DOCUMENT RESUME

ED 068 131 LI 003 927

AUTHOR	Scheffler, F. L.; March, J. F.
TITLE	Determination of the Consistency of Relevance Judgments and the Reliability of Search Strategies Among Information Specialists for the Aerospace Materials Information Center.
INSTITUTION	Dayton Univ., Ohio. Research Inst.
SPONS AGENCY	Air Force Materials Lab., Wright-Patterson AFB, Ohio.
REPORT NO	AFML-TR-72-51
PUB DATE	Apr 72
NOTE	100p.;(0 References)
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	Information Retrieval; *Information Scientists; Information Systems; *Relevance (Information Retrieval); *Search Strategies
IDENTIFIERS	*Aerospace Materials Information Center; AMIC

ABSTRACT

The ability of various Aerospace Materials Information Center (AMIC) information specialists to prepare search strategies for document retrieval was studied by providing ten typical search request statements to seven information specialists. Each specialist prepared search strategies independently. Significant variations occurred among the strategies, although even with these variations reasonably consistent document returns resulted. The experiment indicated that the proper interpretation of a search request and the conversion of the request to an appropriate search strategy even with a well-established thesaurus is a considerably more difficult task than indexing. In another experiment, the consistency of relevance judgments among information specialists was examined. Relevance judgment is more difficult than indexing and search strategy preparation. Agreement on nonrelevance is better than agreement on relevance. The system of relevance judgment, according to nonrelevant, partially relevant and relevant, appears optimum for AMIC. Communication between the requester, the information specialist and the retrieval system itself are of prime importance. Because of certain human interactions which must occur, some variability is unavoidable. However, current AMIC procedures of searching to achieve high recall and screening the results for relevance provide good results to the ultimate requester. (Author)

AFML-TR-72-51

DETERMINATION OF THE CONSISTENCY OF RELEVANCE JUDGMENTS AND THE RELIABILITY OF SEARCH STRATEGIES AMONG INFORMATION SPECIALISTS FOR THE AEROSPACE MATERIALS INFORMATION CENTER

F. L. SCHEFFLER
J. F. MARCH

UNIVERSITY OF DAYTON RESEARCH INSTITUTE
DAYTON, OHIO

TECHNICAL REPORT AFML-TR-72-51

APRIL 1972

AIR FORCE MATERIALS LABORATORY
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

NOTICE

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the government may have formulated furnished, or in any way supplied the said drawings specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation. or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Copies of this report should not be returned unless return is required by security considerations, contractual obligations, or notice on a specific document.

AIR FORCE: 31-5-72/450

FOREWORD

This report was prepared by the University of Dayton Research Institute, Dayton, Ohio, under Air Force Contract F33615-71-C-1069. The work described herein was accomplished under Project 7381 "Materials Application" and Task 738103 "Materials Information Development, Collection and Processing." The effort was administered under the direction of the Materials Information Branch, Materials Support Division, Air Force Materials Laboratory with Mr. Harold B. Thompson (AFML/LAM) as Project Monitor.

This is a final summary report and covers the work accomplished from 1 December 1970 through 30 November 1971.

The authors acknowledge the efforts and contributions of Mrs. C. Marie Shanley, Mr. Howard H. Schumacher, Mr. Eugene R. Egan, Mr. David Z. Winters as well as a number of students who participated in the program.

This technical report has been reviewed and is approved.

EDWARD DUGGER
Chief, Materials Information Branch
Materials Support Division
Air Force Materials Laboratory

TABLE OF CONTENTS

SECTION	TITLE	PAGE
I.	INTRODUCTION	1
	1. Description of AMIC System	1
	2. Summary of AMIC Procedures	2
	3. Indexer Consistency Analysis	2
	4. Purpose of Most Recent Experiments	5
II.	DOCUMENT RETRIEVALS AS A FUNCTION OF SEARCH STRATEGY	7
	1. Experimental Design	7
	2. Criteria for Analysis of Results	9
	3. Results	10
III.	CONSISTENCY OF RELEVANCE JUDGMENTS OF INFORMATION SPECIALISTS	29
	1. Experimental Design	29
	2. Criteria and Method for Analysis of Results	30
	3. Results	31
IV.	CONCLUSIONS	38
V.	DOCUMENT RETRIEVAL SYSTEM OPERATION	40
	1. Input	40
	2. Searching	40
	3. Thesaurus Development	40

TABLE OF CONTENTS (Cont'd)

		PAGE
REFERENCES		43
APPENDICES		
APPENDIX I	Definition of Task Numbers	45
APPENDIX II	Distribution of Personnel Time by Task Number	47
APPENDIX III	Subject Categories	48
APPENDIX IV	SDI Search Requests Processed 1 December 1970 - 30 November 1971	54
APPENDIX V	Retrospective Search Requests Processed 1 December 1970 - 30 November 1971	69
APPENDIX VI	Polymers	90

LIST OF TABLES

TABLE		PAGE
I	Summary of Various Studies of Inter- and Intra-Indexer Consistency	4
II	Retrospective Search Statements	8
III-XII	Retrospective Searches 1-10	14-23
XIII	Combined Retrospective Searches	24
XIV	Number of Individual Retrieval Terms Used in Search	25
XV	Commonality of Retrieval Terms Used In Searching	26
XVI-XIX	Consistency of Relevance Judgments for Abstracts (Groups A-D)	33-36
XX	Differences of Relevance Judgments for Different Groups	37

LIST OF FIGURES

FIGURE		PAGE
1	Recall as a Function of Precision	27
2	Recall as a Function of Individual Terms in Strategies	28
3	Documents Indexed and Searches Processed by Year	42

SECTION I

INTRODUCTION

1. DESCRIPTION OF AMIC SYSTEM

The Information Systems Section of the University of Dayton Research Institute (UDRI) has established and presently maintains and operates a document retrieval system in support of the Aerospace Materials Information Center (AMIC). The document retrieval system operated by the University of Dayton contains approximately 60,000 documents concerning materials research and development with new accessions being made continually. The establishment, modification and operation of the document retrieval system are described in the following reports: RTD-TDR-63-4263 (AD 428 423)[1], AFML-TR-65-20 (AD 613 301)[2], AFML-TR-66-36 (AD 633 614)[3], AFML-TR-66-391 (AD 651 039)[4], AFML-TR-67-379 (AD 666 462)[5], AFML-TR-68-367 (AD 686 804)[6], AFML-TR-70-27 (AD 670 597)[7] and AFML-TR-71-11 (AD 725 036)[8]. The present report describes the work performed from December 1970 to December 1971.

The AMIC document retrieval system has been in operation with retrospective search capabilities since 1963. The purpose of the system is to provide scientific and technical information to qualified requesters in a timely and efficient manner. The information is supplied in the form of abstracts of documents pertinent to the search request; these abstract forms also contain complete bibliographic information including AMIC access number, DDC AD number or NASA N number, generating agency, report number, title, author, contract number (if applicable), and date of issue of the document. The documents themselves are available from the Materials Documentation Center (MDC) maintained at the Air Force Materials Laboratory (AFML). These documents are available on loan to the local requester, or may be referred to in the center. Abstracts of the documents are provided to the requesters.

The AMIC document retrieval system is primarily concerned with the materials aspect of technical documents. Because of the concentration on materials, retrieval capabilities from a materials standpoint are very comprehensive. Retrieval can be very specific, as, for example, all information on the alloy Aluminum 2024-T6, or retrieval could be as general as high temperature fatigue of all metals and alloys. Similarly, one may request information on boron reinforced Epon epoxy composites, or one may ask for aircraft structural applications of any composite material.

Searches encompassing the entire range of materials information are regularly run by the UDRI in response to requests from technical personnel in the AFML. To ensure that the requester receives abstracts which are relevant to the request, all abstracts and index cards retrieved are screened for content by a UDRI information specialist to assess their relative pertinence to the originally-stated request.

2. SUMMARY OF AMIC PROCEDURES

The Aerospace Materials Information Center prepares documents by human indexing from the full text using a controlled vocabulary of index terms. The index terms serve as the storage and retrieval records for the computer system. The AMIC thesaurus is used to aid the indexer in the selection of appropriate terms. The indexers are familiar with the discipline represented by the document content, and they are carefully trained in indexing procedures. Automatic hierarchical posting of terms is provided to ensure that retrievals can be accomplished at the highest generic level desired.

Searching is performed using Boolean logic linking of allowable index terms. A unique search cut-off feature provides a means of searching at various levels of specificity within a given search. This feature permits the search to be so constructed that the information specialist can be certain of achieving high recall. The cut-off feature also permits sorting of the search results by groups so that the most pertinent documents appear in the first groups. Retrospective search results are screened before they are submitted to the requester so that the requester receives only those abstracts judged relevant to his request.

A Selective Dissemination of Information (SDI) program is in operation to provide abstracts on a recurring basis to the technical personnel in the AFML participating in the SDI program. The SDI results are run and distributed for each update of the search file; each update represents the most recent input of indexed technical documents.

The effectiveness of the AMIC system is dependent on three basic operations which represent interactions of the information specialists with the system. These are: indexing, search strategy formulation and the screening of retrospective search results. The consistency of indexing was investigated in a previous UDRI study.[5]

3. INDEXER CONSISTENCY ANALYSIS

An evaluation procedure was developed to measure the indexing consistency of indexers in the AMIC program. The evaluation was based upon the choice of index terms of an experienced information specialist, as a standard of indexing performance. The selection of index terms chosen by trained indexers was compared.

Distinction was made between index terms which are essential for indexing a particular document and those which were helpful for retrieval but not essential to the information content. This distinction accommodates the indexing philosophy employed at UDRI governing the selection of index terms by which it is considered better to "overindex" (risking a false retrieval) than to "underindex" (risking nonretrieval of pertinent documents).

Studies of intra- and interindexer consistency were undertaken to determine the validity of using an experienced indexer's indexing as a reference standard and to assess the quality of indexing among various indexers. In 1966, 35 documents were selected which dealt primarily with chemistry as the primary subject. These documents were indexed independently by indexers and the information specialist. Several months later the experiment was repeated with another series of documents. Comparisons were made of essential terms, total terms, and time required for indexing. In 1967, the first set of 35 documents was recalled and indexing was performed by the two new indexer trainees and by two experienced indexers. Both experienced indexers were instructed to designate the essential terms for each indexed document.

By comparing the indexing performed by the same indexer of the same document, a statistical correlation coefficient was obtained for essential terms which served as a measure of intraindexer reliability or consistency. The common essential terms were obtained between the two experienced indexers as a measure of interindexer consistency. The statistical correlation techniques used were the phi coefficient ($\emptyset$) and chi square (X^2).

The essential and total terms were compared by groups and the degree of correlation was determined between groups. For intraindexer consistency, the first group of terms was taken from one year's indexing and compared with the second group of terms from other year's indexing, all taken from the same set of documents. The results show statistically significant correlation for essential terms regarding intraindexer and interindexer consistency.

Intraindexer consistency for the experienced information specialists was determined to be 78% overall and 92% for essential terms. When trained indexers were compared to experienced information specialists, the interindexer consistency was 62% overall and 83% for essential terms.

The UDRI results compare reasonably well with the human indexing consistency studies reviewed by Mary Elizabeth Stevens in Automatic Indexing: A State-of-the-Art Report. Table I contains a list of results. This is especially true when the consistency values are derived from the statistics on essential terms. However, it is important to recognize the difficulties of comparison across differences in systems operation and subject areas.

TABLE I

SUMMARY OF VARIOUS STUDIES OF INTER- AND INTRA-INDEXER CONSISTENCY[9]

	Inter-Indexer Consistency	Intra-Indexer Consistency
Macmillian and Welt	18%	
Kyle	70%	
AEC	65%, 54%	86%
Jacoby and Slamecka	20%	50%
Rodgers	59%	
Painter	62%	
Korotkin and Oliver	53%, 54%	
UDRI	62% (overall) 83% (essential terms)	78% (overall) 92% (essential terms)

Several aspects of the UDRI AMIC operation enhanced the quality of indexing consistency. These include the extensive training program with which all indexers are introduced to the system, the well-developed AMIC thesaurus, and the comparatively specialized subject area of materials information.

4. PURPOSE OF THE MOST RECENT EXPERIMENTS

Students have been trained to index with reasonable consistency for the AMIC system. The most recent study sought to determine the ability of trained students to prepare search strategies independently with similar recall and relevance results and to examine their relevance judgments. Student performance was compared with professionals in a typical request and search situation.

Various factors were recognized in studying relevance judgments. The amount of background in indexing and involvement with search requests could affect relevance judgments. Indexers from various disciplines were represented in the experiment. Since the same group of documents was used for eliciting relevance judgments, the formal academic training of the indexers might significantly affect their viewpoints in relevance judgments. Biology, chemistry, physics and engineering were disciplines represented among the indexers participating in the experiment. A fatigue factor is introduced by the quantity of abstracts for which relevance judgments must be made. Larger numbers of abstracts for a particular search for which judgments must be made may tend to reduce the discriminatory ability of persons applying relevance assessments.

A review of the literature suggested that certain situations could be expected. Specifically, Saracevic [10] suggests that persons with a particular subject expertise and professional involvement tend to display greater disagreement in judging a set of documents than persons with a more general background. Furthermore, the persons with less subject knowledge of the documents tend to be more lenient in their judgments of relevance. Another influential factor in relevance judgments is the judges' understanding of the intended use of the relevant documents.

In a more philosophical vein, Saracevic questions whether relevance judgment is a very subjective human process, or whether it has "associated with it regularity patterns that may be eventually utilized in the design of more effective IR systems." Saracevic says "agreement as to what is not relevant may be expected to be greater than agreement as to what is relevant; judging relevance is not the same as judging non-relevance."

Lancaster claims "a relevant document is a document that is useful to the requester in relation to the information need that prompted his request." Doyle[12] warns that "there may be a great difference between relevance to a given request statement and relevance to a person's real information need." The ideal would be "to retrieve all and only those documents the searcher would regard as relevant to his need if he could personally inspect every document in the library." In his exploratory study, Cuadra[13] considered the effect of academic and professional training on relevance judgments and concluded: "It appears likely that the disagreement at low experience levels stems from lack of knowledge, while that at higher levels reflects academic and interest specialization."

The AMIC experiments on the formulation of search strategies and on relevance judgments by various individuals were designed primarily to show the degree of consistency which could be expected by having different trained individuals perform these functions. It should be recognized that the experiments were specifically intended for the AMIC system which deals specifically with aerospace materials information. Furthermore, the individuals involved consisted of both trained students and professionals. Although a number of factors were recognized as contributing to results which might be obtained, the primary purpose was to determine if adequate reliability in AMIC searching and screening operations could be obtained with the personnel assigned to these functions.

SECTION II

DOCUMENT RETRIEVALS AS A FUNCTION OF SEARCH STRATEGY

The ability of information specialists to formulate effective search strategies in response to information requests is of great importance in the AMIC operations. As indicated earlier, the AMIC system depends on authorized keywords for indexing and retrieval. Retrieval is accomplished by Boolean logical linking of keywords with a cut-off feature, and access numbers corresponding to the various groupings of retrieval terms within the search are printed out.

The students employed by AMIC receive training in the formulation of search strategies after they have mastered the indexing function. Experienced student personnel as well as professionals have been used to process technical search requests. In order to determine the consistency with which trained students and professionals can formulate searches, it was desired to investigate search strategies derived independently for a group of searches on various subjects. Differences in search strategies between individuals would be expected, but the degree to which various strategies are able to retrieve the same documents and, specifically, the ability to retrieve relevant documents (see Section III on consistency of relevance judgments) is important. Ideally, the requester should be provided with those abstracts from the entire file of documents which are relevant for his needs. In order to provide relevant documents to the requester, it is first necessary to retrieve approximately the same groups of documents regardless of the information specialist formulating the search strategy. The experiment on document retrievals as a function of search strategy was to determine the degree to which similar retrieval results would be attained by various information specialists.

1. EXPERIMENTAL DESIGN

Ten retrospective search requests were selected from our files of previous actual search requests. Care was exercised to include a variety of subject areas. A list of the requests used in this experiment appears in Table II. The requests were processed by six trained student indexers with varying backgrounds and one professional information specialist. The students' backgrounds were as follows:

Student	Field of Study	Experience with AMIC
S1	Mathematics, Physics	18 mo.
S2	Biology, Chemistry	3 mo.
S3	Chemistry	15 mo.
S4	Chemistry	9 mo.
S5	Chemical Engineering	3 mo.
S6	Chemistry	3 mo.

TABLE II

RETROSPECTIVE SEARCH STATEMENTS

1) Diffusion bonding, diffusion welding, solid state bonding, or solid state welding of aluminum and aluminum alloys

2) The use of nematic liquid crystals in electro-optical display devices. There are three types of liquid crystals: nematic, cholesteric, and smectic. The first two are of special interest in that they are sometimes mixed for use in particular devices. The phenomenon of light-scattering by these materials is called dynamic scattering and the phase they are in is sometimes called mesomorphic. Temperature range -- 20°C to 80°C.

3) The effect of reentry environments on the thermochemical erosion characteristics of ablative plastic composites. Rain/dust erosion effects to be excluded.

4) Effect of heat treatment on microstructure and mechanical properties of titanium-6Al-4V.

5) Laser cutting

6) Flammability of organic and inorganic textile materials in all environments (air, oxygen, mixed gas system).

7) Production, forming or joining metal matrix composites. Ni, Al, Ti, Co, or Nb reinforced by metal wires; B, SiC, Al_2O_3, graphite etc. filaments; rods, thin films, or indigenous phase particles (in-situ reinforced composites).

8) Gallium phosphide for light emitting diodes, especially crystal growth and characterization.

9) The use of photochromic and thermochromic compounds for nondestructive inspection systems.

10) Adhesion of electroplated coatings to nonmetallic substrates (except ABS plastics or substrates).

Each indexer was instructed to formulate his own strategy independently for each request, following normal AMIC procedures. Index terms were selected using the AMIC Thesaurus as a guide. Boolean AND, OR, NOT logic was applied to the grouping of terms used for retrieval in the search strategy. The students also utilized the cutoff feature, which enables the returns to be sorted into groups in order of anticipated relevance and allows the separation of different sub-topics. All of the returns were screened for relevance by an information specialist who was not involved in the strategy formulation aspect of the experiment.

Certain assumptions were made in the conduct of the experiment. First, it was assumed that among all the strategies prepared all of the relevant documents would be represented. This assumption is of course an approximation, since practical considerations obviate the possibility of manually screening the entire file of 60,000 documents. A second assumption was that the relevance judgments applied to the search returns by an independent information specialist were sufficiently consistent to serve as a basis for recall and precision. Third, because of the cutoff feature, certain search strategy results included groups representing large numbers of documents known to have low relevance. This situation is consistent with the AMIC philosophy of effecting high recall, but in those cases where the screening process would have been prohibitive and it was known that very low relevance would have resulted, these groups were omitted from screening.

2. CRITERIA FOR ANALYSIS

The primary consideration for analyzing the results was the ability of retrieval strategies prepared by different individuals to elicit from the entire document file similar document subsets. In particular, it would be most desirable for a high degree of consistency to occur among the various individuals for those documents actually considered relevant.

Another consideration for assessing the performance of various search strategies is the precision and recall performance. Precision is defined as the proportion of relevant documents retrieved to the total documents retrieved and recall is defined as the proportion of relevant documents retrieved to the total available relevant documents; the approximation of total available relevant documents should be kept in mind.

A third criterion is the degree to which the same retrieval terms were used among the various individuals for retrieval in response to a given request. A related factor is the number of distinct individual retrieval terms used by each person. It should be noted that with the AMIC search program a given term can be used more than once to achieve sorting of the documents retrieved.

3. RESULTS

The number of documents retrieved by each person's strategy for all ten searches is given in Tables III - XII. These tables also indicate the precision and recall results. The commonality of the relevant retrievals is shown by a frequency distribution. The commonality refers to the number of searchers out of seven retrieving the same relevant documents. Table XIII gives the combined results for all ten searches. Precision, also called relevance, is defined as the ratio of the relevant documents retrieved to the total number of documents retrieved. Recall is defined as the ratio of the relevant documents actually retrieved to the number of relevant documents available; in this study the number of relevant documents available is assumed to be the summation of the relevant documents retrieved by all searchers. The search results indicate a considerable variation between individual searches. For certain searches there is surprising uniformity, whereas for others much variation occurs both with search strategy and with results obtained. In analyzing the search strategies it was found that in some cases the inclusion or exclusion of a particular term can make a great difference in retrieval results. This was particularly true in the case of RS 9, in which Searcher S5 included the term LIQUID CRYSTALS. This term retrieved many relevant documents which were not retrieved by the others. In Search RS 1, one individual used more general terminology for retrieval resulting in a large number of retrieved documents.

Referring to Table XIII, one can see that there is relatively little difference between precision and recall ratios among various individuals across the ten searches. As would be expected, [9] the recall tends to vary inversely with the precision. This trend is shown in Figure 1.

To evaluate the effect of the number of individual terms in the search strategy on precision and recall, terms used by each searcher for each request was examined as shown in Table XIV. From each searcher's average number of individual terms in relation to average recall as shown in Figure 2, recall increases with more terms in the strategies, but this effect becomes less pronounced as the overall number of individual terms increases. The recall achieved by searcher S3 using 10.2 terms per search strategy does not significantly exceed that of another searcher P1 using 8.0 terms per search strategy. It should also be noted that the number of retrieval terms is only an indication of the retrievals to be anticipated. The posting density of documents under the terms also has an effect.

To obtain an indication of the degree of consistency among searchers, a frequency distribution of search terms was determined as shown in Table XV. According to this table, the frequency with which nearly all searchers used the same term for retrieval was fairly high. On the other hand, for many searches a number of retrieval terms was used by only one or two of the searchers. It is interesting to note that even with a fairly high degree of variability in the terms used for retrieval, the precision and recall results

for most individuals was nearly the same. This situation can be attributed in large measure to the fact that many of the same documents are retrieved even with different strategies. This, in turn, reflects the AMIC philosophy of indexing documents in some depth (about 20 terms per document before automatic hierarchical posting), to index with specificity and to use as many portions of the document as necessary (up to the complete text of the document) as a source of index terms.

Since search strategies and the corresponding results varied among individuals, it was considered whether experience might influence average precision and recall. However, the two most experienced student searchers (S3 and S1) tended respectively toward the highest and lowest recall rates. The same situation is true for two of the less experience searchers. S2 had the highest and S6 the lowest recall of the entire group. The professional information specialist P1 was among the searchers achieving high recall.

The consistency of results of different searchers on the same request varied considerably for different requests, indicating that perhaps the nature and wording of the statement are important. Some requests are concise and fairly straightforward, and the principal terms in the request used are also AMIC thesaurus terms. Other requests, however, leave considerable latitude for variation in term selection. This is due in some cases to ambiguous statement of the request.

Search RS 4 is one of the more direct and clearly-worded requests. All of its key terms (HEAT TREATMENT, MECHANICAL PROPERTIES, MICROSTRUCTURE, and TITANIUM-Al-V) are AMIC terms, so that little imaginative effort is necessary for expression of these concepts. As a result, for an average of 5.3 individual terms used for this search, these 4 AMIC terms were used by at least 6 searchers, (3 of these terms were used by all 7). Four searchers had identical returns as a result of using a variation of this strategy:

AND	TITANIUM-Al-V
AND	HEAT TREATMENT
AND	MECHANICAL PROPERTIES
OR	MICROSTRUCTURE

The other three searchers used a few other related terms in addition to those in the above strategy. One such strategy was:

AND	TITANIUM-AL-V
AND	HEAT TREATMENT
OR	CHARRING
OR	QUENCHING
OR	HEATING
AND	MICROSTRUCTURE
OR	MECHANICAL PROPERTIES

As a result of this consistency in strategy formulation, 39 (60%) of the 65 relevant documents returned were found by at least 6 searchers. Twelve of these documents were retrieved by everyone. This consistency is reflected in the recall statistics. Five of seven searchers had recall higher than 0.70, and all seven achieved recall greater than 0.50.

When the results from Search RS 3 is examined, a different trend is observed. Since the phrase "thermochemical erosion" is not directly represented in the AMIC Thesaurus, many different terms (EROSION, SPALLING, ABRASION, DECOMPOSITION, SUBLIMATION, VAPORIZATION, CHEMICAL REACTIONS, etc.) were used by various individuals to express this concept. The average strategy used 9.7 individual terms for this request; only three of these terms were common to six or more searchers. Some strategies were short and restrictive, like the following:

NOT	RAIN
NOT	SAND
NOT	WEATHERING
AND	RE-ENTRY
OR	RE-ENTRY VEHICLES
AND	ABLATION
AND	POLYMER COMPOSITES
AND	EROSION

Other strategies, however, were quite long and allowed for much broader coverage of the subject:

NOT	RAIN
NOT	SUSPENSIONS
AND	POLYMER COMPOSITES
AND	RE-ENTRY
OR	RE-ENTRY VEHICLES
AND	ABLATION
OR	DECOMPOSITION
OR	CHEMICAL REACTIONS
OR	VOLATILIZATION
OR	SUBLIMATION
OR	VAPORIZATION
AND	EROSION
OR	SPALLING
OR	SURFACES
OR	RE-ENTRY
AND	EROSION
OR	SPALLING
OR	SURFACES
AND	RE-ENTRY
AND	EROSION

Because the strategy formulations differed so widely for this request, there was little consistency in results. Of a total of 35 relevant documents retrieved, only 2 (6%) were common to more than two different searchers. 20 relevant documents were retrieved only once. As a result of this inconsistency, recall figures were low: 4 searchers had a recall of less than 0.25 while only one searcher attained a recall of more than 0.5.

The variation of consistency in search strategies and results with the nature of the search request seems to indicate that, in some cases, clarification of the request statement would have improved search results. Normally, the searcher is able to contact the original requester if the request statement is not clear. However, due to the design of this experiment, the searchers were required to work only from the written request.

TABLE III

SEARCH RS* 1

Individual Searcher	Total Documents Retrieved	Relevant Documents Retrieved	Precision	Recall
S1**	52	20	.38	.32
S2	243	60	.25	.97
S3	145	30	.21	.48
S4	69	20	.29	.32
S5	32	13	.41	.21
S6	1	1	1.00	.02
P1***	79	21	.27	.34

Commonality of Retrieval Among Searchers****	No. of Relevant Documents Retrieved
7 out of 7	1 (2%)
6 out of 7	8 (13%)
5 out of 7	8 (13%)
4 out of 7	2 (3%)
3 out of 7	1 (2%)
2 out of 7	17 (27%)
1 out of 7	25 (40%)
Total relevant documents*****	62

*RS = Retrospective Search

**S = Student

***P = Professional

****
Number of searchers out of seven who retrieved the same document

*****The total relevant documents refers to the approximation that the summation of relevant documents retrieved by all seven searchers represents the total available relevant documents.

TABLE IV

SEARCH RS 2

Individual Searcher	Total Documents Retrieved	Relevant Documents Retrieved	Precision	Recall
S1	18	10	.55	.91
S2	NA*	NA	NA	NA
S3	20	6	.30	.55
S4	18	10	.55	.91
S5	9	6	.66	.55
S6	NA	NA	NA	NA
P1	18	10	.55	.91

*NA = Not available

Commonality of Retrieval Among Searchers	No. of Relevant Documents Retrieved
5 out of 5	5 (45%)
4 out of 5	1 (9%)
3 out of 5	4 (36%)
2 out of 5	0 (0%)
1 out of 5	1 (9%)
Total relevant documents	11

TABLE V

SEARCH RS 3

Individual Searcher	Total Documents Retrieved	Relevant Documents Retrieved	Precision	Recall
S1	3	2	.67	.06
S2	53	20	.37	.57
S3	13	6	.46	.17
S4	15	11	.73	.31
S5	7	3	.43	.09
S6	2	2	1.00	.06
P1	20	11	.55	.31

Commonality of Retrieval Among Searchers	No. of Relevant Documents Retrieved
7 out of 7	0 (0%)
6 out of 7	1 (3%)
5 out of 7	1 (3%)
4 out of 7	0 (0%)
3 out of 7	0 (0%)
2 out of 7	13 (37%)
1 out of 7	20 (57%)
Total relevant documents	35

TABLE VI

SEARCH RS 4

Individual Searcher	Total Documents Retrieved	Relevant Documents Retrieved	Precision	Recall
S1	123	48	.39	.74
S2	123	48	.39	.74
S3	205	43	.21	.66
S4	134	51	.38	.78
S5	123	48	.39	.74
S6	128	35	.27	.54
P1	123	48	.39	.74

Commonality of Retrieval Among Searchers	No. of Relevant Documents Retrieved
7 out of 7	12 (18%)
6 out of 7	27 (41%)
5 out of 7	9 (13%)
4 out of 7	0 (0%)
3 out of 7	2 (3%)
2 out of 7	9 (13%)
1 out of 7	6 (9%)
Total relevant documents	65

TABLE VII

SEARCH RS 5

Individual Searcher	Total Documents Retrieved	Relevant Documents Retrieved	Precision	Recall
S1	4	3	.75	.33
S2	19	9	.47	1.00
S3	19	9	.47	1.00
S4	19	9	.47	1.00
S5	19	9	.47	1.00
S6	19	9	.47	1.00
P1	16	8	.50	.89

Commonality of Retrieval Among Searchers	No. of Relevant Documents Retrieved
7 out of 7	3 (33%)
6 out of 7	6 (67%)
5 out of 7	0 (0%)
4 out of 7	0 (0%)
3 out of 7	0 (0%)
2 out of 7	0 (0%)
1 out of 7	0 (0%)
Total relevant documents	9

TABLE VIII

SEARCH RS 6

Individual Searcher	Total Documents Retrieved	Relevant Documents Retrieved	Precision	Recall
S1	26	14	.54	.67
S2	26	14	.54	.67
S3	66	19	.29	.90
S4	20	10	.50	.48
S5	7	4	.57	.19
S6	26	14	.54	.67
P1	21	11	.52	.52

Commonality of Retrieval Among Searchers	No. of Relevant Documents Retrieved
7 out of 7	3 (14%)
6 out of 7	4 (19%)
5 out of 7	4 (19%)
4 out of 7	3 (14%)
3 out of 7	2 (10%)
2 out of 7	5 (24%)
1 out of 7	0 (0%)
Total relevant documents	21

TABLE IX

SEARCH RS 7

Individual Searcher	Total Documents Retrieved	Relevant Documents Retrieved	Precision	Recall
S1	51	25	.49	.45
S2	15	7	.47	.13
S3	82	37	.45	.66
S4	102	37	.36	.66
S5	75	34	.45	.60
S6	40	17	.42	.30
P1	109	48	.44	.86

Commonality of Retrieval Among Searchers	No. of Relevant Documents Retrieved
7 out of 7	1 (2%)
6 out of 7	11 (20%)
5 out of 7	11 (20%)
4 out of 7	8 (14%)
3 out of 7	4 (6%)
2 out of 7	13 (23%)
1 out of 7	8 (14%)
Total relevant documents	56

TABLE X

SEARCH RS 8

Individual Searcher	Total Documents Retrieved	Relevant Documents Retrieved	Precision	Recall
S1	6	5	.83	.20
S2	48	25	.52	1.00
S3	33	18	.54	.72
S4	11	7	.64	.28
S5	11	7	.64	.28
S6	11	7	.64	.28
P1	48	25	.52	1.00

Commonality of Retrieval Among Searchers	No. of Relevant Documents Retrieved
7 out of 7	5 (20%)
6 out of 7	2 (8%)
5 out of 7	0 (0%)
4 out of 7	0 (0%)
3 out of 7	11 (44%)
2 out of 7	7 (28%)
1 out of 7	0 (0%)
Total relevant documents	25

TABLE XI

SEARCH RS 9

Individual Searcher	Total Documents Retrieved	Relevant Documents Retrieved	Precision	Recall
S1	2	1	.50	.05
S2	2	1	.50	.05
S3	4	3	.75	.14
S4	4	3	.75	.14
S5	40	19	.47	.91
S6	2	1	.50	.05
P1	2	1	.50	.05

Commonality of Retrieval Among Searchers	No. of Relevant Documents Retrieved
7 out of 7	0 (0%)
6 out of 7	1 (5%)
5 out of 7	0 (0%)
4 out of 7	0 (0%)
3 out of 7	0 (0%)
2 out of 7	1 (5%)
1 out of 7	19 (90%)
Total relevant documents	21

TABLE XII

SEARCH RS 10

Individual Searcher	Total Documents Retrieved	Relevant Documents Retrieved	Precision	Recall
S1	32	5	.16	.26
S2	32	5	.16	.26
S3	76	15	.20	.79
S4	44	9	.20	.47
S5	8	1	.13	.05
S6	10	2	.20	.11
P1	36	5	.14	.26

Commonality of Retrieval Among Searchers	No. of Relevant Documents Retrieved
7 out of 7	1 (5%)
6 out of 7	1 (5%)
5 out of 7	1 (5%)
4 out of 7	2 (11%)
3 out of 7	0 (0%)
2 out of 7	2 (11%)
1 out of 7	12 (63%)
Total relevant documents	19

TABLE XIII

COMBINED RS SEARCHES

Individual Searches	Total Documents Retrieved	Relevant Documents	Precision (document basis) *	Recall (document basis)	Precision (search basis)**	Recall (search basis)
S1	317	133	.42	.41	.53	.41
S2	561	189	.34	.58	.41	.61
S3	663	186	.28	.57	.36	.60
S4	436	167	.38	.52	.49	.55
S5	331	144	.43	.44	.46	.46
S6	239	88	.37	.27	.56	.34
P1	472	188	.40	.58	.44	.59

Commonality of Retrieval Among Searchers	No. of Relevant Documents Retrieved
7 out of 7	26 (8%)
6 out of 7	66 (20%)
5 out of 7	35 (11%)
4 out of 7	19 (6%)
3 out of 7	20 (6%)
2 out of 7	68 (21%)
1 out of 7	90 (28%)
Total relevant documents	324

*Document basis refers to the precision and recall obtained from the total number of documents retrieved for ten searches

**Search basis refers to the mean average precision and recall for ten searches

TABLE XIV

NUMBER OF INDIVIDUAL RETRIEVAL TERMS* USED IN SEARCH

SEARCHES RS 1 - RS 10

SEARCHER	RS 1	RS 2	RS 3	RS 4	RS 5	RS 6	RS 7	RS 8	RS 9	RS 10	AVERAGE
S1	7	5	8	4	3	8	17	6	4	3	6.5
S2	7	NA	10	4	4	8	20	3	5	3	7.4
S3	5	8	14	8	4	14	20	9	10	10	10.2
S4	6	4	7	7	5	6	20	6	6	10	7.7
S5	11	6	8	6	4	10	16	9	5	5	8.0
S6	7	NA	10	4	3	7	12	7	3	4	6.3
P1	8	6	14	4	2	6	14	11	6	8	7.9
AVERAGE	7.3	5.8	9.7	5.3	3.6	8.4	17.0	7.3	5.6	6.1	

*Boolean NOT Terms excluded

TABLE XV

COMMONALITY OF RETRIEVAL TERMS USED IN SEARCHING

Commonality of Retrieval Terms among Searchers	RS 1	RS 2* (5 searches)	RS 3	RS 4	RS 5	RS 6	RS 7	RS 8	RS 9	RS 10	Total
7 out of 7	3	NA	3	3	2	2	6	3	1	2	25
6 out of 7	1	NA	0	1	1	2	5	0	3	1	14
5 out of 7 (5)*	1	2	3	0	0	2	0	1	1	0	10
4 out of 7 (5)*	1	1	0	0	1	1	3	1	0	1	9
3 out of 7 (5)*	2	2	4	0	0	0	1	0	0	1	11
2 out of 7 (5)*	1	2	7	1	0	5	9	2	2	2	31
1 out of 7 (5)*	10	5	9	8	2	6	14	13	5	17	89

* Results based on five searchers' results for this search

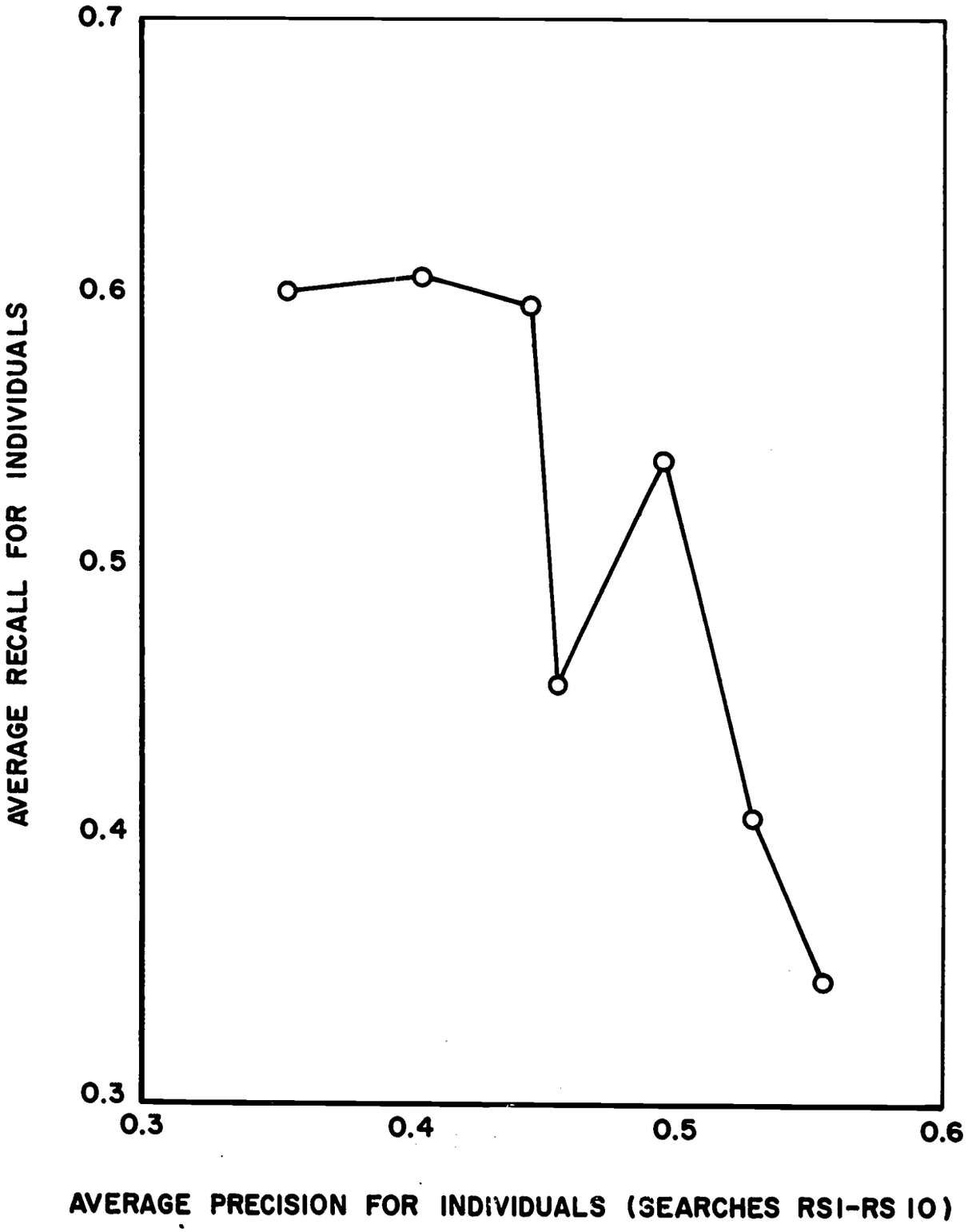

Figure 1. Recall as a Function of Precision

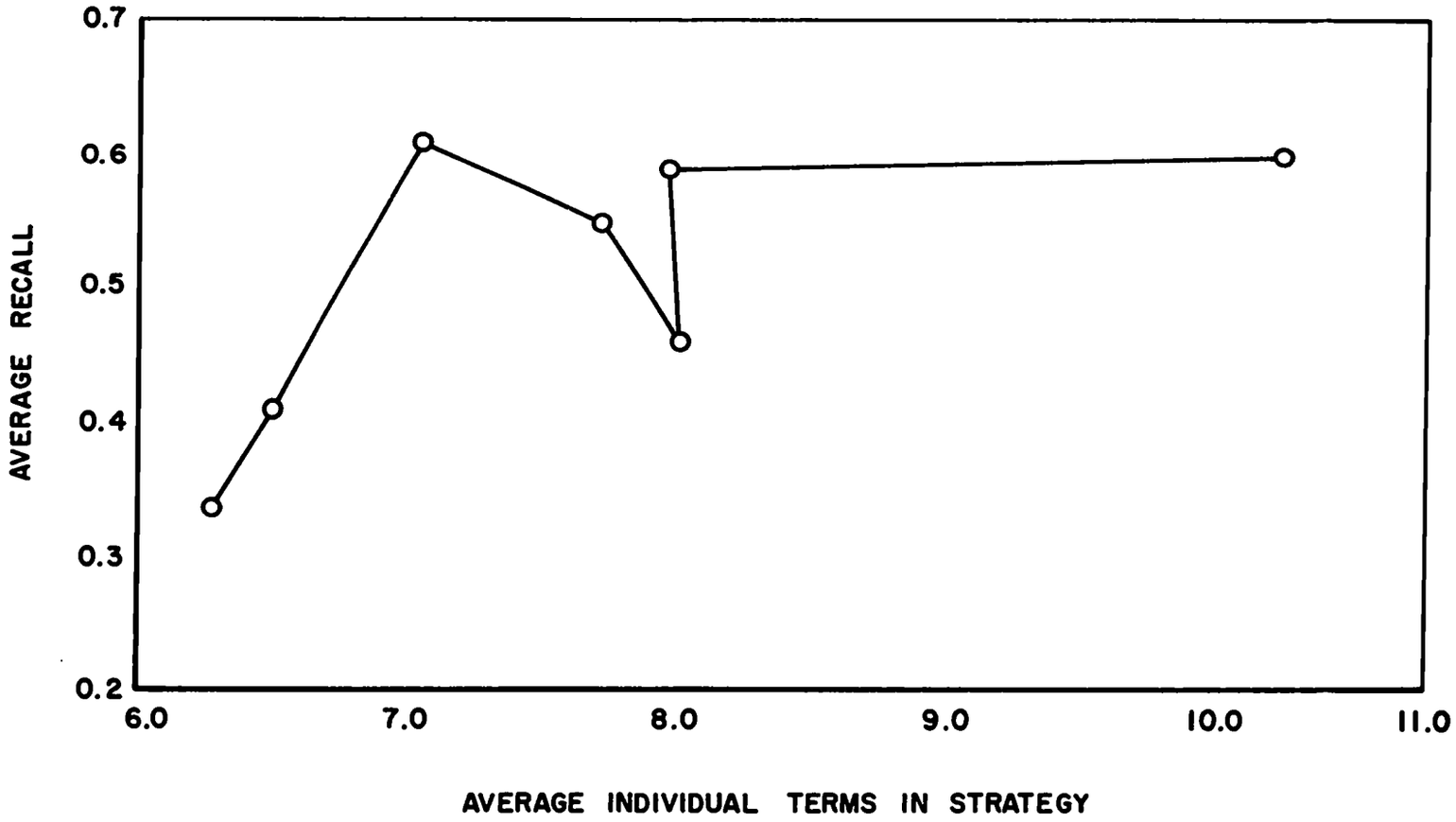

Figure 2. Recall as a Function of Individual Terms in Strategies

SECTION III

CONSISTENCY OF RELEVANCE JUDGMENTS OF INFORMATION SPECIALISTS

The consistency of relevance judgments of various individuals associated with the screening of AMIC searches is an important factor, because the material received by the requester is dependent on the relevance judgments assigned by the information specialist. The AMIC system philosophy of searching is to strive for high recall to ensure that failure to retrieve relevant documents does not occur. With high recall, there is also a tendency toward low relevance. To provide the requester with useful documents, all search results are screened, and a judgment of relevance is applied by the information specialist. The judgments are indicated as probably relevant, possibly relevant and not relevant. The abstracts and index cards corresponding to the retrieved documents serve as the basis for judgment. Only those abstracts deemed either probably relevant or possibly relevant are actually forwarded to the requester, thus obviating the need for him to look through nonrelevant material. A prime consideration in this process is the consistency with which relevance judgments are applied by various information specialists.

1. EXPERIMENTAL DESIGN

The basic philosophy of the experimental design was to simulate actual AMIC operations as closely as possible. Four search results were selected. These were composed of four groups of retrieved access numbers designated as Group A, Group B, Group C and Group D. For each group, a statement of the search request was provided. The retrieved abstracts were compared one at a time with the search request statement and a relevance judgment of probably relevant, possibly relevant, and nonrelevant was indicated for each abstract by each individual participant in the experiment. Six trained students in technical disciplines took part in the experiment. Group C was also screened by two professional information specialists. The search request statements were as follows:

Group A 205 documents	Interest is in vibration damping, especially of aircraft, aerospace vehicles and components thereof. Keywords: vibration damping, vibration theory, infrasonic vibration, mechanical vibration, flexural vibration, vibration damping, vibration measurement, vibration analysis, vibration synthesis vibration simulation, vibration stress, acoustic damping, acoustic shielding, noise, structural vibration.

Group B 196 documents	The entire area of hypervelocity impact is of interest including materials, testing methods and theoretical studies. Hypervelocity is being explored in connection with research on the meteoroid hazard to spacecraft, impact craters on planetary surfaces, material properties under conditions of shock loading. Meteoroid protection, debris clouds, impact craters, shock waves, shock hydrodynamics, shock physics, gas guns, powder guns, sensors for impact measurement, computer programs and simulation of impact, rain erosion, high pressure and velocity behavior of materials, explosions and effects on materials. Nuclear physics is <u>not</u> of interest.
Group C 213 documents	Interest is in protective coatings to prevent corrosion. Electrochemical and stress corrosion are of particular concern. Inorganic polymers, semi-organic polymers, silicones, phosphonitrile materials as nonrigid coatings are of interest. High temperature environments are of interest, it is desired to develop a semiflexible high temperature resistant coating. The area of interest is research and development oriented.
Group D 112 documents	Interest is in erosion resistant coatings both metallic and nonmetallic; the application is for turbine blade coatings in gas turbine engines.

2. CRITERIA AND METHOD FOR ANALYSIS RESULTS

The basic criterion for analyzing the results was the degree of agreement among the participants in the experiment. The three-value relevance judgment conditions represented by probably relevant (✓or C), possibly relevant (X), and nonrelevant (O) were used. For any two given individuals, the following combinations of values could occur, namely, C-C, X-X, O-O, C-O, X-O, X-C. To analyze the consistency of the relevance judgment results of the six students, the frequencies of the six possible combinations were derived by considering two students at a time until all possible combinations of students had been exhausted. In this way, a composite frequency distribution for all students was calculated and presented in terms of percentages. This procedure was repeated for all four searches. In the case of the two professional indexers, only a single calculation was needed, since only two individuals and one search group was involved.

Another aspect of interest was the degree of variation between the various groups of documents screened. This degree of variation was expressed in terms of the standard deviation among the four searches for each relevance judgment combination. The standard deviation represents the tendency of data to cluster about the mean value. Eighty-four percent of the data will fall within two standard deviations of the mean value. Therefore the smaller the standard deviation, the less variability of data occurs.

3. RESULTS

The results are presented in Tables XVI-XX. These tables show the frequencies with which indexers taken two at a time agree and disagree on their relevance judgments. The columns are ordered from left to right such that the left hand column represents the best situation (agreement that the document is nonrelevant) and the right hand column represents the worst situation (one person judges that the document is probably relevant, the other judges that the document is nonrelevant).

For Group C shown in Table XVIII two professionals also screened the document group for relevance. A comparison of the performance of professionals for Group C with the performance of the composite group of students tends to indicate that the professionals tended to agree better on judgments of nonrelevance. However, it is surprising to see that the frequency of disagreement as indicated by the frequency of O-C is actually higher than for the student composite.

Table XX shows that there may be some difference between searches as indicated by the standard deviations for the six possible combinations of agreement on relevance. The standard deviation for the O-O condition is very small. This finding suggests that differences in subject matter and search statements probably have little effect on the composite relevance judgments.

The normal procedure in the AMIC operation is for the information specialist performing the search to screen the search results for relevance and to forward probably relevant and possibly relevant abstracts to the requester. The differentiation is made primarily as an aid to the requester so that he can decide if he wishes to review all the abstracts or just those indicated as having close relevance to his request. Thus, both C and X abstracts are forwarded. Nonrelevant abstracts are not sent in order to preclude the need for the requester to have to sort through them. Therefore, from the standpoint of reviewing the results of the experiment, the situation in which disagreement of relevance value occurs between a C and an X is not as significant as disagreements resulting in O-C or O-X, since the latter situation would cause the document either to be sent or not to be sent.

The experiment shows that there is fairly good agreement on nonrelevant abstracts but there is significantly less agreement regarding the attributes which cause an abstract to be judged probably relevant or possibly relevant. An additional factor which is not accounted for in this experiment is the judgment of relevance which would have been assigned by the requester himself. However, previous UDRI studies [7, 8] indicated that generally requesters were satisfied with the relevance of material received. The findings of this experiment show that although the judgment of nonrelevance

is fairly good, the judgment of relevance is much more difficult. The practical result of the findings is that the group of abstracts actually forwarded to the requester for any given search request will vary depending on the information specialist handling the request.

An informal study was made of the possibility of using a two-value relevance judgment system for the screening of abstracts; that is, the abstract must be judged either as relevant or nonrelevant. The results of this brief study indicated that judging with a two-value situation required more time in decision making and usually resulted in fewer abstracts which would have been sent to the requester.

With reference to other studies on relevance, [9,10,11,12,13,14,15,16,17] our results tend to confirm findings of some others that relevance judgments are somewhat elusive. Many factors can contribute to variations in relevance judgments including the experience and background of the individual judge, the understanding and interpretation of the request statement, the content of the abstracts being screened, and others. There seems to be a difference in judging nonrelevance in contrast to judging relevance, as indicated by Saracevic[11].

TABLE XVI

CONSISTENCY OF RELEVANCE JUDGMENTS FOR ABSTRACTS IN GROUP A (205 ABSTRACTS)

Pairing	Relevance Judgment Condition (Frequency %)					
	O-O	C-C	X-X	X-C	O-X	O-C
* S1 - S2	64.4%	5.4%	7.9%	8.3%	15.1%	3.9%
S1 - S3	38.1%	8.8%	4.9%	11.2%	25.8%	11.2%
S1 - S4	69.9%	5.4%	2.4%	7.8%	9.8%	4.9%
S1 - S5	63.5%	7.8%	1.0%	10.7%	10.2%	6.8%
S1 - S6	37.1%	8.8%	2.9%	11.2%	17.5%	22.4%
S2 - S3	35.1%	9.8%	3.4%	11.2%	29.8%	11.7%
S2 - S4	65.4%	7.8%	2.0%	3.9%	14.6%	6.3%
S2 - S5	60.0%	9.3%	3.4%	9.7%	10.2%	11.2%
S2 - S6	34.6%	11.2%	3.9%	7.8%	19.0%	23.4%
S3 - S4	36.1%	11.2%	2.4%	5.4%	29.8%	15.1%
S3 - S5	35.1%	17.5%	3.4%	7.3%	26.3%	10.2%
S3 - S6	27.3%	23.4%	8.3%	18.5%	17.1%	5.4%
S4 - S5	63.0%	8.8%	1.0%	5.4%	8.8%	13.2%
S4 - S6	38.0%	11.7%	2.0%	6.3%	17.5%	24.9%
S5 - S6	34.2%	16.6%	0.5%	9.3%	18.0%	21.4%
Mean percent	46.8%	10.9%	3.0%	8.7%	17.9%	12.8%

* S = Student

TABLE XVII

CONSISTENCY OF RELEVANCE JUDGMENTS FOR ABSTRACTS IN GROUP B (196 ABSTRACTS)

Pairing	Relevance Judgment Condition (Frequency %)					
	O-O	C-C	X-X	X-C	O-X	O-C
* S1 - S2	45.4%	18.9%	3.6%	7.1%	17.9%	7.1%
S1 - S3	33.7%	20.9%	9.7%	9.2%	21.9%	4.6%
S1 - S4	48.0%	13.8%	1.0%	8.7%	20.4%	8.2%
S1 - S5	48.5%	14.8%	2.0%	4.1%	18.4%	12.2%
S1 - S6	44.9%	19.4%	5.1%	8.2%	15.8%	6.6%
S2 - S3	37.8%	18.9%	4.6%	6.6%	9.7%	10.2%
S2 - S4	59.7%	13.8%	1.0%	6.6%	9.7%	9.2%
S2 - S5	59.2%	14.8%	0.0%	3.1%	10.7%	12.2%
S2 - S6	54.1%	19.9%	3.1%	5.1%	10.2%	7.7%
S3 - S4	38.8%	14.8%	1.0%	6.6%	28.1%	10.7%
S3 - S5	39.8%	16.3%	2.6%	1.5%	25.5%	14.3%
S3 - S6	36.7%	19.4%	4.6%	8.7%	21.9%	8.7%
S4 - S5	67.3%	13.3%	0.5%	3.6%	8.2%	7.1%
S4 - S6	57.7%	13.8%	1.5%	7.7%	9.7%	9.7%
S5 - S6	58.2%	15.8%	0.5%	4.1%	10.7%	10.7%
Mean percent	48.6%	16.6%	2.7%	6.1%	16.7%	9.3%

* S = Student

TABLE XVIII

CONSISTENCY OF RELEVANCE JUDGMENTS FOR ABSTRACTS IN GROUP C (213 ABSTRACTS)

Pairing	Relevance Judgment Condition (Frequency %)					
	O-O	C-C	X-X	X-C	O-X	O-C
* S1 - S2	53.1%	3.8%	3.3%	4.2%	27.7%	8.0%
S1 - S3	54.9%	5.2%	3.3%	3.3%	22.5%	10.8%
S1 - S4	53.1%	10.3%	4.7%	7.0%	17.4%	7.5%
S1 - S5	51.2%	9.9%	5.6%	6.6%	18.3%	8.5%
S1 - S6	30.0%	9.9%	7.0%	12.2%	24.4%	16.4%
S2 - S3	64.8%	2.8%	4.7%	3.8%	18.3%	5.6%
S2 - S4	56.8%	4.7%	4.2%	6.6%	17.8%	9.9%
S2 - S5	56.3%	3.8%	4.2%	8.9%	17.8%	8.9%
S2 - S6	32.9%	4.2%	4.2%	13.1%	28.2%	17.4%
S3 - S4	55.9%	5.2%	1.4%	6.6%	17.4%	13.6%
S3 - S5	54.0%	5.2%	1.4%	6.6%	19.7%	13.1%
S3 - S6	33.8%	7.0%	2.8%	11.3%	26.8%	18.3%
S4 - S5	60.6%	17.4%	12.2%	2.3%	3.8%	3.8%
S4 - S6	29.1%	13.1%	5.2%	10.3%	24.4%	17.8%
S5 - S6	29.6%	13.6%	6.1%	11.3%	23.9%	15.5%
+ P1 - P2	69.0%	2.3%	1.4%	3.8%	8.9%	14.6%
Mean percent	47.7%	7.7%	4.7%	7.6%	20.6%	11.7%
Professional	69.0%	2.3%	1.4%	3.8%	8.9%	14.6%

* S = Student + P = Professional

TABLE XIX

CONSISTENCY OF RELEVANCE JUDGMENTS FOR ABSTRACTS IN GROUP D (112 ABSTRACTS)

Pairing	Relevance Judgment Condition (Frequency %)					
	O-O	C-C	X-X	X-C	O-X	O-C
* S1 - S2	52.7%	5.4%	1.1%	3.6%	26.8%	8.9%
S1 - S3	40.2%	7.1%	8.0%	10.7%	30.4%	3.6%
S1 - S4	70.5%	8.0%	0.9%	8.0%	10.7%	1.8%
S1 - S5	54.5%	6.3%	1.8%	7.1%	23.2%	7.1%
S1 - S6	64.3%	7.1%	5.4%	8.9%	9.8%	4.5%
S2 - S3	40.2%	7.1%	13.4%	7.1%	23.2%	8.9%
S2 - S4	59.8%	6.3%	0.0%	1.8%	18.8%	13.4%
S2 - S5	60.7%	8.0%	9.8%	5.4%	8.9%	7.1%
S2 - S6	52.7%	5.4%	1.8%	4.5%	21.4%	14.3%
S3 - S4	42.9%	12.5%	0.9%	4.5%	35.7%	3.6%
S3 - S5	41.1%	9.8%	14.3%	6.3%	20.5%	8.0%
S3 - S6	42.0%	9.8%	6.3%	11.6%	26.8%	3.6%
S4 - S5	62.5%	8.9%	0.0%	3.6%	15.2%	9.8%
S4 - S6	70.5%	12.5%	0.9%	3.6%	8.9%	3.6%
S5 - S6	52.7%	8.0%	0.9%	4.5%	21.4%	12.5%
Mean percent	53.8%	8.2%	4.5%	6.1%	20.1%	7.4%

*S = Student

TABLE XX

DIFFERENCES OF RELEVANCE JUDGMENTS FOR DIFFERENT GROUPS

	Relevance Judgment Condition (Mean %)					
	O-O	C-C	X-X	X-C	O-X	O-C
Group A	46.8%	10.9%	3.0%	8.7%	17.9%	12.8%
Group B	48.6%	16.6%	2.7%	6.1%	16.7%	9.3%
Group C	47.7%	7.7%	4.7%	7.6%	20.6%	11.7%
Group D	53.8%	8.2%	4.5%	6.1%	20.1%	7.4%
Composite Mean	49.2%	10.8%	3.7%	7.1%	18.8%	10.3%
Variance	7.4%	12.4%	0.7%	1.2%	2.4%	4.4%
Standard Deviation	2.7%	3.5%	0.9%	1.1%	1.6%	2.1%

SECTION IV

CONCLUSIONS

The results of the experiments on determining document retrievals as a function of search strategy and the consistency of relevance judgments of information specialists tended to show that overall consistency among various individuals is extremely difficult to achieve. Our earlier study on indexer consistency showed that the indexing function is probably the easiest factor to control. Good indexing consistency is not entirely unexpected, since the indexer has available to him the entire text of a document for reference in conjunction with the AMIC thesaurus and other reference materials. Consequently the meaning and intent of the document usually can be recognized and AMIC index terms can be selected with relative ease.

In the case of retrieving documents from the AMIC system, one is provided with a fairly short statement of a request, although at times the request statement can be so detailed that improper retrieval terms may be suggested. Thus the problem of properly interpreting a search request and properly correlating it with the available retrieval terms even with the aid of a carefully constructed thesaurus is much more difficult than the indexing problem. Perhaps an encouraging result was that even with fairly wide variations in strategy, reasonably consistent document returns were obtained. The number of relevant documents recalled seems to increase with an increasing number of individual retrieval terms. This result is not surprising, since the possibilities for retrieval increase with an increased number of retrieval terms. However, there is the risk of poorer precision.

The consistency of relevance judgments among information specialists is also based on the interpretation of the search request. Furthermore, the information specialist also must correlate his relevance judgment based on an abstract of the document with his interpretation of the search request. Thus the judgment of relevance is probably the most difficult of the three tasks of indexing, search strategy formulation and screening for relevance. There did seem to be better agreement on judging abstracts to be nonrelevant than on judging the relevance of abstracts.

The experiments pointed out that document retrieval even from the well-established AMIC system is a difficult and highly interactive process involving the search requester, the information specialist and the information storage and retrieval system itself. Because of the many possibilities for differences in human expressions, interpretations and judgments, variability seems inherent in the overall process of information storage and retrieval.

In general it is important that the best possible communication take place between the information requester, the information specialist and the retrieval system itself. Since the possibilities for variability are recognized, the best policy for the information specialist is not to be too restrictive either in search strategy formulation or in screening for relevance. The current AMIC procedures of using the cutoff feature in searching to achieve maximum recall and in providing both relevant and partially relevant abstracts to the requester appear to represent an appropriate means of providing the best results to the ultimate requester.

SECTION V

DOCUMENT RETRIEVAL SYSTEM OPERATION

1. INPUT

During the period covered by this report, 1 Dec 70 through 30 Nov 71, 8913 documents were indexed and processed into the system. Of this number, 88 were handbooks, 109 were state of the art, 76 were bibliographies and 175 were symposia proceedings. The documents were indexed with an average of 20.9 terms per document (exclusive of automatic generic postings) with an average indexing time of 31.5 minutes. There are now approximately 60,000 documents in the AMIC document retrieval system.

2. SEARCHING

A total of 322 technical requests were processed by the Information Systems Section during the report period. An average of 9 abstracts was printed per search for forwarding to the search requesters. Figure 3 presents the number of searches processed in each contract year since 1966.

3. THESAURUS DEVELOPMENT

A thesaurus updating was made during the reporting period. New terms were added as shown to be necessary from indexing and searching, and certain infrequently used terms were deleted from the system after a search to determine recent use. Custom thesauri were provided according to the preference of individual indexer: 1. separated into three sections - general terminology, metallic materials terminology and organic chemical fragments; 2. two sections with general terminology and chemical fragments combined, and the metallic materials terminology printed separately; 3. only the chemical fragments printed separately; 4. an alphabetical listing of the complete thesaurus. A Master Word List was also provided.

Non-technical special type document retrieval terms are now indicated, such as: = = = Bibliography 70 = = =

Dates are designated as follows: DECADE 1920 - 1929; YEAR 1960

Thirty foreign country terms representing the foreign technology source are listed in the introduction to the thesaurus, for example AFRICA, AUSTRALIA etc. General non-technical terms such as LITERATURE REVIEW are included. Generating or sponsoring agencies that can be recalled specifically include AEC (Atomic Energy Commission), AFML IN-HOUSE, etc. More explanatory notes as well as reference terms are included. The thesaurus

provides a high degree of specificity as demonstrated by the following: 1. Twenty-two military types of aircraft can be searched for: B-52, C5A, F-111, etc. 2. Seventeen coefficient terms including COEF. OF FRICTION, DRAG COEF., HALL COEF. There are 44 listings of collection terms ranging from Additives through Waves. Conversion tables are available for Energy terms, Mach number, Pressure, Temperature, Frequency and Wavelength. One hundred forty-one items under Polymers list a specific type or individual trade name as listed in Appendix VI.

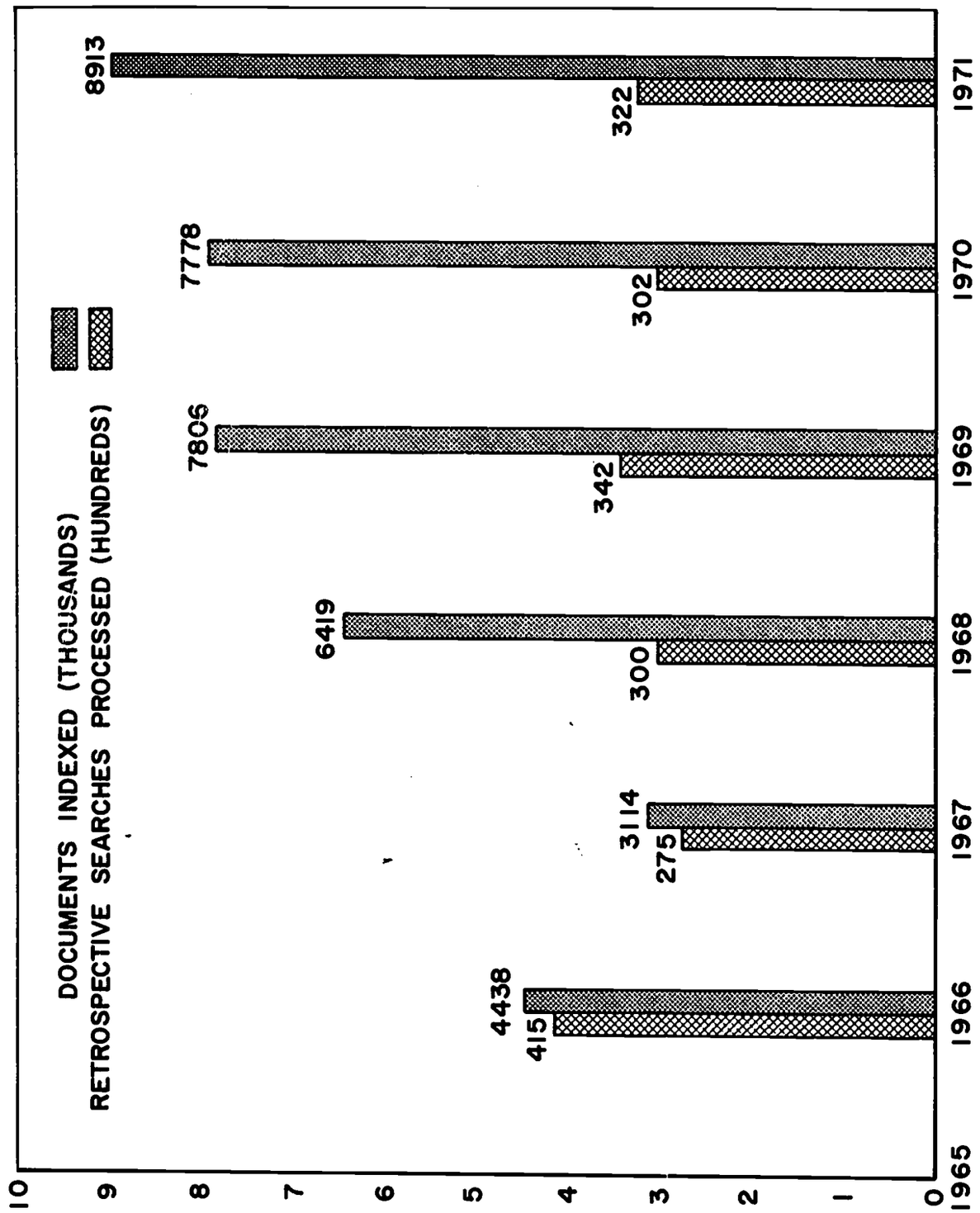

Figure 3. Documents Indexed and Searches Processed by Year

REFERENCES

1. E. A. Janning, Establishment of a Coordinate Indexing Retrieval System for the Air Force Materials Laboratory, RTD-TDR-63-4263, (AD 428 423), Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio. November 1963.

2. E. A. Janning, The Modification of an Information Retrieval System by Improving Vocabulary Control, Indexing Consistency, and Search Capabilities, AFML-TR-65-20, (AD 613 301), Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio.

3. E. A. Janning, Operations of a Document Retrieval System Using a Controlled Vocabulary, AFML-TR-66-36, (AD 633 614), Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio. March 1966.

4. F. L. Scheffler, Student Indexer Training Program and the Improved Operation of a Document Retrieval System, AFML-TR-66-391, (AD 651 039), Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio. January 1967.

5. F. L. Scheffler, Indexer Performance Analysis and Operations of a Document Retrieval System, AFML-TR-67-379, (AD 666 462), Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio. February 1968.

6. F. L. Scheffler, and R. B. Smith, Document Retrieval System Operations Including the Use of Microfiche and the Formulation of a Computer Aided Indexing Concept, AFML-TR-68-367, (AD 686 804), Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio. February 1969.

7. F. L. Scheffler and J. F. March, User Appraisal and Cost Analysis of the Aerospace Materials Information Center, AFML-TR-70-27, (AD 670 597), Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio. March 1970.

8. F. L. Scheffler and J. F. March, Evaluation of the Selective Dissemination of Information (SDI) Program for the Aerospace Materials Information Center. AFML-TR-71-11, (AD 725 036), Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio, March 1971.

9. F. W. Lancaster, Information Retrieval Systems, John Wiley and Sons, Inc. 1968

10. M. E. Stevens, Automatic Indexing: A State-of-the-art Report, Center for Computer Sciences and Technology, National Bureau of Standards, Washington, D.C. National Bureau of Standards Monograph 91. March 1965. Reissued with Additions and Corrections in February, 1970.

11. T. Saracevic, On the Concept of Relevance in Information Science, PhD. Dissertation, Case Western Reserve University, Cleveland, O., 1970, 342 p.

12. L. B. Doyle, Is Relevance an Adequate Criterion in Retrieval System Evaluation? System Development Corporation, Santa Monica, Calif. July 1963.

13. C. A. Cuadra, R. V. Katter, Experimental Studies of Relevance Judgments, Final Report, 3 vols. Systems Development Corp., Santa Monica, Calif., 1967, 498 p.

14. H. W. Batchelor, et al., Relevance of Documents to Search Questions in an Information Retrieval System, Fort Detrick, Frederick, Md. December 1967.

15. M. E. Lesk, and G. Salton, Relevance Assessments and Retrieval System Evaluation. Department of Computer Science, Cornell University, Ithaca, New York. Scientific Report No. ISR-14, Information Storage and Retrieval. October 1968.

16. D. J. Hillman, Document Retrieval Theory, Relevance, and the Methodology of Evaluation. Report No. 1: Characterization and Connectivity. Center for the Information Sciences, Lehigh University, Bethlehem, Penna. May 1966.

17. R. W. Hilton, and D. J. Hillman, Document Retrieval Theory, Relevance, and the Methodology of Evaluation. Report No. 2: The Structure of LECOM. Center for the Information Sciences, Lehigh University Bethlehem, Penna. June 1966.

18. E. C. Bryant, et al., Some Theoretical Aspects of the Improvement of Document Screening by Associative Transformations. Westat Research Analysts, Inc., Denver, Colo. November 1965.

APPENDIX I

DEFINITION OF TASK NUMBERS

01 General	Includes:
	Supervision
	Meeting & trips
	Holidays & sick leave
	Writing of reports
	Training of students
	Time spent with visitors
02 Input	Includes:
	Assignment of accession numbers
	Document accounting records
	Preparation of index and abstract cards
	Indexing
	Keypunching
03 Output	Includes:
	Preparation of search strategy
	Search
	Screening of searches
	Search accounting records
	Library loan functions
	Keypunching
04 Updating	Includes:
	Review of vocabulary and thesaurus
	Changes or additions to previous records
	Keypunching
	Acquisition of missing documents

05	(UD) Research	Includes: Evaluation studies Studies of new techniques Investigation of new systems
05	(AFML/MDC)	Includes: Preparation of Materials Information Bulletin
06	Special Projects	Includes: Work performed in support of the AFML not directly related to AMIC retrieval system
07	Microfilming	Includes: Time spent on the microfilming of index/ abstract records
08	SDI	Includes: Preparation of SDI profiles SDI records Keypunching Photocopying of abstracts Distribution of abstracts
16	1498s	Includes: Keypunching of MASIS Data

APPENDIX II

DISTRIBUTION OF PERSONNEL TIME BY TASK NUMBER

Professional and Clerical at UD

Task Number	Percent of time
01	15.1
02	48.8
03	11.2
04	2.4
05	2.9
06	12.4
07	0.0
08	3.0
16	4.2

Clerical at the AFML/MDC

Task Number	Percent of time
01	11.7
02	48.8
03	5.1
04	12.5
05	17.1
06	4.8

APPENDIX III

SUBJECT CATEGORIES

AMIC	COSATI	CATEGORY
01	01	Aeronautics
		Aerodynamics
		Aeronautics
		Aircraft
		Jet engines
		Aircraft flight control and instrumentation
02	03, 04	Astronomy, Astrophysics, Atmospheric Sciences, Geo-sciences
		Astronomy
		Astrophysics
		Atmospheric physics
		Meteorology
		Geo-sciences
03	06, 07	Chemistry, Biology, Medicine
		Biochemistry
		Bioengineering
		Biology
		Chemical analysis
		Chemical engineering
		Inorganic chemistry
		Life support systems
		Medical science
		Organic chemistry

		Physical chemistry
		Radiochemistry
		Toxicology
04	09	Electronics, Electrical Engineering
		Components
		Computers
		Devices
		Electrical engineering
		Electronic engineering
		Telemetry
05	11A	Adhesives
		Ceramic cements
		Organic resin adhesives
		Potting compounds
06	11	Seals, Sealants
		Ceramic-metal bonds
		Mechanical seals
		O-rings
		Seals, sealants
		Self-healing membranes
07	11B	Ceramics, Graphites, Refractories, Glasses, Minerals
		Borides
		Carbides
		Carbon, graphites
		Cermets
		Glasses

		Minerals
		Mixed oxides
		Nitrides
		Single oxides
08	11C	Coatings, Paints, Oxide Films
		Ceramic coatings
		Cladding
		Coating
		Elastomer coatings
		Oxide films, coatings
		Paints
		Plastic coatings
		Protective coatings
		Reflective coatings
09	11D	Composite Materials
		Composites
		Honeycomb
		Laminates
		Sandwich structure
10	11E	Fibers, Textiles, Cloth
11	11F	Metallurgy, Metallography
		Alloys
		Metals
		Welding, brazing
12	11H	Lubricants, Oils
		Antiseize compounds

		Greases
		Heat transfer fluids
		Hydraulic fluids
		Lubricants
		Oils
13	11I	Polymers, Plastics
14	11J	Elastomers, Rubber
15	11K	Cleaning Compounds, Surface Active Agents
16	11L	Wood and Paper Products
17	21	Fuels, Propellants
		Fuel, aviation
		Fuel, nuclear use category 20
		Fuels
		Explosives
		Liquid propellants
		Solid propellants
18	13	Mechanical, Industrial, Civil, and Marine Engineering
		Civil engineering
		Construction equipment, supplies
		Containers, packaging
		Couplings, fittings, joints, fasteners
		Industrial processes
		Machining, tools
		Machine elements e.g. bearings, gears, gas bearings, etc.

		Marine engineering
		Pumps, filters, pipes, tubing valves
		Safety engineering
		Structural engineering
19	14	Methods and Equipment
		Apparatus
		Detectors
		Equipment
		Laboratories, test facilities and test equipment
		Recording devices
		Testing methods
20	18	Nuclear Science and Technology
		Fuel elements, fuel, nuclear
		Nuclear explosions
		Nuclear power plants
		Nuclear reactors
		Radiation shielding
		Radioactive wastes
21	20	Physics
		Acoustics
		Crystallography
		Electricity and magnetism
		Fluid mechanics
		Lasers and masers
		Optics

		Particle accelerators
		Particle physics
		Plasma physics
		Quantum theory
		Solid mechanics
		Solid state physics
		Thermodynamics
		Wave propagation
22	10, 16, 22	Space Technology, Missiles
		Astronautics
		Energy conversion, solar cells
		Launch vehicles
		Missile technology
		Re-entry, re-entry vehicles
		Rockets
		Satellites, artificial
		Spacecraft
		Trajectories

APPENDIX IV

SDI SEARCH REQUESTS PROCESSED
1 DECEMBER 1970 - 30 NOVEMBER 1971

SEARCH NO.	SEARCH TITLE
99001	Polymer Degradation Thermal Stability
99002	Vapor Pressure Osmometry
99003	Physics of Polymer Solutions
99004	Nitroso Copolymers
99005	Ladder, Spiro, Thermal Stable Polymers
99006	Properties of Rigid Polymers
99007	Organic Fluorine Compounds
99008	Ferrocene Compounds Metallocene Polymers
99009	Spiropolymers Sirocompounds
99010	Ablation, Heat Shields, Thermal Insulation
99011	Rocket Nozzles, Insulation
99012	Advanced Composite Applications
99013	Ceramic Reinforcement Materials
99014	Properties of Ceramics
99015	Hydraulic Fluids, Lubricants
99016	Heat Transfer Fluids, Antiseize Gyro Fluids
99017	Lubricant Fluid Additives
99018	Lubricant Property Effect on Design
99019	Hydraulic Fluids and Lubricants
99020	Lubricant Behavior Environment
99021	Theoretical Analysis of Lubricant Behavior
99022	Damping Flotation Fluids
99023	Thermal Stability of Polymers
99024	Elastomers, Sealants, Polymers
99025	Structural Composites
99026	Adhesives Surface Preparation

SEARCH NO.	SEARCH TITLE
99027	Elastomers, Sealants, Rubber
99028	Engineering Properties of Metal Alloys
99029	Structural Composites
99030	Composites for Rocket Insulation
99031	Properties of High Temperature Polymer Composites
99032	Thermal Decomposition of Polymer Composites
99033	Testing of Polymer Composites
99034	Processing Polymer Composites
99035	Glass Technology, Properties
99036	Transparent Materials
99037	Transparent Films for Windows
99038	Attachment Design of A/C Windows
99039	Glass Technology, Properties
99040	In-Service Failure Analysis
99041	Cleaning of Aircraft
99042	Stress Corrosion In-Service
99043	Measurement of Surface Properties
99044	Metal, Polymer Composites
99045	Structural Adhesives
99046	Transparent Materials
99047	Armor
99048	Radar Absorbing Materials
99049	Radomes
99050	Composites Reinforcement Interfaces
99051	Elastomeric Materials
99052	Flame Resistant Liquid Propellant Compatible Elastomers
99053	Tires
99054	Viscoelastic Damping Materials
99055	Fluid Seals and Sealants
99056	Block and Graft Polymers

SEARCH NO.	SEARCH TITLE
99057	Fuel Cells
99058	Expulsion Bladders
99059	Electrical Insulation Material
99060	Ablative Elastomeric Rocket
99061	Rain Erosion Resistant Materials
99062	Mechanical Properties Evaluation of Metals
99063	Mechanical Properties Evaluation of Composites
99064	Compatibility of Metals Composites With Oxidizers Propellants
99065	Structural Application of Metals Composites Aerospace Vehicles
99066	Failure Analysis of Metals Composites
99067	Fabrication of Metals Composites
99068	Hypervelocity Impact
99069	Shock Impulsive Loading Phenomena
99070	Aircraft Armor Materials Impact
99071	Carbon Fiber Research Technology
99072	Three Dimensional Fabrics
99073	Design Properties Composites
99074	Ablation Thermal Degradation
99075	Fibers
99076	Structural Polymer Composites
99077	Micromechanics, Mechanics Composites
99078	Mechanics, Micromechanics Composites
99079	Photosensitive Compounds
99080	Carbon Fibers Pyrolysis of Organic Fibers
99081	Transpiration Cooling
99082	Environmental Effect on Fibrous Materials
99083	Fabric Properties
99084	Flammability of Materials, Fabrics
99085	Recovery, Safety of Personnel
99086	Parachute System Loading

SEARCH NO.	SEARCH TITLE
99087	Expandable Structures
99088	Coated Fabrics
99089	Properties High Strain Rate Fibers
99090	Ceramics, Polymers, Nonmetallics
99091	Liquid Crystals, Photochemistry
99092	Inorganic Nonmetallic Reinforcing Fibers
99093	Polymeric High Strength Fibers
99094	Fiber Optics
99095	Electrically Conductive Fibers
99096	Properties of Ceramics
99097	Intermetallic Compounds
99098	Plastic Radomes for Aircraft Missiles
99099	Compressor Blades for Aircraft Engines
99100	Joining, Welding, Brazing
99101	Stress Corrosion Cracking
99102	Shells; Panels, Structural
99103	Shock Phenomena
99104	Vibration Damping
99105	Mechanical, Physical Properties Testing
99106	Dynamic Stress Properties
99107	Reliability
99108	Mathematical Model Life Prediction
99109	Heat Resistant Polymers
99110	Thermoplastics
99111	Polymer Composites Not B Fibers
99112	Forming of Metals
99113	Microstructure Crystal Structure Metals
99114	Metal Matrix Composites
99115	Strengthening Metallurgical Reactions
99116	Metallurgy of Various Metals Alloys

SEARCH NO.	SEARCH TITLE
99117	Powder Metallurgy Techniques
99118	Diffusion Data On Metals Alloys
99119	Hydrogen Embrittlement Stress Corrosion
99120	Environmentally Induced Failure
99121	Mechanical Properties of Metals Alloys
99122	Thermomechanical Processing
99123	Thermodynamics of Borides
99124	Coating Processes
99125	Corrosion Mechanism and Protection
99126	High Temperature Plastic Coatings
99127	Thin Metal Films
99128	Paints, Primers, Surface Finish
99129	Paint Formulation Ingredients
99130	Thermal Controls, Coatings
99131	Rain Resistant Electrical Dissipating Coatings
99132	Ablation, Composites, Re- Entry
99133	Coatings, Erosion, Infrared Gun
99134	Polymer Composite Tankage
99135	Batteries Materials
99136	Nondestructive Testing Inspection
99137	Energy Interactions With Materials
99138	Emission From Stressed Materials
99139	Production Quality Control Materials
99140	Ceramics, Ceramic Materials
99141	Cermets, Intermetallics
99142	Ceramic Coatings
99143	Flow, Wear, Fracture Behavior Ceramics
99144	Superconductor, Semiconductors, Ceramics
99145	Ceramic Composites, Reinforcement
99146	Characterization, Chemical Behavior Ceramics
99147	Instrumentation for IR Spectra
99148	Molecular Crystal Structure Vibration

SEARCH NO.	SEARCH TITLE
99149	Infrared Spectra, Spectrometry
99150	Microwave, Electronic Development and Material
99151	Electrical Power Devices, Electro-Chemical
99152	Radomes High Temperature Dielectrics
99153	Lasers, Materials and Effects
99154	Photoconductivity Silicone Semiconductors Delay Lines
99155	Semiconductor Materials Properties
99156	Magnetism Magnetic Materials
99157	Intermetallic 3D-4F Compounds
99158	Intermetallic Magnetic Materials
99159	Magnets, Magnetic Properties
99160	Semiconductors, Related Phenomena
99161	Magnets Rare Earth Intermetallics
99162	Semiconductors Related Phenomena
99163	Boundary Layer Flow; Vehicles, Hypersonic
99164	Infrared Thermal Optics of Bodies
99165	Ablation, Thermal Protection
99166	Thermal Protection Systems
99167	Fluoro Organic Compounds
99168	Fluorinated Polymers
99169	Melting of Metals And Alloys
99170	Metal Working Processes
99171	Lubrication for Metal Working
99172	Thermo-mechanical Processing of Metals
99173	Material Properties at Processing Condition
99174	Defects Arising from Metal Processing
99175	Mathematical Analysis of Metal Working
99176	Ablation of Composites, Graphites
99177	Temperature Measuring Instrumentaion
99178	Carbon Fibers Chemical Analysis Decomposition from PAN
99179	Polyacrylonitrile Decomposition

SEARCH NO.	SEARCH TITLE
99180	Rain, Dust Erosion Phenomena
99181	Dynamic Response Properties of Metals
99182	High Temperature Ceramics
99183	Ceramic, Metal Composites
99184	Orthopedic Implant Materials
99185	IR Sign Optics Contamination
99186	Mechanical Properties of Graphites, Composites
99187	Thermal Stress, Stress Analysis
99188	Ablation of Composites, Graphites
99189	Thermophysical Properties
99190	Hypervelocity Impact
99191	Ablation, Heat Transfer, Re-Entry
99192	Powder Metallurgy Technology
99193	Compatibility of Metals, Composites with Oxidizers, Propellants
99194	Structural Application of Metals, Composites Aerospace Vehicles
99195	Failure Analysis of Metals Composites
99196	Fabrication of Metals Composites
99197	Crystal C Fibers Thermal Analysis
99198	Rare Earth Alloys Crystal Structure
99199	Rare Earth Co Magnetic Materials
99200	Holography, Crystal Deformation
99201	Ceramic Coatings Flame Spray
99202	Mechanical Properties of Mg O Glasses
99203	Design of Instrumentation
99204	Aerothermodynamics
99205	Liquid Vapor Phase Transitions
99206	Optical Properties
99207	Fiber Optics
99208	Solar Radiation Solar Furnace
99209	Nuclear Aircraft Antenna Harding

SEARCH NO.	SEARCH TITLE
99210	High Temperature Oxidation Kinetics
99211	Absorption Cross Section IR, UV
99212	Cryogenics, Cyrogenic Insulation
99213	Mass Spectrometry Mossbauer
99214	Temperature Measurement
99215	Thermal Control Coatings
99216	Thin Films
99217	Electronic Countermeasures
99218	Gas Chromatography, Decomposition of Polymers
99219	Ablation Transpiration Cooling
99220	Re-Entry Ballistic and Lifting
99221	Hypersonic Vehicle Boundary Layers
99222	Ablation, Especially High Pressure Ablation
99223	High Temperature Thermal Insulation
99224	Thermal Optical Properties - IR
99225	Ceramics, Graphites for Thermal Protection
99226	Nondestructive Biaxial Testing
99227	Mechanical Properties of Graphite C/C Materials
99228	Thermophysical Properties
99229	Thermal Stress, Stress Analysis
99230	Thermionic Tubes, Materials and Processes
99231	Fabrication Process, Electronic Components
99232	Physical Properties of Magnetic Materials
99233	Ceramic Substrates Packaging for Magnetic Devices
99234	Dielectric for Magnetic Devices
99235	Garnets and Ferrites
99236	Semiconductor Compounds
99237	Energy Conservation Materials
99238	Masers and Lasers

SEARCH NO.	SEARCH TITLE
99239	Luminesence, Optic Property Special Material
99240	Glasses-Fabrication, Properties
99241	Design Behavior of New Composites
99242	Advanced Structural Composites
99243	Metal Processing
99244	Photosensitive Materials
99245	Elastomeric Fluid Seals
99246	NMR, EPR Spectra and Phenomena
99247	Polymeric Dielectric Coatings
99248	Elastomers and Applications
99249	Temperature Control Coatings
99250	Paint Coating Formulation Camouflage
99251	Thin Metal Foils Preparation
99252	High Temperature Corrosion Protective Coatings
99253	Physics, Molecular Weight Determination - Polymer Solutions
99254	Molecular Vibration Spectra of Materials
99255	Instrumentation for IR Spectra
99256	Ablation, Re-Entry Phenomena
99257	Nonmetallic Radomes Fabrication
99258	IR Eros, Oxidation Resistant Coatings
99259	Decomposition of Polymers
99260	Protection Materials for Rocket Nozzles
99261	Emission From Materi als Under Stress
99262	Nondestructive Testing, Quality Control
99263	Energy Effects on Materials
99264	Reinforced Metal Polymer Composites
99265	Ablation, High Temperature Behavior
99266	Metallurgy, Behavior of Metals
99267	Diffusion, Stress Corrosion, Embrittlement
99268	Metal Matrix Composites

SEARCH NO.	SEARCH TITLE
99269	Vibration, Damping, Noise
99270	Mechanical Properties Testing
99271	Dynamic Load Behavior of Materials
99272	Math. Statistical Prediction of Behavior
99273	Ablation Re-Entry Nose Tips
99274	Ceramic, Graphite Materials
99275	Ceramic Composites Armor
99276	Purity Nitroso Elastomers Benzidine
99277	Manufacturing Technology of Propellants
99278	Manufacturing Technology of Nonmetallic Materials
99279	Ceramic Materials Properties Application
99280	Cratering
99281	Plastic Cartridge Cases
99282	Shock Dynamic Loading of Materials
99283	Hypervelocity Impact
99284	Lubricants and Related Materials
99285	Theoretical Study of Lubricants
99286	Ceramics Properties and Applications
99287	Joining, Welding of Metals
99288	Metal Composites
99289	Carbides, Cermets Phase Diagram
99290	E-M Window Material for IR Laser Radiation
99291	Optical Properties of Inorganic Materials
99292	Solar Radiation Energy
99293	High Temperature Oxidation Reaction Kinetics
99294	Radar IR UV Absorption Materials
99295	Cryogenic High Temperature Thermal Insulation
99296	Time of Flight Mass Spectrometry

SEARCH NO.	SEARCH TITLE
99297	Noise Pollution
99298	Chemical, Physical Behavior in Ablative Wakes
99299	Fibrous Materials for Clothing
99300	Lasers, Laser Window Materials
99301	Processing of Ablative Composites
99302	Ablation Phenomena, Mechanism
99303	Adhesives, Properties and Interfacial Phenomena
99304	Properties of Structural Polymer Composition
99305	Effect of Electrical Field on Interfaces
99306	Composites

SDI

REQUESTER INDEX

REQUESTER*	ORGANIZATION
Adamczak, Dr.	AFML/LNL
Allinikov, S.	AFML/LAE
Askins, D. R.	UD**
Bentley, F.	AFML/LPA
Benz, Lt. Wm.	AFML/LTF
Bertke, R. B.	UD
Blakeslee, H. W.	Franklin Institute Research Lab.
Cunningham, A.	Lockheed-Georgia Co.
Davidson, J. E.	UD
Denman, G. L.	AFML/LAS
De Pierre, V.	AFML/LLN
Donlan, V. L.	AFML/LPE
Dueweke, P. W.	UD
Duvall, D.	UD
Dyer, D.	AFML/LPA
Emrich, B.	AFML/LAM
Engel, Dr. O. G.	UD
Evers, R. C.	AFML/LNP
Ezekiel, H. M.	AFML/LNF
Farmer, R. W.	AFML/LNC
Fiscus, I.	UD
Garrett, H. J.	AFML/LPE
Gehatia, Dr. M.	AFML/LNP
Glenn, G. M.	AFML/LTP
Gloor, W.	AFML/LNF
Goldfarb, Dr. I.	AFML/LNP
Grant, R.	UD
Graves, R.	UD
Harmer, Dr. R.	UD
Headrick, R.	AFML/LNE

*Some requesters had more than one search

**UD requesters involved with AFML projects

REQUESTER*	ORGANIZATION
Hecht, N.	UD
Helminiak, Dr. T.	AFML/LNP
Hemenger, P. M.	AFML/LPE
Hickmott, R. L.	AFML/LPE
House, P	AFML/LAE
Iden, Lt. Col. D. J.	AFML/LPE
Johnson, W. P.	AFML/LNE
Knight, M.	AFML/LAE
Koenig, J. R.	AFML/LAS
Kopell, L.	AFML/LTP
Lehn, W.	AFML/LNE
Leinberger, K.	UD
Litvak, S.	AFML/LTE
Marcus, Hy	AFML/LPT
Material Science Corp.	Material Science Corp.
May, D. R.	AFML/LNF
Metzger, G. E.	AFML/LLP
Mildrum, H.	UD
Minges, M. L.	AFML/LAS
Morrissey, E.	AFML/LAE
Olevitch, A.	AFML/LAE
Olson, J.	AFML/LPE
Opt, P. C.	AFML/LNF
Pirrung, P.	AFML/LNC
Poynter, J. W.	AFML/LLS
Pratt, C.	AFML/LAS
Preonas, D.	UD
Ramke, W.	AFML/LLM
Ray, J. D.	AFML/LNC
Reinert, Major H. S.	AFML/LC

REQUESTER*	ORGANIZATION
Robinson, A. L.	AFML/LAE
Rosenberg, Dr. H	AFML/LPH
Rowand, R.	AFML/LLN
Rubey, W.	UD
Schulman, S.	AFML/LNF
Schwartz, H. S.	AFML/LN
Schimmin, K. D.	AFML/LLD
Shinn, D. A.	AFML/LAM
Standage, Dr.	UD
Stevison, D. F.	AFML/LAS
Sullivan, J. J.	AFML/LAE
Tamborski, D. C.	AFML/LNP
Tanis, C.	AFML/LTF
Tanner, H. A.	AFML/LPE
Telford, Major	AFML/LTP
Tesson, Lt. J.	AFML/LAS
Tolley, L. G.	AFML/LNC
Tsai, Dr. S. W.	AFML/MAX
Turner, H. A.	AFML/LPE
Van Deusen, Dr. R.	AFML/LNP
Wheeler, W.	AFML/LAS
Williamson, Lt.	AFML/LTF
Wittebort, J.	AFML/LTE
Wittman, R. E.	AFML/LAE

SDI INDEX OF REQUESTING ORGANIZATIONS

COMPANY	NUMBER OF SEARCHES
AFML	178
LAE	20
LAM	7
LAS	18
LC	1
LLD	8
LLM	7
LLN	7
LLP	1
LLS	11
LN	6
LNC	6
LNE	6
LNF	15
LNL	4
LPA	4
LPE	11
LPH	4
LPT	11
LTE	7
LTF	7
LTP	7
MAX	1
Franklin Institute Research Lab.	1
Lockheed - Georgia Co.	1
Materials Science Corp.	3
UD	29

APPENDIX V

RETROSPECTIVE SEARCH REQUESTS PROCESSED*

1 DECEMBER 1970 - 30 NOVEMBER 1971

SEARCH NO.	SEARCH TITLE
2218	Asbestos Reinforced Plastics
2219	Diffusion Bonding Aluminum
2220	Properties and Technique of Carbon
2221	Foaming of Liquids
2222	Niobium Phase Diagram
2223	Oxidation of Niobium
2224	Thermal Conduction Plastics
2225	Fatigue of Aluminum 7075-T76
2226	Protective Coatings for Styrofoam
2227	Hypervelocity Flow by Electrofluid Dynamics
2228	Computerized Analysis
2229	Shot Peening Landing Gear
2230	Heat Treatment Effect on Ti-6-4
2231	Molding Miniature Gears
2232	Ceramics in Jet Engines Turbine Blades
2233	Electrical Discharge Machining
2234	Fatigue Testing of Polymer Composites
2235	Glass-Ceramic Enclosures
2236	Physiological Effects of Ozone + NO
2237	Zinc Chromate Removers
2238	Sources and Measurement of Ozone + NO
2239	Foreign Technology
2240	Ultrasonic Soldering
2241	Meteorid Impacts
2242	Vapor Thermal Conductivity
2243	Rare Earth Glasses
2244	Energy Crisis Alternatives
2245	Solar and Geyser Power
2246	Gelcel Battery Information

*Includes special searches run by UD for updating and for research

SEARCH NO.	SEARCH TITLE
2247	Wear Resistant Coatings
2248	IR Detectors, Lasers, Emissivity
2249	Injected Molding Fiberglas
2250	Polyvinyl Chloride Pipes
2251	Audio Frequency 20-20K
2252	Lightweight Shelter Materials
2253	Fatigue Cu Alloys
2254	Thermal Fatigue Cu Alloys
2255	Welding Steels and Ti Alloys
2256	Standards for High Pressure Pumps Fluid Motors
2257	Ballistics
2258	Fatigue Cu-Ag-Zr Alloys
2259	Thermal Fatigue Cu Metal Systems
2260	Liquid Crystals
2261	Foreign Technology-Update Term
2262	Supercooling - Update
2263	Work Functions - Update
2264	Superheating - Update
2265	Polysulfones - Update
2266	Polarons - Update
2267	Maneuverability
2268	Arsenites - Update
2269	Chemical Reactivity - Update
2270	Fiber Reinforced Composites
2271	Aluminum Phosphate Properties
2272	Jet Blast Deflection Coatings
2273	Properties of CdTe, ZnSe
2274	Non-Aqueous Electrochemical Cells
2275	Beryllium Nb - Update
2276	Aircraft BlA - Update
2277	Work Hardening Coefficient - Update

SEARCH NO.	SEARCH TITLE
2278	Chemical Reactors - Update
2279	Fatigue Properties of Steel 8620
2280	Fracture Behavior of Composite
2281	Hydrogen Phosphates - Update
2282	Hydrogen Carbonates - Update
2283	Hydrogen Arsenates - Update
2284	Hydrogen Sulfate - Update
2285	Honeycomb - Standards, Quality Control
2286	Boron, Graphite Fiber Fabricate
2287	Void Content In Composites
2288	Costs of Filaments
2289	Environmental Effects
2290	Impact Effects on Composites
2291	TD Nickel, TD Nickel Chromium
2292	Dispersion Hardening Theory
2293	Nichrome, Inconel Mechanical Properties
2294	Catalysis of Graphitization
2295	Self-Sealing Fuel Lines
2296	High Intensity Radiation Effects
2297	Electrically Conductive Plastics
2298	Transparent Plastics
2299	Adhesive Bonded Components
2300	High Performance Thermoplastics
2301	Polyester - Wool Fibers
2302	Properties of Carbon Fibers
2303	Fiber Formation
2304	Degradation of Plastics
2305	Permeability of Coatings
2306	Stress Corrosion Coating
2307	Metallic Corrosion Due to Polymer Composites
2308	Reliability Theory of Random Fatigue

SEARCH NO.	SEARCH TITLE
2309	Fiber Reinforced Plastic Pipe
2310	Intermetallic Alloys
2311	PAN Oxidation, Degradation
2312	Electrical Resistant Carbon Graphite Fibers
2313	Coating, Aircraft vs Nuclear Flash
2314	Nuclear Flash Curtain
2315	UV Polymer Film in Vacuum
2316	Flammability of Textiles
2317	Static Electric Buildup
2318	Thermal Radiation Sources
2319	Ballistic Impact
2320	Low Cycle Fatigue Copper-Zr
2321	Thermal Fatigue Copper-Zr
2322	Nitinol 55
2323	Thermal Fatigue, Copper-Ag-Zr
2324	Thermal Fatigue, Dispersion Hardening Cu
2325	Fatigue Copper-Ag-Zr
2326	Fatigue, Dispersion Hardening of Copper Alloys
2327	Rare Earth Magnets
2328	Refractory Materials as Transpiration Matrices
2329	Transpiration Film Cooling
2330	Optical Properties IR Glasses
2331	Characterization of Solids
2332	Superconducting Materials
2333	Cobalt-Rae Magnets
2334	Cathode Materials - Batteries
2335	Carbon Insulation - Heat Shields
2336	Composite Armor
2337	Windows for High Power Lasers
2338	Electrical Insulation
2339	Potting Compounds for Aircraft
2340	Growth Technique for Telluride
2341	Ultrasonic Nebulization

SEARCH NO.	SEARCH TITLE
2342	Thin Film Beryllides, Carbides
2343	Electric Discharge Initiated Reactions
2344	Electric Discharge Initiated Reactions
2345	Tungsten Thermal Conductivity, Electrical Resistivity
2346	Oxidation of Ceramic Composites
2347	Plastic Armor Backing
2348	Integral Armor
2349	Reflective Materials Barium as Electromagnetic Radiation
2350	Quartz Fiber Quartz Matrix AS3DX
2351	Hypersonic Insulation Material
2352	Solidification of Eutectics
2353	Laser Spectroscopy - Solutions
2354	Properties of Polymers
2355	Fatigue Failure Low Alloy Steels
2356	Stainless Steel 304 Fatigue
2357	Properties of Astralloy
2358	B-Phase Vandium - 3Al
2359	Adhesive Bonded Joints
2360	Dielectric Properties Adhesive Bond
2361	Fatigue Adhesive Bonded Joints
2362	Thermal Properties of Adhesive
2363	Impact Strength of Adhesives
2364	Heat Resistant Plastics
2365	Additives for Adhesives
2366	In-Space Adhesives
2367	Surface Treatment for Metals
2368	High Temperature Adhesives
2369	Organosilicon Polymers
2370	Cellular Strucutral Materials
2371	Intumescent Coatings
2372	Inflatable Impact
2373	Properties Textile Materials
2374	Textile Coating Properties

SEARCH NO.	SEARCH TITLE
2375	Heat Transfer in Textiles
2376	Textiles
2377	Thermal Protection Textiles
2378	1, 3 Addition Reactions
2379	Photochemical Ring Closures
2380	Diels - Alder Reactions
2381	Room Temperature Curing Epon
2382	Toxic Fumes in Composites
2383	Bolts
2384	Decontamination
2385	UV or IR Pumped Phosphors
2386	Polishing Zinc Telluride
2387	Fracture in Ti, Al, Mo, V, Alloys
2388	Scanning Electron Microscopy
2389	Infrared Nondestructive Tests
2390	Titanium, Titanium - Mg
2391	Titanium - Mg Part II
2392	Pyrolyzed Plastic Composites
2393	3-D Reinforcement Composites
2394	Aromatic and Heterocyclic Polymers
2395	Ablation, Ablative Materials
2396	Missile Thermal Protection
2397	Analytical Modeling
2398	Thermal Protective Materials
2399	Thermal Conductivity Fiberglas
2400	Toxicity of Aircraft Materials
2401	Magnesium Effect on Titanium
2402	Carbon Composites
2403	Carbon-Carbon Thermal Systems
2404	Fluorimetry of Phosphates
2405	Pollution
2406	Plastic Composite Properties

SEARCH NO.	SEARCH TITLE
2407	Phase Equilibrium of Rae Oxides
2408	Nonmetallic Cutting Tools
2409	Cryogenic Liquid Helium Seals
2410	Fatigue Stainless 15-7
2411	Gyro Bearings
2412	Lubricant Composites
2413	Instrument Bearings
2414	Oxide Reinforcement
2415	Reactions of Oxides
2416	Task I S. Rusek
2417	Task I J. M. Ascenzi
2418	Task I J. F. Hoffman
2419	Task I C. M. Erdman
2420	Task I R. Graves
2421	Task I T. E. Moloney
2422	Task II R. Graves
2423	Task II J. M. Ascenzi
2424	Task II J. F. Hoffman
2425	Task II S. Rusek
2426	Task II T. E. Moloney
2427	Task II C. M. Erdman
2428	Fuel Permeability
2429	Task III R. Graves
2430	Task III J. M Ascenzi
2431	Task III J. F. Hoffman
2432	Task III S. Rusek
2433	Task III C. M. Erdman
2434	Task III T. E. Moloney
2435	T-M Technique for Alpha-Beta Ti
2436	Ammonium Perchlorate
2437	Graphite Monofilaments
2438	Electrode Melting Ti Alloys

SEARCH NO.	SEARCH TITLE
2439	Hot compaction of Ti Alloys
2440	High Temperature Casting Technique
2441	IR Detector Preamplifier
2442	Irradiate Integrated Circuits
2443	Cobalt-Rae Magnets
2444	Barium Sodium Niobate
2445	Generic Tape Update
2446	Toughness and Strain
2447	Toughness Aluminum 2020-T6
2448	Magnesium Aluminate Spinels
2449	Silicon Deposition on Spinels
2450	Compaction of Powder Superalloys
2451	Task IV R. Graves
2452	Task IV J. Ascenzi
2453	Task IV S. Rusek
2454	Task IV C. M. Erdman
2455	Task IV T. E. Moloney
2456	Task IV J. F. Hoffman
2457	Task V R. Graves
2458	Task V J. Ascenzi
2459	Task V C. M. Erdman
2460	Task V S. Rusek
2461	Task V T. E. Moloney
2462	Task V J. F. Hoffman
2463	Lubricants for Carbon Steels
2464	Task VI R. Graves
2465	Task VI J. Ascenzi
2466	Task VI S. Rusek
2467	Task VI C. M. Erdman
2468	Task VI T. E. Moloney
2469	Task VI J. F. Hoffman
2470	Task VII R. Graves

SEARCH NO.	SEARCH TITLE
2471	Task VII C. M. Erdman
2472	Task VII S. Rusek
2473	Task VII T. E. Moloney
2474	Task VII J. Ascenzi
2475	Task VII J. F. Hoffman
2476	Task VIII R. Graves
2477	Task VIII J. Ascenzi
2478	Task VIII C. M. Erdman
2479	Task VIII S. Rusek
2480	Task VIII T. E. Moloney
2481	Task VIII J. F. Hoffman
2482	Task IX R. Graves
2483	Task IX J. Ascenzi
2484	Task IX C. M. Erdman
2485	Task IX S. Rusek
2486	Task IX T. E. Moloney
2487	Task IX J. F. Hoffman
2488	Task X S. Rusek
2489	Task X J. Ascenzi
2490	Task X S. Rusek
2491	Task X C. M. Erdman
2492	Task X J. F. Hoffman
2493	Re-Ductilizing Tungsten
2494	Task I Phase Diagram
2495	Task II Hypervelocity Impcat
2496	Task III Vibration
2497	Task IV Ablation
2498	Task V Protective Coatings
2499	Task VI Thin Metal Films
2500	Task VII Rocket Nozzles
2501	Task VIII Erosion Corrosion

SEARCH NO.	SEARCH TITLE
2502	Task IX Craters
2503	Task X Propellants
2504	Triazines
2505	Task X T. E. Moloney
2506	Sealants for Aircraft
2507	Testing Lubricant Additive
2508	Surface Friction and Wear
2509	NDT Steels, Ti Alloy, Superalloys
2510	Corrosion of Nispan C 902
2511	Organic Dye Lasers
2512	Chemical Laser Systems
2513	Laser Effects on Materials
2514	Cordierite
2515	Maximum Posting Search 1
2516	Maximum Postings Search 2
2517	Maximum Postings Search 3
2518	Maximum Postings Search 4
2519	Maximum Postings Search 5
2520	Maximum Postings Search 6
2521	Maximum Postings Search 7
2522	Maximum Postings Search 8
2523	Maximum Postings Search 9
2524	Maximum Postings Search 10
2525	Low Viscosity - Vapor Fluids
2526	Relaxation of Ni and Co Alloys
2527	Weld Microstructure vs Mechanical Properties Ti
2528	Microstructure Reliability to Ti Mechanical Properties
2529	RS J. M. Ascenzi
2530	RS S. J. Rusek
2531	RS C. M. Erdman

SEARCH NO.	SEARCH TITLE
2532	RS J. M. Ascenzi #2
2533	RS S. J. Rusek #2
2534	RS C. M. Erdman #2
2535	RS J. M. Ascenzi #3
2536	RS C. M. Erdman #3
2537	RS J. M. Ascenzi #4
2538	RS C. M. Erdman #4
2539	RS J. M. Ascenzi #5
2540	RS C. M. Erdman #5
2541	Fatigue Aluminum 2219 T8
2542	Stress Corrosion Al-7075-T6
2543	Processes for Carbon Fibers
2544	RS S. J. Russek #5
2545	RS S. J. Rusek #4
2546	RS S. J. Rusek #3
2547	RS R. Graves #10
2548	RS R. Graves #3
2549	RS R. Graves #8
2550	RS R. Graves #1
2551	RS R. Graves #2
2552	RS R. Graves #4
2553	RS R. Graves #6
2554	RS R. Graves #7
2555	RS R. Graves #9
2556	Water Degradable Polymers
2557	Connectors in Amp Arrays
2558	RS S. J. Rusek #6
2559	RS S. J. Rusek #7
2560	RS S. J. Rusek #8
2561	RS J. F. Hoffman #1
2562	RS J. F. Hoffman #2
2563	RS J. F. Hoffman #3

SEARCH NO.	SEARCH TITLE
2564	RS J. F. Hoffman #4
2565	RS J. F. Hoffman #5
2566	RS J. F. Hoffman #6
2567	RS J. F. Hoffman #7
2568	RS J. F. Hoffman #8
2569	RS J. F. Hoffman #9
2570	RS J. F. Hoffman #10
2571	RS C. M. Erdman #6
2572	RS C. M. Erdman #7
2573	RS R. Graves #5
2574	RS S. J. Rusek #9
2575	RS S. J. Rusek #10
2576	RS C. M. Erdman #9
2577	RS C. M. Erdman #10
2578	RS C. M. Erdman #8
2579	RS T. E. Moloney
2580	RS T. E. Moloney #2
2581	RS T. E. Moloney #3
2582	RS T. E. Moloney #4
2583	RS T. E. Moloney #5
2584	RS T. E. Moloney #6
2585	RS T. E. Moloney #7
2586	RS T. E. Moloney #8
2587	RS T. E. Moloney #9
2588	RS T. E. Moloney #10
2589	RS J. M. Ascenzi #10
2590	RS J. M. Ascenzi #8
2591	RS J. M. Ascenzi #6
2592	RS J. M. Ascenzi #9
2593	Clean Blowing of Glass
2594	Cryogenic Adhesives Sealants

SEARCH NO.	SEARCH TITLE
2595	Dielectrics and Insulators
2596	RS J. M. Ascenzi #7
2597	Fiber Reinforcement, Composites, Tapes
2598	Carbon Powder Electrical Insulators
2599	Fabricating Composites
2600	Structural Materials
2601	Levitation Melting Equipment
2602	New Detectro Materials
2603	Reactions of Oxygen With Materials
2604	Grain Size vs Mp of Titanium
2605	Properties of Ti-5Al-2. Sn
2606	Corrosion Stainless Steels by Acetic Acid
2607	Mie Scattering In Air with IR
2608	Smoke for Use of Flow Aids
2609	Cracking of Carbon Steels Saw Blades
2610	RS #1
2611	RS #2
2612	RS #3
2613	RS #4
2614	RS #5
2615	RS #6
2616	RS #7
2617	RS #8
2618	RS #9
2619	RS #10
2620	Chromatography of Lubricants
2621	Fatigue of Stainless Steel 321
2622	Smoke for Use as Flow Aids
2623	Ultrasonic Methods for Defects
2624	Properties for Lithium, Beryllium

SEARCH NO.	SEARCH TITLE
2625	Shock Protection for Humans
2626	Omega Phase MWL Update
2627	Spectrometric Oil Analysis
2628	Solid State Joining
2629	Fiber Reinforced Metal Composites
2630	Hot Pressing of Metals
2631	Testing Equipment Interfaced with Computers
2632	Electrical Field Effect on Interfaces
2633	Mylar Film, Aluminum Coated
2634	Fatigue Properties
2635	Tensile Strength of Materials
2636	Composites
2637	Environmental Effect on Adhesives
2638	Durability
2639	Laser Radiation Effect
2640	Dyeing Epon
2641	Adhesive Bonding Beryllium
2642	M W L Update Omega Ph.,Weight Loss
2643	Creep of Cast Inco 713LC
2644	Absorption of Laser Radiation
2645	Update Antiwear Additives
2646	Leed Spectrometry Update
2647	Aerospace Safety Information
2648	Exo-Electron Emission Metals
2649	Re- Entry Composites
2650	Composites for Re-Entry
2651	Graphite Epoxy Landing Gear
2652	Spectra Emissivity Data
2653	Filament Winding Polyimides
2654	Thermal Pulse Heating Aircraft

REQUESTER INDEX

REQUESTER*	ORGANIZATION
Allgeyer, G. H.	Owens-Illinois
Anderson, C.	AFML/LTP
Anspach, W. F.	AFML/LNE
Aponyi, T. J.	AFML/LNC
Arnold, F. E.	AFML/LNP
Arvay, E. A.	AFML/LNC
Ascenzi, J.	UD
Askins, R.	UD
Baun, W. L.	AFML/LPA
Bennet, J.	ASD/ENVED
Bialer, M.	AFML/LTE
Biffl, J. W.	Bell Aerospace Corp.
Boebel, C. P.	AFML/LNE
Boehman, Dr. L.	UD
Bohlen, Capt. J. W.	AFML/LLN
Boynton, Lt. T. A.	AFML/LTE
Browning, C. B.	AFML/LNC
Burns, T.	UD
Caldewood, F.	Atkins Merrill Inc.
Cervay, R.	AFML/LAE
Charlesworth, J.	AFML/LAM
Conrardy, W. P.	AFML/LA
Crow, Capt. W.	AFIT/NB
Davison, J. E.	UD
Denson, R. F.	Becton and Dickinson Co.
Dervin, O.	AFFDL/EYA
Dimiduk, P. W.	AFML/LPT
Divecha, A. P.	Commonwealth Scientific Corp.
Donlan, V. L.	AFML/LPE
Drosgen, F.	Army Aviation Systems
Dueweke, P.	UD

*Some requesters had more than one search

REQUESTER*	ORGANIZATION
Ehrenfried, Major	AFML/LPE
Emrich, B.	AFML/LAM
Erdman, M.	UD
Erickson, Mrs.	Puget Naval Shipyard
Ezekiel, H.	AFML/LMF
Fenner, J.	AFML/LLM
Fetters, C.	Hughes Research Lab.
Fey, K.	UD
Finley, T. C.	AFML/LPH
Garrett, H. J.	AFML/LPE
Gehatia, Dr. M. T.	AFML/LNP
Geigendorfer, R. F.	AFML/LLP
Graham, T. L.	AFML/LNE
Graves, R.	UD
Greenfield, M.	AFML/LLP
Griffin, W. R.	AFML/LNE
Griffith, G. H.	AFML/LPH
Gunderson, A.	AFML/LAE
Hall, J.	AFML/LLP
Halpin, Dr. J. C.	AFML/LNC
Hecht, N.	UD
Henderson, R. L.	AFML/LAD
Hickmott, R. L.	AFML/LPE
Hoffman, J.	UD
House, P.	AFML/LAE
Houston, J.	Bendix Corp.
Husman, G.	AFML/LC
Iller, W. J.	AFML/LAA
Jacobson, L.	AFML/LLP
Johnston, J.	UD
Kamm, H.	AFML/LAA
Kelley, L. G.	AFML/LC
Kennard, R. L.	AFML/LTP

REQUESTER*	ORGANIZATION
Knight, M.	AFML/LAE
Koenig, J. R.	AFML/LAS
Koogler, F.	Bell Aerospace Corp.
Kopell, L.	AFML/LTP
Krentz, D. M.	E. I. DuPont & Co.
Krol, J.	UD
Kuhl, G. E.	AFML/LPE
Latva, J. D.	AFML/LLM
Lehn, W. L.	AFML/LNE
Lester, J.	Ball Bros. Research Corp.
Lopez, A.	AFML/LTP
McConnell, B. D.	AFML/LNL
McGinty, T. P.	Vought Aeronautical Co.
McKelvey, E. W.	AFML/LAA
Mandel, G.	NASA
March, J. F.	UD
Marcus, H.	AFML/LPT
Mardis, J. V.	AFIT/ENP
Martin, D.	RDP Associates
Materne, H. P.	AFML/LNC
Mattice, J.	AFML/CA
May, D. R.	AFML/LNF
May, J. A.	Small Business Administration
Moloney, T.	UD
Moore, T. K.	AFIT-EN/GAW
Morris, G. J.	AFML/LNL
Morrissey, E.	AFML/LAE
Muntz, J. H.	AFML/LRA
Myers, B.	General Electric
Naughton, J.	UD
Naumann, W.	Effects Tech. Inc.
Neff, R.	AFML/LC
Norbert, T.	AFAPL/TBP
O'Hara, Wm.	AFML/LTP

REQUESTER*	ORGANIZATION
Ohmer, M.	AFML/LPE
Olevitch, A.	AFML/LAE
Olson, J. C.	AFML/LPE
Opat, H.	Picatinny Arsenal
Parsons, L. D.	AFML/LLP
Paterson, Capt. W.	ARL/LG
Patterson, J. L.	AFFDL/FXG
Peters, Lt. L.	AFML/LAS
Petrak, J.	AFML/LAE
Pierce, C.	Small Business Corp.
Poesch, J.	Hercules Powder C.
Prager, W.	AFML/ESE
Pratt, C.	AFML/LAS
Prince, Capt. D. E.	AFML/LNE
Pruitt, F.	Bell Aerospace Corp.
Reaven, E.	Standford University
Reimann, Dr. W. H.	AFML/LLD
Reinhart, T. J.	AFML/LAE
Rice, Lt. D.	AFML/LLS
Rosenberg, Dr. H.	AFML/LNP
Rubey, W.	UD
Rusek, S.	UD
Sajdak, Capt.	AFML/LLP
Saul, G.	AFML/LLN
Scardino, W.	AFML/LAA
Scheffler, F. L.	UD
Schimovetz R.	AFFDL/FYA
Schmidt, D. L.	AFML/LNC
Schramm, R.	Institute for Basic Standards
Schulman, S.	AFML/LNE
Schwartz, H. S.	AFML/LN
Schwartz, L.	Rep. Corp.
Schwenker, H.	AFML/LNL
Shanley, M.	UD

REQUESTER*	ORGANIZATION
Simpson, Capt. R.	AFML/LLP
Stanton, Capt. R. L.	AFML/LNF
Stevison, D.	AFML/LPT
Stout, R. L.	AFML/LNE
Sudzina, R. F.	UD
Sullivan, J.	AFML/LAE
Tanis, C.	AFML/LTF
Tanner, H. A.	AFML/LPE
Tarrants, E.	AFML/LTE
Tesson, Lt. J. T.	AFML/LAM
Thompson, H.	AFML/LAM
Tressler, R. E.	AFML/LLS
Trickett, G.	AFML/LTP
Tuffias, Dr. R. H.	Litton Systems Inc.
Van Vliet, R. M.	AFML/LPT
Vos, G. B.	Honeywell
Wells, D.	Delphi Corp.
Whitford, D.	UD
Winters, D.	UD
Wittebort, J.	AFML/LTE
Wolff, R. L.	UD
Woodrum, G. T.	AFML/LC
Wurst, Dr. J.	UD
Zakanycz, S.	ASD/XRHP
Zimmerman, B.	General Electric
Zirkle, J.	AFAL(RSA-665A)
Zolg, B.	NCR

INDEX OF REQUESTING ORGANIZATIONS

COMPANY	NUMBER OF SEARCHES
AFAL(RSA-665A)-1	1
AFAPL/TBP	1
AFFDL	3
AFIT	3
AFML	196
DO	1
LA	1
LAA	8
LAE	16
LAM	17
LAS	4
LC	8
LLD	10
LLM	2
LLN	11
LLP	10
LLS	4
LN	12
LNC	23
LNE	13
LNF	8
LNL	3
LNP	6
LP	1
LPA	2
LPE	8
LPH	6
LPT	7
LTE	6
LTF	1
LTP	8
AFWL/ESE	1

COMPANY	NUMBER OF SEARCHES
ARL/LG	1
Army Aviation Systems	1
ASD	2
Atkins Merrill Inc.	1
Ball Bros. Research Corp.	1
Becton and Dickinson Co.	1
Bell Aerospace Corp.	5
Bendix Corp.	2
Commonwealth Scientific	3
Delphi Corp.	1
Effects Technical Inc.	1
E. I. DuPont & Co.	12
General Electric	2
Hercules Powder Co.	1
Honeywell	1
Hughes Research Lab.	1
Institute for Basic Standards	1
Litton Systems Co.	1
Martin Marietta	1
NASA	2
NCR	1
Owens Illinois	1
Picatinny Arsenal	1
Puget Naval Yard	1
RDP Associates	1
Rep Corp.	1
Small Business Administration	5
Stanford University	1
UD	186
Vought Aeronautical Co.	1

APPENDIX VI

POLYMERS

COPOLYMERS
ACETAL POLYMERS
ACLAR
ACRYLIC POLYMERS
ACRYLONITRILE-BUTADIENE-STYRENE POLYMERS
ADDITION POLYMERS
ALDEHYDE CONDENSATION POLYMERS
ALKADIENE POLYMERS
ALKALI CELLULOSE
ALKENE POLYMERS
ALKYD POLYMERS
ALKYNE POLYMERS
ALLYL-X POLYMERS
AMINE-ALDEHYDE POLYMERS
AROMATIC POLYMERS
ARSENIC CONTAINING POLYMERS
ARYL-R POLYMERS
BBB POLYMERS
BLOCK POLYMERS
BORON CONTAINING POLYMERS
BROMINE CONTAINING POLYMERS
BUTADIENE-ACRYLONITRILE ELASTOMERS
BUTADIENE-STYRENE ELASTOMERS
BUTYL RUBBER
CELLOPHANE
CELLULOSE ESTERS
CELLULOSE ETHERS
CHLORINE CONTAINING POLYMERS
CONDENSATION POLYMERS
COORDINATION POLYMERS
DACRON
DEXSIL
DICARBOXYLIC ACID POLYMERS
EBONITE
ELASTOMERS
EPD POLYMERS
EPON
EPOXY POLYMERS
ETHYLENE-PROPYLENE POLYMERS
FEP
FLUOREL
FLUORINE CONTAINING POLYMERS
FLUOROELASTOMERS
FURFURYL POLYMERS
FUSED RING POLYMERS
GEMON
GRAFT POLYMERS
HEAT RESISTANT POLYMERS

HETEROCYCLIC POLYMERS
HIGH DENSITY POLYETHYLENE
HIGH DENSITY POLYPROPYLENE
HIGH DENSITY POLYSTYRENE
INORGANIC ELASTOMERS
INORGANIC POLYMERS
IODINE CONTAINING POLYMERS
ION EXCHANGE RESINS
IONIC POLYMERS
KAPTON
KEL-F
KETONE CONDENSATION POLYMERS
LADDER POLYMERS
LATEX
LEXAN
LOW DENSITY POLYETHYLENE
LOW DENSITY POLYPROPYLENE
LOW DENSITY POLYSTYRENE
MELAMINE POLYMERS
MELAMINE-FORMALDEHYDE POLYMERS
METAL CONTAINING POLYMERS
METHYL-PENTENE POLYMERS
MYLAR
NATURAL RESINGS
NEOPRENE
NITRILE ELASTOMERS
NITRILE POLYMERS
NITROGEN CONTAINING POLYMERS
NITROGEN HETEROCYCLE POLYMERS
NITROSO ELASTOMERS
NOMEX
NOVOLAC
NYLON 11
NYLON 12
NYLON 6
NYLON 6/1
NYLON 6/6
NYLON
OLIGOMERS
ORLON
OXYGEN HETEROCYCLE POLYMERS
PAN
PBI
PENTON
PHENOLIC POLYMERS
PHENYL-R POLYMERS
PHOSPHORUS CONTAINING POLYMERS
PLASTICS
PMM
POLYALCOHOLS
POLYAMIDES
POLYAMINES
POLYCARBONATES
POLYESTERS
POLYETHERS

POLYETHYLENE
POLYIMIDES
POLYISOBUTYLENE
POLYMER COMPOSITES
POLYPHENYL ETHERS
POLYPHENYLENE
POLYPROPYLENE
POLYSILANES
POLYSULFONES
POLYSTYRENE
POLYSULFIDES
POLYURETHANE ELASTOMERS
POLYURETHANES
POLYVINYL ACETAL
POLYVINYL CHLORIDE
POLYVINYL FLUORIDE
POLYWATER
SARAN
SELENIUM CONTAINING POLYMERS
SILICON CONTAINING POLYMERS
SILICONE ELASTOMERS
SILICONES
SILOXANE POLYMERS
SKYBOND
SPIROPOLYMERS
STEREOSPECIFIC POLYMERS
SULFUR CONTAINING POLYMERS
TEFLON
TENITE ESTERS
THERMOPLASTICS
TN-ELASTOMERS
TYVEK
UREA-FORMALDEHYDE POLYMERS
VINYL POLYMERS
VINYLIDENE POLYMERS
VITON

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)*
University of Dayton Research Institute
300 College Park Ave.
Dayton, Ohio 45409

2a. REPORT SECURITY CLASSIFICATION
UNCLASSIFIED

2b. GROUP

3. REPORT TITLE
DETERMINATION OF THE CONSISTENCY OF RELEVANCE JUDGMENTS AND THE RELIABILITY OF SEARCH STRATEGIES AMONG INFORMATION SPECIALISTS FOR THE AEROSPACE MATERIALS INFORMATION CENTER

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Final Summary Report, 1 December 1970 - 30 November 1971

5. AUTHOR(S) *(First name, middle initial, last name)*
Frederic L. Scheffler
Jacqueline F. March

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
March 1971	92	18

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
F33615-71-C-1069	
b. PROJECT NO. 7381	UDRI-TR-72-14
c.	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
d.	AFML-TR-72-51

10. DISTRIBUTION STATEMENT
Approved for public release; distribution is unlimited

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Air Force Materials Laboratory Wright-Patterson AFB, Ohio 45433

13. ABSTRACT The ability of various AMIC information specialists to prepare search strategies for document retrieval was studied by providing ten typical search request statements to seven information specialists. Each specialist prepared search strategies independently. Significant variations occurred among the strategies, although even with these variations, reasonably consistent document returns resulted. The experiment indicated that the proper interpretation of a search request and the conversion of the request to an appropriate search strategy even with a well-established thesaurus is a considerably more difficult task than indexing. In another experiment, the consistency of relevance judgments among information specialists was examined. Relevance judgment is more difficult than indexing and search strategy preparation. Agreement on nonrelevance is better than agreement on relevance. The system of relevance judging according to nonrelevant, partially relevant and relevant appears optimum for AMIC. Communication between the requester, the information specialist and the retrieval system itself are of prime importance. Because of certain human interactions which must occur, some variability is unavoidable. However, current AMIC procedures of searching to achieve high recall and screening the results for relevance provide good results to the ultimate requester.

DD FORM 1 NOV 65 1473

UNCLASSIFIED
Security Classification

UNCLASSIFIED

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Aerospace Materials Information Center						
Search strategy						
Relevance judgment						
Evaluation						
Document retrieval						
Information retrieval						
Information systems						
Recall						
Precision						
Consistency						
Reliability						

UNCLASSIFIED

Security Classification

*U.S.Government Printing Office: 1972 — 759-086/577