make changes to the Thesaurus File. Change cards containing code numbers and designations

(e.g., GT, PO, SA, RT, and "see" terms) are read, sorted, checked for validity against the Vocabulary File, and posted. Invalid terms are printed for correction.

(15) Punch

The contents of the Posting Index are punched into cards for transfer to the IBM 7094 for retrieval. This step is necessary because of magnetic tape incompatibility between equipments.

(16) Compare

This program compares the vocabulary to the thesaurus to find terms that exist in the vocabulary but do not appear in the thesaurus. These terms and invalid terms from the Thesaurus Update are reconciled by deleting or by adding in the proper place, to assure one-to-one correspondence in the two files.

(17) KWIC

This is a standard program provided by IBM to all users. It prints a permuted title listing for all new documents.

IV. EQUIPMENT, COSTS, AND EVALUATIONS

1. EQUIPMENT

NCR 304

The NCR 304 system is owned by the University of Dayton and is used primarily for nonscientific data processing problems. In addition to the following equipment, the computer also has paper tape in and out and typewriter control at the console.

	304-B	with 4K memory
	330	magnetic tape controller
8	332	magnetic tape handlers
	320	multipurpose converter
	340	printer
	380	card reader
IBM	514	card punch

IBM 7094-7044

The 7094-7044 system has been rented by the Digital Computations Division, a service facility for all of W-PAFB, for about one year. It is used primarily for scientific computations, and about 85 percent of the programs are in FORTRAN language.

	7094	direct couple system with 32K memory
8	729	Mod IV tapes
		disk (10 million words)

	7044	input-output computer
	1402	card reader/punch
6	1403	line printers

2. TIME AND COSTS

The University of Dayton personnel assigned to the contract consist of five full-time employees (professional, technical for subject indexing) at the University and five full-time employees located at the Center.

The contract with the University of Dayton has cost the Center approximately \$150,000 per year for the last three years. This includes system development, indexing, retrieval statement composition, and file maintenance.

The search program, which ran approximately 30 minutes on the 304, takes only 3 minutes to run on the 7094. Some 400 searches were made during the past year, and some 600 are expected this year. In addition, 10 to 15 manual searches are made each month.

Costs on the 7094 (at \$400 per hour) have been approximately \$15,400 in the 15 months since September 1964, including \$2,300 in November 1965. This includes the cost of printing KWIC title listings

and operation of the system. Since the Center is not charged for search time on the Materials Laboratory's IBM 7094, they feel they save \$11,000 by using this computer.

3. EVALUATIONS

The information retrieval system established by the University of Dayton became operable in mid-1963. At that time, a thesaurus of approximately 10,000 terms and a dictionary containing references to approximately 6,500 documents were tabulated on the NCR 304 computer, and multiple copies of each were forwarded to the Laboratory. It was only after this date that any form of an evaluation could be made on the propriety of the selected system and its various components.

The use of links and roles had been added to the indexing process in order to reduce the number of false drops and to permit highly sophisticated searches. It became desirable to determine the depth of indexing being performed on each document and whether links and roles were serving the purpose for which they were intended.

(1) Evaluation of Links and Roles in Searches

A study of the value of links and roles was undertaken by a student of the Air Force Institute of Technology (AFIT) as his graduate thesis. Working with the University of Dayton staff, he

ran actual searches on which to base his evaluation. In this study, roles were found inferior to links. The use of links showed a reduction of irrelevant information by over 56 percent while incurring less than five percent loss of relevant information. The study recommended the dropping of roles, or an increase of the word limit for computer searches from 40 to 100 (40-word limit is sufficient when using links alone). The recommendation to drop roles was accepted, recognizing that it was almost impossible to provide definitions which would assure the use of the same role in a question as in the original indexing. Complete results of this study are given in ML TDR 64-152 (see Reference 1).

A second evaluation of links and roles was made by a University of Dayton employee experienced in setting up actual search questions. This study supplemented the first and confirmed the decision to drop roles.

(2) Special Indexing Studies

A special study has been made of the indexing process. This study was devoted to the indexing of documents in which attention was paid to the location of the terms indexed. Each document was indexed in four parts: the abstract, summary and

conclusions, table of contents and figures, and the body of the report. The indexing was done in the indicated sequence, and a color code was used to distinguish the indexing of the four parts. The indexing of each subsequent section was used to complement and/or supplement the indexing of the preceding sections. The results of this study are tabulated in Tables 1 and 2 of RTD-TDR-63-4263 (see Reference 2).

Realizing that different disciplines presented distinct indexing problems, the documents were categorized as being in the area of ceramics, chemistry, metallurgy, or physics. However, since the reports did not necessarily contain all four sections from which terms were indexed, i. e. , all reports did not have abstracts, etc. , additional tabulations were made of those reports having similar sections. In addition, the results of this study show some of the costs added to the system by the use of links and roles; e. g. , 50 percent more entries caused by use of links and roles undoubtedly results in increased indexer's time, keypunch expenses for time and materials, additional computer processing time, and additional postings.

(3) Additional Studies

The Center has, for the past three years, run searches on projects proposed for contract and distributed these to the project offices involved. Following these searches, a questionnaire (see Figure 6) was sent to each recipient to determine the value of the particular search. At the end of 1964, some 42 replies had been received; 22 indicated that the search results had been of help, and six indicated that the search results had actually cancelled parts of projected projects. Some 183 searches were performed this past year, but results of the questionnaire are not yet available.

EVALUATION OF INFORMATION RECEIVED FROM

	Estimated Percent
Material was closely related to my work	_____ %
Material was moderately related to my work	_____ %
Material was remotely related to my work	_____ %
Material was totally unrelated to my work	_____ %
Material was new to me	_____ %
Material was not new to me	_____ %
Receiving this material affected the course of the work	☐
Receiving this material affected the choice of contractor	☐
This material indicated some anticipated work was unnecessary	☐
This material made no contribution to my work	☐
would have appreciated Journal Literature ☐ Patent Literature ☐	_____ ☐
s material adequately pin-pointed? YES ☐	NO ☐
ments.	

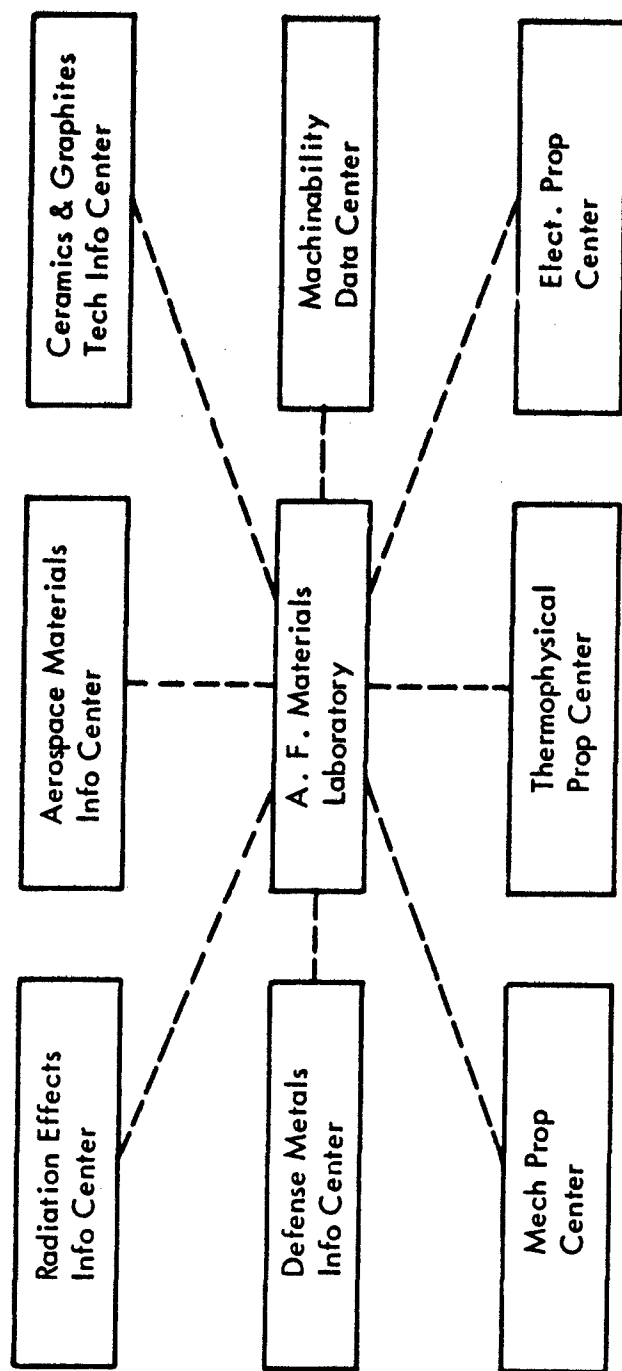
FIGURE 6
Search Questionnaire

R E F E R E N C E S

1. "An Evaluation of Links and Roles Used in Information Retrieval," Technical Documentary Report No. ML TDE 64-152, July 1964, AF Materials Laboratory, RTD, AFSC, Wright-Patterson Air Force Base, Ohio (AD 606 192).
2. "Establishment of a Coordinate Indexing Retrieval System for the Air Force Materials Laboratory," Technical Documentary Report No. RTD-TDR-63-4263, March 1964, AF Materials Laboratory, RTD, AFSC, Wright-Patterson Air Force Base, Ohio (AD 428 423).

APPENDIX A

AIR FORCE MATERIALS INFORMATION CENTERS



APPENDIX B

MAINTENANCE OF THE THESAURUS

THINGS YOU CAN DO TO THE VOCABULARY

	CODE	COMMENTS
1.	A	Add a NEW word to the system; should have a number which has never been used
2.	C	Change the spelling of an existing number. Effect is to delete one word and add another with the same word number
3.	D	Delete existing word on vocabulary which DOES NOT have postings on the posting index
4.	F	a.) Flip to "zeros" for a delete only--those words which DO HAVE postings on the posting index. Effect is to delete the word from the vocabulary AND the postings from the posting index; new word is NOT added to vocabulary. b.) Flip to another word number for delete and add. Effect is to delete one word from vocabulary and add a NEW word with a NEW number, while "flipping" documents from the old word number to the new word number, deleting the documents from the old word number.

THINGS YOU CAN DO TO THE THESAURUS

COMMENTS

1. Add a new master word # (not previously in the thesaurus) using 00 as the posting.
2. Add SA, PO, GT, or RT to an already existing master word # in the thesaurus. If no master item exists (a 00 item) then program prints error and new card is not added into thesaurus.
3. Delete master word # and ALL corresponding postings using 00 and ERASE

4. Delete individual postings SA, PO, GT, or RT using ERASE. This is used when master word item is to remain in thesaurus with or without other postings.

THINGS YOU CAN DO TO THE GENERIC TAPE

CODE	COMMENTS
1. A	Add a NEW PO to the generic tape; both the master word # and the PO word # MUST be in the vocabulary
2. D	Delete an existing item from the generic tape; there must be a one-to-one correspondence between cards and items you wish to delete; i. e. , one card must be punched for each item you wish to delete

THINGS YOU CAN DO TO THE POSTING INDEX

1. Add new documents--word items to the Posting Index (from index cards or error sheets). Cards will be matched with vocabulary (sorted by word) and output will be matched with generic tape. You will get a new error sheet, also, the generic tape match output will be merged with the search tape and a supplement will be printed (or the entire search tape, if desired).
2. FLIPS--the flip cards from the vocabulary update will be used to delete access #'s and add them under new master word #'s. This output WILL be matched with the generic tape, which output in turn will be merged with the search tape. A printout can be made available if you so desire.
3. "Bad" access numbers can be deleted from the posting index. One card per access # must be punched. The "bad" documents will be deleted, leaving good documents untouched--even under the same master word #, i. e. , you can delete any number of "bad" documents under a certain word #, leaving "good" documents under that word #. Just remember that one card must be

punched for each "bad" document. Also, some of the deleted documents may belong elsewhere. You can add these documents to the proper word simply by utilizing this feature on the input cards. If additions exist, the output will be matched with the generic tape and in turn will be merged with the search tape. The effect is similar to that of a flip card--the difference being the ability to "flip" certain but not all the documents under a given word #.

APPENDIX C
INDEXING GROUND RULES

APPENDIX C

INDEXING GROUND RULES

The elimination of role indicators simplified the indexing procedures and reduced the number of indexing ground rules. Specific indexing techniques are primarily concerned with terminology or vocabulary control while the basic indexing procedures remain unchanged. First, the information analyst must become familiar with the contents of a document before he can determine its important concepts. For the majority of documents, this can be accomplished by reading the abstract and conclusions, and by scanning the table of contents and the body of the report. The key terms that best describe the report's contents are then chosen, and links are used to maintain separation of the terms of principal concepts. The use of links has become valuable in separating organic compounds and preventing the "connection" of substituent groups to the wrong basic structure.

Any indexed terms that are not already included in the system's vocabulary are recorded on master word cards. These cards are reviewed once a week by all staff members. This method permits the revising of the vocabulary tape prior to the updating of the Posting Index, and at that time, only keypunching errors should be rejected by the computer.

The changes made in the system's vocabulary made it advisable to make one other change in the indexing procedure. Realizing the possibility that users might ask for information on specific materials, a decision was made to use more scope notes on the index cards in order to simplify the screening of search results. Any notes that an information analyst thinks would be beneficial in the screening process are written on the index card in script and enclosed in parentheses. These notes are not keypunched and, therefore, do not affect the computer programs.

APPENDIX D
SAMPLES OF OUTPUTS

3460500 RHEOLOGICAL PROPERTIES
1498000 PC FLOW PROPERTIES
2122500 PC PHYSICAL PROPERTIES

3441500 RHODIUM
2440500 PC METALS
3430500 PC REFRACTORY METALS
4346410 PC TRANSITION METALS

3462500 RHODIUM ALLOYS
3422500 PC REFRACTORY ALLOYS

3462100 RHODIUM ANTIMONIDE
3449500 PC ANTIMONIDES

3462200 RHODIUM BORIDE
3424500 PC BORIDES

3463000 RHODIUM COATINGS
3473500 PC COATING
2420310 PC METALS
3423500 PC REFRACTORY METAL COATINGS
3430500 PC REFRACTORY METALS
3441500 PC RHODIUM
4346410 PC TRANSITION METALS

3463450 RHODIUM SILICIDE
3598000 PC SILICIDES

3466000 RHODIUM-IR
3422500 PC REFRACTORY ALLOYS
3462000 PC RHODIUM ALLOYS

3461500 RHODIUM-OS
3422500 PC REFRACTORY ALLOYS
3462000 PC RHODIUM ALLOYS

3467000 RHODIUM-PD
3423500 PC REFRACTORY ALLOYS
3462000 PC RHODIUM ALLOYS

3468000 RHODIUM-PT
3423500 PC REFRACTORY ALLOYS
3462000 PC RHODIUM ALLOYS

3463500 RHODIUM-RU
3423500 PC REFRACTORY ALLOYS
3462000 PC RHODIUM ALLOYS

3470000 RHODONITE
3762200 PC CALCIUM SILICATE
2330600 PC MANGANESE SILICATE
2545550 PC MINERALS
2572800 PC MIXED OXIDES
3596300 PC SILICATES

3474500 PIVETS
1440100 PC FASTENERS

3474500 POCKET MOTOR CASES

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INFORMATION RETRIEVAL -- DOCUMENT SEARCH NO 8533 DATE 25 NOV 65

ARCH TITLE - CERAMIC REINFORCED COMPOSITES REQUESTED BY - H EMRICK 36123 PR CJTOFF 5 MAX NO. ALL

ORDER	CONN	WORD NO.							
1	AND	3433000	REINFORCEMENT						
2	OR	4587500	WHISKERS						
3	OR	1467500	FILAMENTS						
4	OR	1463000	FIBERS						
5	NOT	3250000	POLYMERS						
6	AND	1026500	COMPOSITES						
7	NOT	1644000	GLASSES						
8	NOT	2862000	NITRIDES						
9	NOT	791500	CARBIDES						
10	NOT	1677500	GRAPHITES						
11	NOT	624500	BORIDES						
12	NOT	3679050	SINGLE OXIDES						
13	NOT	630000	MONOM						
14	NOT	2572500	MIXED OXIDES						
1343A	0126751	0133628	0133620	014034A	014272A	014452A	0146660	015678A	016301C
6783A	017111A	018434A	019250A	020611A	020727A	021312A	022141A	022176A	022238A
2273A	022513A	022532A	022538A	022724A	023569A	023570A	023628A	023949A	024522A
4708A	024734A	024897A	024909A	024909A					
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14	8	DOCUMENTS LISTED ABOVE CONTAIN	THE FIRST	12	WORDS.				
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1372C									
14	1	DOCUMENTS LISTED ABOVE CONTAIN	THE FIRST	10	WORDS.				
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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 (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		
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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.		

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14

KEY WORDS

Digital Computers
Indexes
Information Retrieval

Data
Analysis

LINK A

ROLE WT

LINK B

ROLE WT

LINK C

ROLE WT

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