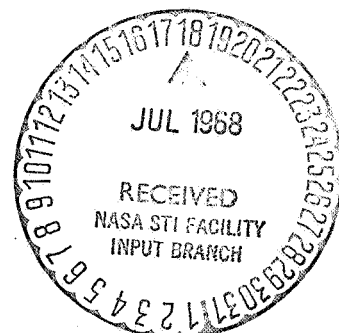


RESULTS OF AN EXPERIMENTAL PROGRAM
TO PROVIDE LOW COST COMPUTER SEARCHES
OF THE NASA INFORMATION FILE
TO UNIVERSITY GRADUATE STUDENTS IN THE SOUTHEAST



Technical Report No. 103

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INTRODUCTION

Thorough diffusion of scientific and technological information throughout the industrial community is a slower and more uncertain process than is generally realized. Originally such information usually appears in a paper printed in a scientific journal or presented before a technical society or as a detailed article in a trade journal. Unfortunately, even the rare engineer, scientist, or industrialist who is acutely cognizant of the benefits to his activity which can accrue by thorough and repeated perusal of the literature in his field can seldom spare time from his immediate responsibilities to engage in manual library searches or even to read a number of journals regularly. He therefore tends to rely less on personal knowledge of outside advances and more on solutions which require no new methods or materials.

This attitude also seems to pervade corporate management collectively. Most industries spend less than two or three cents of each sales dollar on "research." It is not very surprising, then, that new scientific or technological information--which almost always requires rather extensive development and hence considerable commitment of capital resources to bring about a commercially-successful product or process--is not eagerly sought. Also, as a result of this philosophy in industry, the individual who rises to positions where he is able to direct the allocation of resources seldom has practiced and improved his scientific and technical skills to the point where he can make valid judgements on the adaptability of new technology to his activity. He is therefore understandably reluctant to commit himself to a course whose implications he does not fully understand.

Despite this slow diffusion of new technology into industrial practice, the generation of scientific and technical information continues at an ever-increasing pace. It would appear then that the opportunity for new and improved products and processes is today greater than ever before. Also, if the United States is to maintain its position in the commercial markets of the world, it is mandatory that it employ its superior capital resources in the development of new products and processes to compensate for its higher labor rates.

In the search for means to increase the diffusion of this new technology, at least two factors seem evident: (1) increased reliance must be placed on faster, more economical means of information retrieval such as that based on computer technology; (2) those individuals likely to reach positions of technical responsibility rapidly either in industry, government, or education, must be shown the advantages of more extensive literature reviews and the saving in time possible by performing such reviews by computer.

The group most likely to attain this position rapidly and which is at the same time receptive to innovation and capable of perceptive evaluation consists of university graduate students in science and engineering. This group, together with their professors, also is the most numerous, technically-sophisticated group extant in many regions of the country. It is for these reasons that a long-term program was undertaken with the support of the National Aeronautics and Space Administration to provide university graduate students in science and engineering with low cost, computer-based literature searches in support of their thesis problems. This is a report on the first year of the program's operation.

PLAN OF ORGANIZATION

This program was undertaken by the North Carolina Science and Technology Research Center (STRC), an agency of the State Government of North Carolina, which already operates a computer-based information retrieval activity for industrial and academic subscribers. The program was supported by the National Aeronautics and Space Administration (NASA) under Contract NSR 34-007-005, Task No. 3. Its principal resource is the tape file prepared by NASA for its own activities and which is the basis of the abstract journals Scientific and Technical Aerospace Reports (STAR) and International Aerospace Abstracts (IAA).

Regular operations of STRC are supported jointly by NASA and the State of North Carolina. Industrial and academic clients pay a per-search charge of \$75 which, experience has indicated, is sufficient to cover the direct costs of computer time, clerical labor and reproduction of some documents. Subscribers receive free of charge copies of pertinent documents retrieved by the search.

Realizing that the average graduate student operates on a very limited budget, NASA provided funds to subsidize search costs. A \$5 fee was set for service to graduate students. For this fee, the student received a computer-produced bibliography and/or abstracts of documents identified by the computer. Each student was limited to one search and any documents reproduced would be at a charge of 5¢ per page. This was done to encourage the students to use the service and to obtain an indication of the fee level they would support.

Authorization to proceed with the program was received in May 1967. Efforts were then directed toward having the program ready for full operation by September. The marketing material and campaign were prepared. Forms for monitoring the activity and recording the students' needs and impressions of the program were also prepared. Several preliminary searches were conducted to determine (1) the extent to which a student might prepare his own search strategy and (2) the extent to which the NASA file would serve the needs of students in the life sciences and chemistry. These preliminary searches revealed that to obtain a good search it was necessary to employ the services of a trained engineer familiar with the search system and the indexing philosophy. Evaluation of the search output, however, was left to the student, a departure from the usual practice at the Center. Each search output for commercial subscribers is screened by a staff engineer and pertinent documents identified before the search is sent to the customer.

The preliminary searches also revealed that support for students in the life sciences and some areas of chemistry was likely to be limited. For this reason the marketing plans did not include heavy emphasis in these departments.

Miss Becky Walker was assigned the task of keeping all the records on the program, serving as the students' point of contact with the Center, and coordinating the various activities within the Center relative to the program. She also assisted in the marketing effort. The assignment of one person to this activity throughout the life of the experiment is regarded as of significant benefit to maintaining good relationships with the students and in securing a high degree of response to the utility questionnaires.

Usually, the students were provided with computer printouts within two weeks of their conference with a Center engineer. This delay was necessitated by the fact that the NASA Search Program (designated NLSS II) is a long program which for economic reasons was run only once a week. During periods when many students wished service, the engineers required considerable time to prepare the strategies and substantial time was needed to code and key punch the required cards. As a result, not every request could be processed during the week in which it was received.

Requests for abstracts and documents from local sources were filled within one week.

The program was allotted 150 subsidized searches. Actually, 155 were processed before service was discontinued in early Spring 1968.

Table I lists the search titles, the department and institution of the requestor, the number of hits produced by the search, and the number of documents ordered by the student. Table II presents the subject categories of these documents and Table III gives a summary of the document categories for all searches.

MARKETING EFFORT

The initial mailing of the program announcement poster (see page 113) plus an explanatory article was made to the student newspapers at eleven institutions (nine state and two private) in North Carolina which have accredited graduate programs. Most featured the article. The release also appeared in the official bulletin of North Carolina State University. Later, the announcement was sent to each of the academic departments at North Carolina State (55) and several briefing sessions were held at Duke, N. C. State, and the University of North Carolina at Chapel Hill. This effort resulted in about sixty student searches by early December. Department Heads and faculty did not promote the program; the biggest boost came from satisfied fellow graduate students.

At this point the decision was made to extend the marketing effort to eight other universities in the Southeast. The graduate deans were contacted and asked to arrange meetings at which a representative of STRC could inform the students and faculty of the program. This effort resulted in about eighty searches. Additional contacts were also made in North Carolina which produced the remaining searches.

Conspicuous by their absence were mathematics students. Further, only two physics students chose to conduct searches. The NASA information system is rather heavy in these areas and fruitful results are to be expected. When questioned about the reason for this situation, a physics professor replied that it was his opinion that most physics professors and probably most mathematics professors felt they were the generators of the information in the NASA collection or at least aware of it; it was therefore superfluous to conduct a search of the file. This attitude apparently was also reflected by the students in those disciplines. By contrast many students in the life sciences paid to conduct searches on the barest chance that something useful would turn up.

These contrasting views seem to be related to the tradition or state of ferment in various disciplines. In physics and mathematics a graduate student enters a given branch and usually works in this area throughout his professional career. This is the expected modus operandi. Over the years he becomes acquainted with the others working in his field--often personally--and reads the journals in which they publish. These workers become rather tight-knit groups which have little serious professional contact with other scientists.

Biological scientists have a similar tradition. Nevertheless, the unusual national emphasis on their problem areas which has developed within the last few years, coupled with a growing realization on their part that natural science has developed many advanced analytical and experimental tools which may have application in their fields has led biological scientists to search for information outside the usual channels.

Engineers are expected to marshal all the scientific knowledge available in fields applicable to the problem at hand in order to supplement their experience when undertaking the design of new systems. Since the problem areas traditionally vary, no one individual can hope to keep up in all the fields necessary. Hence there has always been a greater willingness on the part of engineers to seek information from sources outside their usual professional circles. This attitude also seems to be communicated by the faculty to the students.

At North Carolina State University studies indicated that in Mechanical and Aerospace Engineering--the department receiving the most intensive marketing effort--approximately half of the graduate students who had selected a thesis topic but had not finished their research chose to conduct a search. Some wanted to insure that they had been sufficiently thorough in their previous literature searches; some wanted to see how an automated search operated; some relied primarily on the computer search for a beginning to their research problems. The diversity of reasons given by these students for conducting a search leads one to conclude that 50% of the prime group is the largest fraction which one can reasonable expect will take advantage of the program.

DESCRIPTION OF SEARCH SYSTEMS

Two search systems were used during this program. The one most frequently used was the NASA Linear Search System supplied by NASA for use on IBM 1410 computing equipment. This system uses magnetic tape for file residence. The other system used was the STRC Inverted Search System, designed and developed by Center personnel. This system uses IBM 360/75 equipment and employs 2314 disk drives as file residence.

The NASA Linear Search is an Information Retrieval System designed exclusively to process the NASA data base. North Carolina Science and Technology Research Center operates this system on an IBM 1410 with 40,000 word storage capability and six tape drives. This machine is the property of the Phillip Morris Tobacco Company of Richmond, Virginia. Searches were processed during this period on a weekly basis, with one batch of searches being processed per week. In addition, the Center utilizes an IBM 1401 located at the Duke University Medical Center as an output printer. Industrial rates are paid for both machines. The NLSS routine has a data file of approximately twenty 556 BPI density magnetic tapes, containing approximately 300,000 postings. The search routine uses a pseudo-Boolean logic format, and has the capability to search on accession number, author, corporate source, or any of several other parameters. The search output may be arranged in accession number order, or in any one of several other formats. STRC engineers usually request the full citation data available on all entries. This citation data includes accession number, author, corporate source if any, title, notation of content, and index terms. The program has been modified to include a hit limit, which

causes the machine to discontinue the processing of any search when this hit limit has been reached. A complete description of this system may be seen in Reference 1.

STRC has coded a search routine for use on an IBM 360/75 which processes an inverted file which is mounted on 2314 direct access storage devices. The program itself is written in Fortran, and utilizes assembler language sub-routines to facilitate data transfer. IBM utility file management routines are utilized to manipulate the file. The file used in the Graduate Student Program occupied approximately 217 cylinders of an IBM 2316 disk-pack. A study was conducted to determine the optimum blocking factors and storage parameters to be used in the file loading process. Results of this analysis are shown in Reference 2. The search routine processes accession numbers in a simple Boolean logic format, with provisions for logical "and," "or," and negation. The output of this system is an accession number string, displayed in such a fashion as to show the user the output of each individual operation as the search progresses. Rapid turn-around is possible between the user and the machine which enables him to prepare more than one search profile for submission to the machine, and permits him to refine his search strategy as he examines the output of each successive search.

As the output string is accession number only, it is necessary to pull and copy abstract cards for all accession numbers in order to present the students with a complete search.

It must be emphasized that this search system was still in a developmental stage as it was being used in this program. More recent refinements to the search routine and data manipulation schemes have improved its operational characteristics beyond those listed in this report.

DISCUSSION OF PRICING CONSIDERATIONS ON THE NLSS SEARCHES

North Carolina Science and Technology Research Center has analyzed the NASA Mod II Linear Search System in an effort to define the principal parameters which determine the computer time required to process any given search. It was determined that computer time for a search processed in batch processing mode was proportional to the number of query terms, number of hits, and number of searches per batch. If one assumes that the search routine is compute-bound (i.e., the computer is processing at its maximum internal speed and is not delayed by tape-drive speed) and that there is not preferential selection of terms or unsymmetrical distribution of postings to bias search processing, then one may write that the time to process a search is given by:

$$T_q = AN_t + BN_h + C \quad (1)$$

where T_q = time to process question

N_t = number of query terms per question

N_h = number of hits.

The constant A is proportional to the amount of time the machine requires to process a given term. This is a function of the number of postings (tape length) which the machine must process. The constant B is proportional to the number of hits which must be sorted, formatted, and printed. The constant C is related to the number of searches processed per batch. Based upon the rental rates paid by STRC for IBM 1410 computer machines,

$$A = 4.05 \text{ \$/term}$$

$$B = 0.135 \text{ \$/hit}$$

$$C = 1.54 \text{ \$/search.}$$

This simple model has been proven to be accurate within a few per cent in predicting the total cost for any batch of searches for which there are no errors or abnormalities within the search population. This formula was used to cost all linear searches processed on the Graduate Student Program.

Since the inverted searches were run one at a time, computer costs incurred on the IBM 360/75 were easily obtained. Generally, the cost is directly proportional to the number of postings processed per search.

OPERATIONAL DATA

STRC realized at the beginning that this program would be a good opportunity to analyze the operational characteristics of a retrieval system in that the study involved a well-defined group. Consequently, careful efforts were made to insure that accurate and detailed statistics of the operational functions were kept. As a means of recording all work and time charged directly to any particular search, simple work order sheets were drawn up which followed each search as it progressed through the Center. Any employee who devoted his time to a particular search entered that time in the appropriate area of the sheet. In addition, if abstract or document copies were made, either by reproduction from microfiche or by Xerox copying, the number of total pages, the number of documents or abstracts, and the time required to process was recorded directly. As a result, the Center was able to assess to a rather high degree of accuracy those costs which were to be charged directly to a search.

The usual processing routine involved a study of the search topic by the STRC Applications Engineer responsible for the search. He was required to pose the student's question in terms of the appropriate vocabulary and to establish the correct search logic. After he had finished this activity, he recorded his initials and the time required on the work order, and passed his work with the sheet along to the employees responsible for transferring his statement of the search onto computer load sheets from which control cards were key-punched. The time required for both these clerical functions was recorded. When the machine's output was returned, those parameters essential to a description of the search output such as number of key word terms, postings to be processed, number of hits, and a simple count of the Boolean operands was entered. A copy of the search was then mailed to the student so that he might evaluate it and request any abstracts or documents. From this point, except for a few cases in which errors occurred, necessitating revisions to search strategy and reruns, all manpower functions were of a strictly clerical nature, and involved only reproduction of abstracts and documents.

The machine search population was first divided into linear and inverted search categories. Then it was seen that the student population should be subdivided to reflect the response of those students who ordered abstracts and/or documents as opposed to the response of the total population. It was established that the most descriptive categorization was along the following lines:

I. Linear Searches

- A. All linear searches
- B. All linear searches from which abstracts were ordered
- C. All linear searches from which documents were ordered

II. Inverted Searches

- A. All inverted searches (all inverted searches usually included a copy of all abstracts in the original published search.)
- B. Inverted searches from which documents were ordered.

Since the inverted search was used only in a developmental sense, the population is heavily in favor of the linear searches. Only twelve inverted searches were run, and of these, only two students ordered documents from STRC as a result of these searches.

The distribution of man hours for searches as categorized above is given in Table IV. On a general basis, engineering time involved approximately 30% of all labor charged, 15% was required for correspondence and other secretarial functions, and clerical labor accounted for 55% of all time. The average linear search required 1.87 hours of engineering time, 0.83 secretarial hours, and 2.92 clerical hours. This clerical time was separated into 0.53 hours loadsheet preparation, 0.55 hours key-punch

and 1.35 hours to pull and reproduce abstract cards. Since the abstract card files were not complete, it was necessary to cut abstracts from the published journals in order to obtain a complete list. This, of course, increased the average time required to supply abstracts to a student. One may obtain a reasonable idea of the manpower costs to process a search by applying cost weighting factors to the hourly averages shown. Approximately 60% of search manpower costs are accountable to engineering, 8% to secretarial help, and 32% to clerical. (It is interesting to note that the engineering time for these linear searches for students who subsequently ordered documents was 2.25 hours and 1.87 hours for the total linear search population as a whole.)

The manner by which computer costs for linear and inverted searches were obtained has been described earlier in this report. Table V gives a breakdown of costs-per-search based upon these methods. The categorization is the same as that for Table IV. In addition, other figures are given which show the characteristics of the search from an operational standpoint and from the students' point of view.

The average cost per search for the linear system was \$119.11. An attempt was made to draw some statistical inference from the data, so a standard deviation was computed. It is seen that the search population was not normal since the computed standard deviation was \$68.47. The average number of hits per search was 363.86, and the average number of terms was 18.05. This compares to the standard STRC industrial search cost of \$109.54 with 16.52 terms and 309.68 hits. The average inverted search computer cost was \$24.23, with an average of 17.58 terms and 147.00 hits. Those linear searches from which documents were ordered showed slight departure, in that they had 20.62 terms and an average of 344.00 hits.

STRC uses two Relevancy Factors for evaluating its linear searches. These are

$$RF\#1 = \frac{\text{No. of abstracts ordered from search}}{\text{No. of hits}}$$

and

$$RF\#2 = \frac{\text{No. of documents ordered from search}}{\text{No. of hits}}$$

The ratio of RF#1 to RF#2 gives the number of abstracts ordered to the number of documents ordered.

The value of RF#1 for linear searches was approximately 0.1, indicating that students ordered abstracts for one-tenth of those accessions listed in the computer output. The ratio of documents ordered to number of hits was 0.008, indicating that students ordered about one document for every twelve abstract cards received. These values improve significantly when the population is subdivided into groups as discussed above. For those ordering abstracts and documents, the average value of

RF#1 was .15, and the value of RF#2 was 0.12 for the first subgroup and 0.28 for the second. Only 53 of the 155 searches in the program produced searches from which documents were ordered. In certain instances, students indicated that by the time they received their search they had no further requirement for papers and used the search output only to confirm their personal manual searches. Still others stated that they found documents in their own libraries. Nevertheless only a relatively small percentage of the students considered the searches of sufficient value to encourage them to invest five cents per page for printed copy.

Table VI gives a summary of pages and documents ordered by the students along with the reproduction rates and characteristics of those documents. The great majority of all documents ordered were reproduced from microfiche using a Recordak copier. For those students requesting documents from linear searches, the average number of documents requested from all sources was 8.40, requiring reproduction of 25.21 pages from microfiche. Approximately two documents per search were obtained from NASA supplies or from the STRC library, and 1.5 were reproduced from originals using a Xerox copier. This required approximately 1.75 hours labor time to reproduce 25.21 pages, showing a rate of 14.4 pages per hour.

These figures also show the use of complete abstract lists for the inverted searches. As contrasted with the linear searches, the average inverted search required 52 pages of Xeroxed abstract cards.

RESULTS OF USER SURVEY

Table VII presents a complete list of the user responses to the following questions:

1. Of what value was the information retrieved by this search?
2. Do you feel such a service would be generally useful to most graduate students preparing theses and/or research papers?
3. What is your feeling as to the amount other students would be willing to pay for such service in the future?
4. What type of employment do you expect to pursue upon completion of your degree program?
5. Would you recommend to your future employer the use of information retrieval services such as this?
6. Do you care to make any additional comments on this program?

From the 155 students for whom searches were run, 144 responses were obtained.

The students generally appeared to be satisfied with the results of the experiment. This is significant in that the students performing the evaluation of the service represent one of the largest homogeneous (in terms of education) groups to test the NASA data bank and retrieval system. It is interesting to note that many students in aerospace-related disciplines felt their search was adequate, yet they did not order documents. Personal investigation of some of these cases revealed that the pertinent documents were either already known to the student (who often had conducted a manual search prior to running a computer search) or were obtained from the University library as a result of the search. The students were critical of the fact that many NASA-pertinent documents known to them, particularly those in the journal literature, were either unretrievable (due to indexing or strategy problems) or not included in the system. On the other hand, students in fields unrelated to aerospace often ordered documents for background information or assistance in instrumentation, analytical, or experimental techniques even though little of direct pertinence to their research problems was retrieved.

In spite of these deficiencies, the students felt that if the service were continued most graduate students would find it useful.

A fee of \$10 was regarded by most as the maximum which students could be expected to support on a routine basis from their own funds. At higher fee levels students tended to feel they could better afford the time to conduct manual searches. Many expressed the view that the service is really worth \$75 but that they could not afford it at that level. In this connection it is interesting to note that two universities paid the \$5 search cost for each of their students involved in the program. A number of other students were supported to this extent by departmental or project funds. It is thus not unreasonable to expect that university libraries--at the urging of the academic departments--will take steps in the near future to make this service regularly available to all graduate students. One can easily appreciate the increased productivity and efficiency which such a service enables a given library facility to provide.

A disquieting feature of the results is that fewer than 40% of the students using the service plan to enter industry or business. The majority plan to remain in education or enter government service. This suggests that those sections of society which have traditionally attracted the major fraction of the research-minded and the innovative individuals in this country will continue to do so. Business and industry thus are not likely to be staffed with a large number of individuals familiar with the benefits and operation of such an information retrieval program. Possibly as more government officials and educators become familiar with it and speak of it, industry and business generally will begin to respond, but this is likely to be an extended process.

In general, the chief objection to the service was its lack of inclusiveness. Although some of the students' disappointments were recall failures resulting from faulty indexing or search strategy, the majority were due to lack of coverage in the file. While no single system can be all inclusive, the NASA file is of limited utility to students in the diverse areas of chemistry and biochemistry, for example. As noted above, even in the space-related fields, the NASA file contains only selected items from the journal literature. Since this selection is of necessity arbitrary, some students do not retrieve articles they are aware of from other sources but which they feel should have been retrieved in a search of the NASA file.

The user responses shown in detail in Table VII were then assigned to categories for purposes of detailed analysis and correlation. Table VIII presents the results.

The first classification is the interest areas of the respondents. Approximately 36% of the students were investigating problems which could not be classified as directly aerospace-related. Of this number, however, 58% ordered one or more documents. It should be recalled here that unless the document was a NASA publication, the student was charged 5¢ per page for reproduction.

The percentage of non-aerospace-related students ordering documents is perhaps inflated when compared with that which one would obtain in a random non-aerospace population since all of the students using the system investigated the relative abundance of citations in their subject areas before contracting for a search.

In the group of students investigating aerospace-related problems, 63% ordered one or more documents. This is not significantly greater than for the non-aerospace group.

Approximately 30% of the respondents were working in those areas in which NASA is the leading generator of information. Only half of these students ordered documents.

There appears to be a small difference in the student's opinion of the value of the service whether he ordered documents or not. At least 58% of the students in each population were favorably impressed with the service while 77% of the aerospace-related students who ordered documents indicated their approval.

It is interesting that as a result of their experience more students would recommend the service to other graduate students than were impressed themselves.

Only 30% of the students thought graduate students would be willing to pay more than \$10 for search service.

The students generally were willing to recommend the use of computerized information retrieval to their prospective employers, irrespective of their interest areas or success with the present trial as measured by documents ordered.

Of the students participating in the study 19% indicated a desire to see the data base expanded. Significantly, these were students who had already examined the contents of the system before having their searches run. Another 19% suggested changes in procedures and pricing policy. The remainder of the students were either satisfied with the results or offered no comments.

CONCLUSIONS

The program to provide subsidized searches of the NASA information bank to graduate students preparing theses was well-received. If the program is maintained and expanded, it is reasonable to expect that it will result in higher quality research and research administration in the United States within a very few years. Students generally found documents relating to their research they would not have found otherwise and most were impressed by the ease and speed with which this was done. Students in the natural sciences appeared to receive considerable assistance in the area of instrumentation and experimental and analytical techniques. This cross-fertilization should have a salubrious effect on the quality of research in the natural sciences in the next few years. Students in the physical sciences and engineering generally were impressed with the fact that few areas of research are not being actively pursued; one has only the problem of finding their reporting media. In this climate it is particularly incumbent upon researchers to avoid needless duplication. In general the students found that the computer made avoidance of duplication easier than ever before and also turned up help in particular investigations. It is therefore reasonable to expect--and indeed the survey responses indicated this--that researchers familiar with computerized retrieval will recommend its use to their superiors as an economical and productive tool.

A primary objective of the Technology Utilization Program is the more rapid diffusion of new technology into commercial industry. Unfortunately fewer than 40% of the respondents to the user survey (92% of those graduate students for whom searches were run) indicated an interest in entering business and industry. It seems evident, therefore, that acquainting graduate students in science and engineering with the NASA data base and computerized retrieval is not a highly efficient means to accomplish this objective. Some means must be found to present significant technological developments in simple terms to undergraduate students expecting to enter commerce, finance, and manufacturing and to have them recognize the existence of a source from which they can gain such information in the future.

The interest in the present experiment shown by students of mathematics and physics seems indicative of a continuing trend in these disciplines toward insulation from the rest of the scientific community, a trend which, if continued, seems destined to lead to sterility and fiscal starvation.

Operationally, the program statistics illustrate the almost obvious conclusion that those searches to which the assisting applications engineer devoted the most effort and used the most search terms were the most productive. The cost experience of the average graduate student search was approximately 10% greater than normal for industrial subscribers but this can be attributed to the desire of the graduate student for all the relevant references in the field rather than some.

RECOMMENDATIONS

1. The program to provide search service to students preparing graduate theses should be continued and expanded.
2. The cost per search should be limited, by government or university subsidy if necessary, to an average of \$15.
3. A mechanism should be found to expand the data base in order to serve a larger fraction of the student population.
4. Efforts should be made to develop those portions of the NASA file dealing with systems and program management into a separate package which can be searched for students in graduate schools of business.
5. Consideration should be given to developing a program in technical and economic information retrieval suitable for use by business undergraduates.
6. Indexing and abstracting coverage of the journals already reviewed for the NASA file should be increased.
7. New approaches should be developed to encourage the use of the service by students of mathematics and physics.

LIST OF REFERENCES

Brandhorst, W. T. and Eckert, Philip F., Guide to the Processing, Storage and Retrieval of Bibliographic Information at the NASA Scientific and Technical Information Facility, Documentation Incorporated, College Park, Maryland. NASA CR-62033, June 1966.

Phillips, Dennis M. and Williamson, Mary Ann, The Analysis of Large File Mounted on a Direct Access Storage Device, North Carolina Science and Technology Research Center, Technical Memorandum 67-5, North Carolina Science and Technology Research Center, Research Triangle Park, North Carolina, 27 September 1967.

Graduate Student Search Program

NAMES AND LOCATIONS OF PARTICIPATING UNIVERSITIES

<u>Name</u>	<u>Location</u>	<u>Abbreviation</u>
North Carolina State University	Raleigh, North Carolina	NCSU
The University of North Carolina at Chapel Hill	Chapel Hill, North Carolina	UNC-CH
Duke University	Durham, North Carolina	Duke
Clemson University	Clemson, South Carolina	Clemson
Georgia Institute of Technology	Atlanta, Georgia	Ga Tech
Bowman Gray School of Medicine	Winston-Salem, North Carolina	Bowman Gray
The University of Tennessee	Knoxville, Tennessee	UT
Virginia Polytechnic Institute	Blacksburg, Virginia	VPI
Mississippi State University	State College, Mississippi	Miss
The University of North Carolina at Greensboro	Greensboro, North Carolina	UNC-G
Auburn University	Auburn, Alabama	Auburn

DEPARTMENTS ABBREVIATED IN TABLE I

<u>Department</u>	<u>Abbreviations</u>
Mechanical Engineering	Mech. Eng.
Agricultural Engineering	Ag. Eng.
Poultry Science	Poultry S.
Nuclear Engineering	Nuc. Eng.
Electrical Engineering	Elec. Eng.
Chemical Engineering	Clem. Eng.
Biochemistry	Biochem.
Engineering Mechanics	Eng. Mech.
Civil Engineering	Civil Eng.
Aerospace Engineering	Aero. Eng.
Soil Science	Soil Sci.
Environmental Systems Engineering	Env. Sys.
Ceramic Engineering	Cer. Eng.
Child Development	Child Dev.
Experimental Statistics	Exp. Stat.
Mineral Industries	Min. Ind.

TABLE I
SEARCH TITLES AND RESULTS

Search Number	Search Title	University	Department	Hits	Documents
949	Selected Modern Developments in Hydrodynamics	NCSU	Mech. Eng.	428	7
962	Insects	NCSU	Entomology	73	0
1012	Probe Measurement of Plasma Properties	NCSU	Mech. Eng.	1060	0
1015	Ion Emission	NCSU	Mech. Eng.	686	0
1016	High Speed Gas Dynamics	NCSU	Mech. Eng.	642	0
1017	Thermal Transpiration	NCSU	Mech. Eng.	412	0
1018	Flow Through Square-Edged Pipe	NCSU	Mech. Eng.	519	0
1024	Profile Measurement & Vibration Isolation	NCSU	Mech. Eng.	397	11
1025	Vibration Effect on Animals	NCSU	Ag. Eng.	159	0
1028	Beryllium Poisoning	NCSU	Ag. Eng.	87	0
1029	Automatic Control & Computer Simulation of Flue Curing Operations	NCSU	Poultry S.	95	1
1032	Charged Aerosols	NCSU	Ag. Eng.	119	0
1037	Nuclear Architecture	NCSU	Ag. Eng.	438	0
1039	Man Amplifiers & Biocontrol Systems	NCSU	Nuc. Eng.	141	0
1044	Noise Reduction	NCSU	Ag. Eng.	776	2
1045	Energy Balance in Leaves	Duke	Forestry	1289	32

Search Number	Search Title	University	Department	Hits	Documents
1046	Metal Composites	NCSU	Mech. Eng.	535	0
1047	Sonic Radiation Resistance of Conical Shells	NCSU	Mech. Eng.	593	0
1048	Modal Density in Conical Shells	NCSU	Mech. Eng.	131	7
1049	Energy Transfer in Shells	NCSU	Mech. Eng.	111	5
1050	Material Flow During Sinking	NCSU	Mech. Eng.	69	0
1051	Transfer Function Measurement	NCSU	Elec. Eng.	159	2
1052	Optical Data Processing	NCSU	Elec. Eng.	162	6
1054	Analog Model of Ecosystem	UNC-CH	Botany	643	30
1062	Physiological Study of Actinoplanes	UNC-CH	Botany	465	0
1063	Soil Moisture Measurement	NCSU	Ag. Eng.	205	7
1064	Accidents and Safety	NCSU	Psychology	379	0
1065	Holography	NCSU	Mech. Eng.	335	0
1066	Steam Heat Transfer	NCSU	Mech. Eng.	131	27
1067	Jet Flow	NCSU	Mech. Eng.	698	0
1068	Noise Emission	NCSU	Mech. Eng.	205	2
1071	Measurement of Algae Respiration	UNC-CH	Botany	254	0
1072	Tropical Climatology	Duke	Forestry	34	0
1073	Geochemistry of Lake Sediments	Duke	Zoology	1236	0
1074	Iodine Deposition	NCSU	Mech. Eng.	179	0
1075	Nonconventional Waveguides	NCSU	Elec. Eng.	1029	0
1076	Organic Electron Paramagnetic Resonance & Scuba	UNC-CH	Chemistry	225	0
1077	Nitrite Photolysis	UNC-CH	Chemistry	158	0
1078	Boron-Aromatic Reactions	UNC-CH	Chemistry	42	0
1079	Hydroboration	UNC-CH	Chemistry	31	0
1080	Microwave Wire Grid Lens	NCSU	Elec. Eng.	52	1
1083	Holography & Pattern Recognition	NCSU	Elec. Eng.	317	1

Search Number	Search Title	University	Department	Hits	Documents
1084	Scattering by Dielectric Bodies of Revolution	NCSU	Elec. Eng.	76	0
1088	Thermometry	NCSU	Ag. Eng.	1178	1
1089	Physiological Study of Certain Bacterial Families	UNC-CH	Botany	129	7
1091	Work Efficiency	NCSU	Ag. Eng.	412	8
1092	Hydraulic Controls & Transient Air Flow	Duke	Mech. Eng.	708	5
1093	Physiology & Nutrition of Pilimelia	UNC-CH	Botany	66	0
1098	Weight Distribution Codes	UNC-CH	Statistics	427	0
1102	Vehicle Stability	NCSU	Ag. Eng.	138	1
1103	RNA and DNA Studies	Duke	Forestry	70	13
1104	Relativistic Gas Dynamics	NCSU	Mech. Eng.	162	0
1105	Pattern Recognition Theory	NCSU	Elec. Eng.	2701	1
1107	Effect of Growth Hormone on Algae	UNC-CH	Botany	150	0
1112	Radiation-Initiated Polymerization	NCSU	Chem. Eng.	372	26
1113	Millimeter Wave Molecular Beam Masers	Duke	Physics	290	0
1114	P-I-N Junction Equation Solutions	NCSU	Elec. Eng.	57	2
1116	Influence of Potassium on Enzyme Activation	NCSU	Biochem.	144	0
1117	Reduced Water Potential in Crop Plants	Duke	Botany	25	0
1118	Salt Uptake by Plants	Duke	Botany	36	0

Search Number	Search Title	University	Department	Hits	Documents
1119	Transpiration in Plant Leaves	Duke	Forestry	330	0
1121	Sandwich Beams	Clemson	Eng. Mech. Civil Eng.	530	22
1122	Vibration & Flutter of Nonisotropic Plates	Clemson	Mech. Eng.	78	0
1124	Search on Low Speed Aerodynamics	NCSU	Aero. Eng.	181	0
1126	Simulation of Surface Temperature & Burning	NCSU	Aero. Eng.	15	0
1131	Epitaxial Deposition of III-V Compounds	NCSU	Elec. Eng.	730	0
1132	MOS Device Charge Injection	NCSU	Elec. Eng.	723	0
1134	Respiration Control Systems & Autoregulation in Kidney Nephron	Clemson NCSU	Chem. Eng. Soil Sci.	518 62	27 0
1136	Liming of Organic Soils	Clemson	Chem. Eng.	400	0
1137	Computer Simulation of Physiological Functions	Clemson	Chemistry	274	4
1139	Reaction of Transition Metal Compounds & Gases	Clemson	Env. Sys.	372	0
1145	Computer Simulation of Ecological Systems	Clemson	Chem. Eng.	136	25
1146	Gas Adsorption in a Fluidized or Fixed Bed	NCSU	Ag. Eng.	646	0
1147	Pressure & Soil-Moisture Measurement	Ga Tech	Eng. Mech.	157	0
1148	Fatigue of Metals Under Random Loading	NCSU	Eng. Mech.	69	0
1149	Vortex Fluid Flow	NCSU	Eng. Mech.	54	0
1150	Capillary Flow	NCSU	Eng. Mech.		

Search Number	Search Title	University	Department	Hits	Documents
1151	Hemodynamic Model	Bowman Gray	Physiology	294	0
1152	Secondary Nucleation from Solution	NCSU	Chem. Eng.	424	9
1155	Convective Heat Transfer	NCSU	Eng. Mech.	127	0
1156	Uses of Computers in Biomedical Engineering	Clemson	Elec. Eng.	243	0
1157	Hybrid Computers & Real Time Simulation	Clemson	Elec. Eng.	174	0
1158	Diffusion of Stainless Steel, Face-Centered-Cubic Metals & Some Ceramics	NCSU	Nuc. Eng.	250	0
1159	Folded-Plate Theory	Clemson	Civil Eng.	31	1
1160	Optimal Control Subject to Bounds	Ga Tech	Elec. Eng.	119	0
1161	Microscopic Cardiovascular System Measurements	Bowman Gray	Physiology	358	0
1163	Vortex Flow	Ga Tech	Aero. Eng.	419	0
1164	Journal Bearing	UT	Mech. Eng.	174	0
1165	Fluid Flow in Annulus	UT	Mech. Eng.	26	0
1166	Gas Flow in Short Tubes	UT	Mech. Eng.	528	0
1167	Radiative Heat Transfer in Gas Flow	Ga Tech	Aero. Eng.	45	0
1168	Liquid Propellant Combustion Stability	Ga Tech	Aero. Eng.	359	0
1169	Measurement of Properties of Conducting Gas	Ga Tech	Mech. Eng.	269	0
1170	Solid Propellant Combustion Stability	Ga Tech	Aero. Eng.	211	0
1174	Hydrodynamic Seal	UT	Mech. Eng.	29	0

Search Number	Search Title	University	Department	Hits	Documents
1175	Visco Seal	UT	Mech. Eng.	197	2
1176	Sewage Treatment in Experimental Lagoon	Clemson	Chem. Eng.	93	1
1177	Solving Partial Differential Equations	UT	Chem. Eng.	123	0
1178	The Excited State Lifetime of Nuclei Elements 11-28	Duke	Physics	40	0
1181	Fluid Transfer in Vascular System	Bowman Gray	Physiology	371	0
1182	Hippocampus	Bowman Gray	Physiology	203	0
1183	Hippocampus	Bowman Gray	Physiology	356	0
1184	Dispersion Hardening	VPI	Cer. Eng.	359	0
1185	Jet Mixing	VPI	Mech. Eng.	200	0
1186	Shell Stability	VPI	Eng. Mech.	171	0
1187	Thrust Augmentation	VPI	Mech. Eng.	121	0
1188	Infrared Photography	VPI	Mech. Eng.	280	0
1189	Viscoelastic Damping	VPI	Eng. Mech.	250	0
1190	Fretting Corrosion	VPI	Mech. Eng.	216	6
1191	Laminar Jet Flow	VPI	Mech. Eng.	284	0
1192	Low Speed Diffuser	VPI	Mech. Eng.	160	0
1193	Phase Lock Loop	VPI	Elec. Eng.	343	0
1194	Electrohydrodynamics	VPI	Elec. Eng.	736	1
1195	Antenna Array Impedance	VPI	Elec. Eng.	162	2
1198	Infrared Temperature Measurement	USC	Mech. Eng.	98	2
1201	V/Stol Aircraft	Ga Tech	Aero. Eng.	708	0
1202	Absorption of Metals by Graphite	NCSU	Nuc. Eng.	212	15
1203	Trajectory Optimization	Miss	Aero. Eng.	842	0
1204	Temperature Effects on Vascular Tone	Bowman Gray	Physiology	468	1
1205	Terrain Influence in Precipitation	Duke	Forestry	543	20

Search Number	Search Title	University	Department	Hits	Documents
1206	Error Voltage in Instrument Transformer	VPI	Elec. Eng.	18	0
1211	Automatic Frequency Control	Auburn	Elec. Eng.	343	0
1213	Stability of Emulsions	NCSU	Chem. Eng.	112	0
1214	Heat Transfer in Non-Newtonian Fluid	USC	Mech. Eng.	540	0
1215	Convective Heat Transfer in Enclosures	Miss	Mech. Eng.	407	0
1216	Computer Solution	Miss	Mech. Eng.	230	0
1217	Psychological Effects of Isolation	UNC-G	Child Dev.	59	4
1221	Organic Liquid-Crystals	Duke	Chemistry	2294	0
1222	Applications of Electron Spin Resonance	Duke	Chemistry	1500	0
1223	High Speed MHD Shock Waves	Miss	Aero. Eng.	40	0
1224	Shock Wave, Boundary Layer Interaction	Miss	Aero. Eng.	704	0
1225	Magnetohydrodynamic Boundary Layer	Miss	Aero. Eng.	350	0
1226	Magnetohydrodynamic Wave	Miss	Aero. Eng.	700	0
1229	Human Response to Impact Noise	NCSU	Mech. Eng.	93	0
1230	Four Bar Linkages & Cams	NCSU	Mech. Eng.	101	0
1231	Argon Plasma	Miss	Aero. Eng.	422	0
1232	Fourier Coefficients & Stochastic Processes	NCSU	Exp. Stat.	87	0
1233	Relationship of Wettability & Compatability of Metals & Inorganic Materials	NCSU	Min. Ind.	1000	6
1235	Firing Shrinkage Control in Dry Pressed Ceramics	NCSU	Cer. Eng.	473	2

Search Number	Search Title	University	Department	Hits	Documents
1236	Electric Arcs in Magnetic Fields	Miss	Aero. Eng.	114	0
1237	Specific Optimal Control	Miss	Elec. Eng.	197	0
1239	Low Level Amplifiers	UT	Mech. Eng.	218	0
1240	Structural Mechanics of the Heart	USC	Civil. Eng.	101	0
1241	Infrared Photography	UT	Planning	84	2
1242	Ring Vibration	USC	Civil. Eng.	78	0
1244	Structure Optimization	USC	Civil. Eng.	284	5
1247	Heat Exchange Optimization	USC	Civil. Eng.	10	0
1250	Combined Free & Forced Convection	NCSU	Eng. Mech.		
1254	Optimization of Bearings	USC	Mech. Eng.	17	0
1255	Air Pollution & Vegetation	NCSU	Eng. Mech.	180	0
1256	Microenvironment of Soil	Duke	Forestry	34	0
1257	Oscillating Shock Wave-Boundary Layer	Duke	Forestry	500	0
1259	Thermocouple Temperature Measurement in Propellants	UT	Aero. Eng.	138	0
1260	Diffusion of Xenon	USC	Mech. Eng.	238	38
1262	Turbulent Jet	NCSU	Nuc. Eng.	34	0
1264	Effect of Air Pollutants on Trees	NCSU	Eng. Mech.	283	0
1265	Atmospheric Effects on Distribution of Fungus Spores	Duke	Forestry	70	13
		Duke	Forestry	103	0

Graduate Student Search Program

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CATEGORIES OF DOCUMENTS IN EACH SEARCH

Search	STAR Category	Number Ordered	Search	STAR Category	Number Ordered	
949	03	1	1054	04	13	
	11	1		05	4	
	12	5		07	1	
1024	04	4		13	1	
	05	6		16	8	
	06	1		24	1	
	16	1		30	2	
1029	14	1		1066	11	1
		1			12	1
		1			13	2
1044	15	1			22	2
		1			23	2
1045	23	1		33	19	
		01	2	1068	18	1
		04	1		23	1
		08	2	1080	15	1
		10	1		1083	14
		12	5	1088		14
		13	4		1089	04
		14	4	1091		04
		20	4		05	2
		21	1		08	1
		23	2		16	1
		29	2		28	1
		32	1	unc	2	
		33	2	1048	32	7
unc	1	1049	32		5	
1051	22		1		1052	07
	23	1	08	2		
1052	14	3	1102	30	1	
	1054	10		1105	1	

Search	STAR Category	Number Ordered	Search	STAR Category	Number Ordered	
1112	06	16	1175	19	1	
	07	4		33	1	
	10	3	1176	11	1	
	19	1		1190	04	1
	21	1			15	4
	24	1			18	1
1114	09	1	1194	03	1	
	20	1	1195	07	1	
1121	12	1		21	1	
	19	1	1198	26	1	
	23	1		33	1	
	27	1		1202	06	6
	32	13	07		1	
	33	5	13		2	
1134	04	12	18	1		
	05	1	22	1		
	12	1	33	4		
	16	2	1204	04	1	
	unc	11		1205	01	1
1139	06	3			04	2
	17	1			13	6
1146	05	1	14	2		
	06	5	20	4		
	07	2	21	1		
	12	1	20	2		
	13	2	33	2		
	15	1	1217	01	1	
	17	2		04	1	
	20	1		16	1	
	22	7		unc	1	
	33	3	1233	06	1	
	1152	06		1	07	1
17		2		15	1	
20		2		17	2	
25		2		18	2	
26		2	34	1		
1159	32	1				

Search	STAR Category	Number Ordered	Search	STAR Category	Number Ordered
1235	17	1	1264	04	3
	18	1		07	1
1241	23	2		08	1
1244	32	5		12	1
1259	11	1		13	1
	13	4		20	1
	14	7		22	1
	15	6		26	1
	22	6		29	1
	23	1		30	2
	26	4			
	27	2			
	33	5			
	34	2			

The 38 documents distributed under Selective Dissemination are listed by category below.

<u>Category</u>	<u>Number Distributed</u>
01	1
04	7
08	2
11	2
12	2
14	1
17	1
19	2
22	1
23	2
32	13
33	2
unc	2

*Documents ordered represent both "A" and "N" accession numbers

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TABLE III

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SUMMARY OF DOCUMENTS ORDERED BY STAR CATEGORY FOR 155 SEARCHES

Category Title	Category Number	Number Ordered	Percentage Of Total
Aerodynamics	01	5	1.1
Aircraft	02	0	0.0
Auxiliary Systems	03	6	1.4
Biosciences	04	53	12.2
Biotechnology	05	14	3.2
Chemistry	06	33	7.6
Communications	07	12	2.8
Computers	08	8	1.8
Electric Equipment	09	1	0.2
Electronics	10	5	1.1
Facilities, Res. & Support	11	6	1.4
Fluid Mechanics	12	18	4.1
Geophysics	13	22	5.0
Instrumentation & Photography	14	20	4.6
Machine Elements & Processes	15	14	3.2
Masers	16	13	3.0
Materials, Metallic	17	10	2.3
Materials, Non-Metallic	18	6	1.4
Mathematics	19	5	1.1
Meteorology	20	14	3.2
Navigation	21	4	0.9
Nuclear Engineering	22	19	4.4
Physics, General	23	13	3.0
Physics, Atomic, Molecular & Nuclear	24	2	0.5
Physics: Plasma	25	2	0.5
Physics: Solid State	26	8	1.8
Propellants	27	3	0.7
Propulsion Systems	28	1	0.2
Space Radiation	29	5	1.1
Space Sciences	30	5	1.1
Space Vehicles	31	0	0.0
Structural Mechanics	32	45	10.3
Thermodynamics & Combustion	33	44	10.1
General	34	3	0.7
Unclassified		17	3.9
	Total	436	

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TABLE IV

LABOR DISTRIBUTION

Type Search	Engineering Hours/Search	Secretarial Hours/Search	Clerical				Total Hours	Total Engineering	Total Secretarial	Total Clerical	Engineering %	Secretarial %	Clerical %
			Loadsheet Search	Prep/Search	Keypunch/Search	Putting Abstracts/Search							
All Linear	1.87	0.83	0.53	0.55	1.35	2.92	821.60	273.40	121.50	426.70	30.2	13.4	56.4
Linear with Abstracts	1.98	1.07	0.53	0.58	2.14	4.00	649.30	182.40	98.80	368.10	28.1	15.2	56.7
Linear with Documents	2.25	1.43	0.58	0.62	2.13	5.08	481.10	123.70	78.40	279.00	25.7	16.3	48.0
All Inverted	1.65	0.48	0.55	0.51	3.59	4.76	82.90	19.80	5.30	57.30	23.6	6.9	69.5
Inverted with Documents	1.00	0.65	0.40	0.70	2.15	4.00	11.30	2.00	1.30	8.00	17.7	11.5	60.8
All	1.86	0.81	0.53	0.55	1.52	3.08	904.00	293.00	127.30	484.00	32.4	14.1	53.5

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TABLE V

COMPUTER OPERATIONS COST

Type Search	Computer Costs (\$)	Cost/Search (\$)	Cost/Search (\$)	RF#1 Abs/Hit	RF#2 Doc/Hit	RF#1/RF#2 Abs/Doc	Number of Searches in Population	Hits/Search	Terms/Search
All Linear	17390.57	119.11	68.47	.099	.008	12.4	146	363.86	18.05
All Linear with Abstracts	10969.62	119.24	60.19	.154	.012	12.8	92	369.83	17.99
All Linear with Documents	6585.22	124.25	63.23	.176	.028	6.3	53	344.30	20.62
All Inverted	290.79	24.23	29.19	---	.005	---	12	147.00	17.58
All Inverted with Documents	30.91	15.45	1.07	---	.028	---	2	147.00	9.00
Total for All	17681.36	---	---	.099	.008	12.4	158	---	---

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TABLE VI

REPRODUCTION ACTIVITY

Type Search	Abstracts/ Search	Pages Xeroxed/ Abstracts/ Search	Microfiche Documents/ Search	Pages Reproduction/ Search	Pages Documents Recordak	Hours Recordak	Documents Xeroxed/ Search	Average Pages/ Search	Pages/ Document	From NASA-STRC Library
All Linear	35.68	25.45	1.45	35.42	24.51	0.49	0.47	4.90	10.53	0.75
Linear with Abstracts	56.62	40.39	2.13	52.52	24.66	0.75	0.66	7.33	11.05	1.13
Linear with Documents	60.85	44.75	4.89	123.20	25.21	1.75	1.51	3.95	12.67	2.20
All Inverted	130.33	88.50	0.58	9.25	15.86	0.13	0.00	0.00	0.00	0.08
Inverted with Documents	76.50	52.00	3.50	55.50	15.86	0.75	0.00	0.00	0.00	0.50

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TABLE VII

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RESPONSES TO USER SURVEY

QUESTION: Of what value to you was the information retrieved by this search?

Search No.	Documents Ordered	Response
949	Yes	By providing a broad survey of literature on a subject I was only slightly familiar with, the search allowed me to select quickly sufficient literature from which a reasonably good knowledge of the topic was gained.
1012	Yes	This search saved me a great deal of time and effort.
1015	Yes	Two papers gave useful experimental data.
1016	Yes	None. I changed thesis topics. It is however a good search.
1017	Yes	Not a great deal as no new information was obtained.
1018	Yes	The information was of some value as a supplement to that already on hand but was not of major value. That is, no new information was found. The unavailability of reports published over a very few years ago is a very severe limitation which makes the service of dubious value.

Search No.	Documents Ordered	Response
1024	Yes	It is difficult to answer this rather general question in other than rather general terms. However, I did obtain a large amount of very useful literature that I expect I would not have otherwise very easily obtained, especially the Russian literature as one does not often find it referenced. Not having read all the literature obtained from this search either directly or indirectly, and not having completed my program, I am not able to state the total value derived from the search. I am very satisfied, however.
1025	Yes	Not only did the search save me a tremendous amount of time, but I obtained a much more thorough bibliography than would have otherwise been possible. Especially helpful was the access gained to unpublished reports and foreign translations.
1029	Yes	It was of some value in completing the review of literature, especially in the area of control systems. I did not receive as much information as was hoped for, but my area was not directly related to NASA work.
1032	Yes	Limited.
1037	No	Very little.
1039	No	Very helpful as a formative aid to Research Program. Used as literature review.
1044	Yes	Three articles - very great value. One article would be helpful if it had French to English translation.

Search No.	Documents Ordered	Responses
1045	Yes	It has helped me to find references that I would be unlikely to find otherwise. Up to this time, I have not had a chance to fully use this information.
1046	Yes	Served to double-check originality of PhD dissertation topic.
1047	Yes	Marginal.
1048	Yes	Provides the basis for a literature search for my PhD thesis and probably saved me quite a bit of time.
1049	Yes	Considerable value especially with regard to broadening my knowledge of the literature.
1050	No	None.
1051	Yes	Of great help. Provided a much better search than otherwise possible.
1052	Yes	General reference material on my thesis topic.
1054	Yes	Enabled me to obtain government reports and foreign language (especially Russian) translations that would not otherwise have been available to me.
1065	Yes	No doubt the information I received was valuable. I prepared a nice project having gone through the information.

Search No.	Documents Ordered	Responses
1067	Yes	The information provided has not been as valuable as it might have been since my research topic has changed slightly. However, I have found several papers of importance.
1068	Yes	My project on Noise Emission was totally based on information retrieved by this search.
1071	Yes	It helped me realize the diversity of techniques used to measure oxygen concentration.
1072	Yes	Very little. The art of tropical climatology is apparently not well developed; this is useful to know and the search saved me a lot of time finding it out. The most useful papers in historical climatology occur in journals and books not reviewed by NASA.
1073	Yes	The service was of considerable value to me. It allowed me to evaluate the degree of coverage that I had already achieved, and led me to some new sources of literature.
1074	Yes	Very little.
1075	Yes	Found papers I was unaware of which were useful towards thesis completion. It gives one an idea of the vastness of a particular area.
1077	Yes	Very little. Some reassurance since nothing that I had not already found turned up.

Search No.	Documents Ordered	Responses
1078	Yes	Only of negative value. I was able to use this information to assure that I had not failed to find literature references.
1080	Yes	I received one useful article.
1083	Yes	It has provided an excellent base on which to build my own literature review.
1084	Yes	The information is to be included as part of a review of the literature in a thesis.
1088	Yes	My search was not a great deal of value because of the nature of my title. However, I know of several other cases which it was of some value.
1089	Yes	Very little because my own search was more complete than I realized at first, and literature itself was not as helpful as I had hoped it would be.
1091	Yes	I wanted to find out about the literature that existed concerning my research. This method of information retrieval saved me a lot of time. The information retrieved saved my time. Also I could get copies of papers I was most interested in.
1092	No	It was of interest to me although not really of value.
1093	No	None.

Search No.	Documents Ordered	Responses
1098	No	It helped me to get reference, new ones, to really do a complete search. Of course this search did not do all the work but with what it gave me I was able to have a very good and very sure base for getting some more references.
1102	Yes	Not very much direct value, based upon the vehicle stability area of interest. However, it did pinpoint some articles of interest in the area of crash and impact injuries of humans.
1103	Yes	Quite useful as a search of a great amount of literature which would not otherwise have been available.
1104	Yes	The information gave a good survey of the relativistic gas dynamics field.
1105	No	Extremely valuable.
1107	Yes	Unfortunately, the computer search did not provide many significant information to me. Obviously, the literature concerning the effect of growth hormones on algae (in fact, all plants) is not covered in the program.
1112	Yes	Provided ready accessibility to government documents. Information was incorporated into research program for PhD.
1113	Yes	Revealed information at periphery of research area (e.g. experimental detail, areas of interest, etc.).

Search No.	Documents Ordered	Responses
1114	Yes	Some. The search pointed out some articles but missed a goodly number.
1116	Yes	Of very little value since my topic was far too narrow.
1117	No	Very limited value and only limited relevance, and restricted to a narrow field.
1118	Yes	It has not been useful at all.
1121 *	Yes	The information gave me a good, solid background on the area of my research and brought to my attention new methods of solutions.
1121 *	No	The information retrieved by this search was great help to my research.
1124	Yes	The information served to enlighten me as to the work which had and had not been done on my subject.
1126	No	Several articles were a great help.
1131	Yes	The search provided a good background of art. Some articles were specifically useful (i.e. techniques).
1132	Yes	Nominal.
1134	Yes	The search has provided approximately 25% of the information needed for my literature survey and in several instances very important insights for my proposed research.

*NOTE: Search number 1121 was received by two students.

Search No.	Documents Ordered	Responses
1136	No	None. None of the articles found by the search were of any use to me. If Chemical Abstracts or biological abstracts were included this service would be much better for students in the area of biological sciences or chemistry.
1137	No	Essentially none.
1139	Yes	Interesting but no helpful information in my specific area.
1145	No	None. Of the 372 hits only five were remotely applicable to the topic (all of which were classics in the field and generally available).
1146	Yes	The main value seems to be in supplying recent background information in only one of the general areas of my search. I wanted information on gas adsorption of sulfur compounds in fluidized beds. There seems to be a fair amount of material about fluidized beds, but not much on gas adsorption or sulfur compounds, and in particular, there was nothing about the total subject (or even about the combined subject of gas adsorption of sulfur compounds).
1147	No	At the date of this survey I have not yet received any literature or documents to value this search.
1148	No	No response.
1149	Yes	Located eight references which may be of value which weren't uncovered in library search.

Search No.	Documents Ordered	Responses
1150	No	It was useful in completing my literature survey.
1151	No	Facilitated my thesis literature search and yielded references related to my work but in other fields that I would not have obtained otherwise.
1152	Yes	The search extended our field of source material far beyond what was previously available. However, very little concrete value to our specific project was turned up.
1155	No	Saved time.
1156	Yes	Due to the fact that this search was run early in my attempt to define a problem, I would say that it saved me approximately one month's work on the review of literature.
1157	No	Reduces the work necessary to prepare for paper.
1160	Yes	Very little. I had already made a biographical search of the literature.
1161	Yes	It provided a good deal of the literature survey needed for my PhD dissertation.
1163	Yes	Immensely useful.
1164	No	The literature search was of considerable assistance in providing a comprehensive bibliography of work that has been done on problems similar to my thesis problem.

Search No.	Documents Requested	Responses
1165	No	Your information saved me time in my library search.
1166	Yes	Very little.
1167	Yes	It appears that some of the more recent references uncovered by the search would not otherwise have been found.
1168	Yes	Very valuable. I was able to gather a bibliography in one-half the time it would have taken me by hand and much more complete.
1169	No	It was very useful in that it saved an enormous amount of time which would have had to have been spent looking in the indexes. It also brought out papers which might have otherwise been overlooked.
1170	Yes	Of extreme value.
1174	No	The information was of little value because no relevant articles were found.
1175	Yes	It gave me some more papers to list under the references to my dissertation.
1176	Yes	Mostly background information, but filled in on area(s) lacking from much conventional literature being space and life-support oriented.
1177	No	It added literature references that we had not previously located. Some had direct bearing on my work and would have required considerable time to locate otherwise.

Search No.	Documents Requested	Responses
1178	No	The information was not directly applicable to my subject.
1181	No	Thesis bibliography; extends my own literature search capabilities.
1182	No	Although I have had little opportunity to survey the articles, by the titles I do not feel that the information is as valuable, nor as complete as the one which I have conducted by hand. Too many of the articles cited were from the restricted areas of space and did not seem to contribute to the general scope of knowledge.
1183	No	None yet. Its potential value is good.
1184	No	Of little value. Primarily it served as a means of checking for references or articles where a search would not ordinarily be done.
1185	Yes	This search saved me quite a lot of time. I haven't had the time to completely analyze all the information supplied to me.
1186	No	No response.
1187	Yes	The information I received had somewhat limited value to me. However, I didn't expect many direct hits because I knew there was a limited amount of literature of direct interest to my area of research.
1188	No	I believe this information will ultimately prove to be highly valuable to me. As yet I have not had sufficient time to check out but a few of these references.

Search No.	Documents Ordered	Responses
1189	No	The search yielded about 25 pertinent references which I had not already seen.
1190	Yes	Some of the information obtained was directly related to my particular area of research and a number of the references were of value in related areas of interest.
1191	Yes	Three papers proved of interest.
1192	Yes	Very little. Only two or three of the hits were pertinent and I was already aware of them.
1193	Yes	Since my own literature searching had already reached an advanced stage, essentially no new important information was retrieved.
1194	Yes	I found about 20 papers of interest that I had not located previously. About five of these were from the foreign literature; they have been of particular interest. Approximately half of the papers I had found previously appeared in your search. I estimate that about 70% of the bibliography for my thesis could have come directly from this search.
1195	Yes	The literature search turned up an unpublished part of one of my major references in my research problem. Also there was a set of related tables with data which will save me a great deal of time and trouble. I would have had to duplicate this information on my own. This alone was worth the effort.

Search No.	Documents Requested	Responses
1198	No	The several papers related directly to my specific problem were vital to my theoretical analysis and provided a helpful indication of recent work in the field.
1201	No	I haven't finished reviewing the report but so far I consider the information very valuable.
1202	Yes	I obtained vapor pressures of various chlorides and expressions of Knudsen flow for various geometries.
1203	No	The information was of great value in providing sources of information in my particular field which eliminated much of the legwork involved in library research.
1204	Yes	I found one very good review article which had not been published in any journals. Also gave me a good bibliography in related field of hypothermia.
1205	Yes	The information retrieved will be of value in my dissertation research and should be of considerable use to me during my future employment.
1206	No	It was all very interesting but of no practical value in the specific area of my thesis topic.
1211	No	Apparently many useful listings were obtained but have not had time to put to use.
1213	Yes	Additional certainty that work was not done elsewhere in the same area.

Search No.	Documents Ordered	Responses
1214	No	Very little as no papers of interest were revealed by the searches.
1215	No	Provided additional references which had not been detected by our search of abstracts, etc.
1216	No	We found about 10 references that were good and that we would have missed otherwise.
1217	Yes	The value was in the fact that good efforts seemed not to produce information I deemed relevant. Hopefully this is a sign that information is not available.
1221	No	Several hundred hits were directly related to my interests in X-ray analysis and liquid crystals. Many of these I would probably not have found in a normal literature search. I was also given a broad knowledge of the government's research interests in my field.
1222	Yes	Great value. I got many pertinent references which I otherwise would have missed. I also got a better idea of the type of research supported by various agencies. Additionally my rather broad search brought to light many applications of electron spin resonance that I was not formally aware of.
1223	Yes	Time saving.
1224	Yes	It help me get decided on a definite topic for my thesis.
1225	Yes	This information was valuable in thesis background studies.

Search No.	Documents Ordered	Responses
1226	Yes	I feel that the literature search performed will be very valuable mainly due to the time it will save.
1229	Yes	Save lots of time and energy.
1230	No	Fair, since all published articles were not cited.
1231	Yes	The information was really helpful to me.
1232	Yes	The search provides references of published material that is accessible in the literature and material that one would not ordinarily see because the work was done under government contract and not published in the regular literature. One of the biggest benefits lies in the references found in each article and report.
1233	No	It helped to cut down on the time spent in searching for the literature needed in the library. Much easier -- less time consuming.
1235	Yes	I found only two documents through the search that were directly useful that I had not seen before. However, I feel that little research is being carried out by NASA, etc., in my field of interest; someone doing work in a slightly different area would have gained much more material from the search. The two documents which I would use are very useful.
1236	No	Some value although many of the most important papers were missed. (These papers were for a large part in physics journals.)

Search No.	Documents Ordered	Responses
1237	No	It has provided a good bibliography of material surrounding my specific topic, especially in regard to reports of which I would have no knowledge. It is lacking, however, as far as known books and periodicals are concerned, and it did not show hits on my specific problem -- specific optimal control with regard to inaccessible state variables.
1239	No	None yet. Just after receiving the search information I found what I was looking for through another source. This will have to be determined later when the actual research begins.
1240	No	As of yet I have not utilized any of the supplied information, as actually only one of the listed articles pertained to the actual attainment of equations of possibly a similar type to those I am trying to attain. I have not received that article from the Clearinghouse yet as the prices had changed from that listed.
1242	No	None as far as solution of the specific problem at hand. This is accidental however, and in general such a search might prove of immense help. I did get a good survey of the trend of research efforts of related problems, which will prove valuable in extensions of the problem at hand.
1244	Yes	The search has saved me many hours of personally searching the literature which could not have been as complete as the machine search. In short--very valuable.
1247	Yes	Two articles may be of interest to me. I am in the process of getting them.

Search No.	Documents Ordered	Responses
1254	No	It was of little value.
1255	Yes	Essentially none. However, I realized that my field of interest was not well suited to the material in NASA's library.
1256	No	It provided rapid access to information contained in the "grey" literature of government contract reports.
1257	No	I did not get the information I expected to get. I made my own literature search and found that many important papers were not listed in your list.
1259	Yes	From the documents I have, I am disappointed. But my advisor said "you can't expect to get information from others, you should use your own brain."
1260	No	I had done literature survey for my research topic before. It took me two months to cover one abstract consisting of two years, and I notice my survey then is still lacking. Articles published by the government were not on my old survey. This search I have now from STRC cover the government publications and I spent only a couple of hours on it. It is a magnificent time saving for graduate students.
1262	No	Quite a bit of value. I learned of several important documents I would not have otherwise discovered until they were referenced elsewhere.

Search No.	Documents Ordered	Responses
1264	Yes	It was of primary value in two ways: 1) It provided access to literature that is not available from our college library and 2) it afforded a considerable saving of time required to review research literature in my dissertation area.
1265	No	So far I have only seen the abstracts. Judging from these I believe there are about five articles of interest to me. Some of the value of the articles I expect to be in their lists of references.

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TABLE VII

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RESPONSES TO USER SURVEY

QUESTION: Do you feel such a service would be generally useful to most graduate students preparing theses and/or research papers?

Search No.	Responses
949	Yes.
1012	Definitely.
1015	Yes.
1016	Yes, especially in about 10 years when enough material is on tape for a real worthwhile search.
1017	Yes, but under the condition that they had not previously done an extensive literature search.
1018	Yes, if it is made available to them in the early stages of their work so that they can use the references from search articles to find earlier work not available to the search.
1024	I am sure that any graduate student who obtained a search equivalent to the quality of mine would label the service indispensable.
1025	Yes.
1029	Yes.

Search No.	Responses
1032	Only if the thesis or paper was space or aeronautically oriented.
1037	If the scope of the search were expanded to include chemistry, nuclear engineering, etc.
1039	Yes, very much so. The only deficiency is lack of program advertisement.
1044	Yes.
1045	Yes.
1046	Definitely yes.
1047	Yes, definitely.
1048	Yes, definitely.
1049	Yes, if the student does not attempt to make the search too general.
1050	Yes.
1051	Yes.
1052	Yes.
1054	Yes! Of course, the usefulness would be greatly increased if a greater variety of topics were included (e.g. more biological, sociological, psychological).
1065	Of course.

Search No.	Responses
1067	Yes.
1068	Such help given by you is indeed appreciable and it is definitely useful to most of the graduate students.
1071	Yes, if they used it early enough in their problem.
1072	Only if the size of the data bank is vastly increased. Its current contents are highly parochial.
1073	The usefulness of the service would depend upon the field of interest more than anything else.
1074	Generally useful.
1075	Yes, definitely.
1077	Only if the students were in a field in which they were sure there would be a great deal of information already in the system.
1078	Only in certain areas, i.e., those areas where the computer system had many references under a given title.
1080	Yes.
1083	Yes, mostly for thesis preparation.
1084	Yes.
1088	Yes, quite useful.

Search No.	Responses
1089	This service would not be generally useful to botany graduate students because the master collection is weak in biological references. However, for some botany students, this service would be very useful.
1091	Yes.
1092	I think that one should investigate work done by others in the same area, and that the service is useful in that respect.
1093	In many cases perhaps but not for those working in physiology of the family Actinoplanaceae of the order Actinomycetales.
1098	Definitely, yes.
1102	It would depend entirely upon their area of research. It appears it would be most helpful to people in aerospace and electronic engineering, and directly related areas.
1103	Yes.
1104	Yes.
1105	Definitely.
1107	In most areas of research, however, I feel that the search is a very valuable service, which could save a considerable amount of time and frustration.
1112	In some areas, depends strongly upon extent of government involvement.
1113	Yes, but more so at the beginning of the work, rather than toward the end.

Search No.	Responses
1114	Yes, provided they aren't expecting a complete search of government documents.
1116	Not for biochemistry students; the wrong literature is searched.
1117	Theoretically yes, but in practice probably no compensation for proper use of the literature.
1118	I don't think you have all the information. It may be very useful for certain careers, but not for all.
1121	Very definitely.
1121	Yes, I do feel this service is very useful to most graduate students preparing theses and research papers.
1124	The service would be most useful to graduate students in the sciences because the work being done is so broad that it would take valuable time to attempt even to find the articles.
1126	Yes, definitely.
1131	Yes.
1132	Yes.
1134	Yes, a wide variety of topics from which to learn information relatively time saving acquisitions, and the availability of otherwise hard-to-get information make this service most useful.

Search No.	Responses
1136	No, only those students interested in space research and subjects related to space could get any benefit from this search as now operated. As it is now, I don't think there would be any more than 10-20 people out of 10,000 students and faculty on North Carolina State University campus.
1137	Definitely.
1139	Depending on their particular work, then it could be useful.
1145	Not in my field. It seems that my field is not well represented on the machine. Possibly better communication would reveal more information.
1146	If I infer correctly that your present library holdings are slanted towards aerospace technology, then I think the service would not be generally useful to most students, but would be helpful to students writing on technical subjects, especially if research on the subject has been previously government sponsored.
1147	Yes, provided the field of research is covered well enough.
1148	No response.
1149	Yes, would recommend highly.
1150	Yes.
1151	Yes, particularly if it is available early in a student's career and updated throughout his studies.
1152	Yes.

Search No.	Responses
1155	Yes.
1156	Yes, but only if their areas of interest are those actively pursued by NASA supported investigators.
1157	Yes.
1160	Yes, it would be useful at the outset of the thesis or research.
1161	Yes.
1163	Absolutely.
1164	Since a literature review is a necessary part of most theses and research papers, the systematic, extensive search you provide would be an invaluable aid to any graduate research program.
1165	Yes.
1166	Definitely.
1167	Definitely yes.
1168	Yes.
1169	Yes, provided it was in the proper field.
1170	Yes.

Search No.	Responses
1174	I believe that the search was conducted on too narrow a base in my case. The service in general could be very useful.
1175	Yes.
1176	Yes.
1177	Yes.
1178	Yes.
1181	Yes; most, not all.
1182	Initially I felt that this type of search would be valuable as a double-check of the student's own research. However, I was disappointed to find that the scope of the search was so narrow that this service probably would serve poorly as a double-check.
1183	Yes.
1184	It depends on the students field and/or research problem.
1185	Yes.
1186	Yes, it is useful.
1187	Such a service is definitely useful to most graduate students because it provides a literature search with a minimum of effort on the students part.

Search No.	Responses
1188.	This service would in most cases be highly valuable to graduate students. In addition, it would assist them in making a proper selection of thesis area.
1189	Yes, especially if the student receives the results early in his literature search.
1190	Yes.
1191	Yes.
1192	Yes.
1193	Could be quite useful as a beginning step in a literature search.
1194	Yes, it would probably at least save half the time required for a literature search.
1195	Yes. Such a service could save a tremendous amount of time and often wasted effort. I spent three months going through only the major American journals. I still had little idea what was available in European journals, much less unpublished material.
1198	Yes, primarily because it saves valuable time and legwork often encountered in a library search.
1201	Yes.
1202	Yes.
1203	Yes, this service is greatly beneficial to students preparing papers because it allows them to spend more time evaluating the information instead of searching for it.
1204	Yes.

Search No.	Responses
1205	Depending upon their interests. I would think students in the physical sciences would gain most benefit.
1206	It appears that this service would be particularly helpful to people in the so called exotic industries of aerospace and communication electronics.
1211	Yes.
1213	Yes.
1214	Yes, if done in the initial stages of the work.
1215	Yes, if the cost is reasonable.
1216	Definitely.
1217	If they were studying areas appropriate to NASA offerings.
1221	Yes. Almost every thesis and research paper requires a thorough literature search. A well organized, computerized search is a definite aid, especially when so many entries are not readily available in the regular scientific publications.
1222	Most definitely.
1223	Yes.
1224	Yes.
1225	Yes.

Search No.	Responses
1226	Yes.
1229	Very much so.
1230	Yes, if it assures all published related topics.
1231	I'm sure it is useful to most graduate students particularly for PhD students.
1232	Generally, yes.
1233	Definitely.
1235	Yes, very much.
1236	Yes.
1237	Yes, I do.
1239	Yes, I feel that this program could be of great use to a graduate student, especially a PhD candidate doing his dissertation.
1240	I feel that this service could be very valuable in some areas. However, there is a need of eliminating many of the supposed applicable articles which in reality have no direct or perhaps even remotely indirect applicability. A narrower more pointed search would be more useful in all cases I believe.
1242	Most certainly. There may be exceptions, but they should be a minority of cases.
1244	Definitely.

Search No.	Responses
1247	Yes.
1254	Only in special cases.
1255	Yes, if they are able to get a search in their field of interest.
1256	Yes.
1257	I think the general idea to provide such a service is very good, although the search was not satisfactory in my case.
1259	Certainly.
1260	All graduate students who need to write theses have to do their own literature survey. I believe this is the easiest and most efficient way to do it.
1262	Most definitely.
1264	Yes, particularly from the standpoint of time saved and lessening the likelihood of overlooking some articles as often happens when doing such a search "the hard way".
1265	Not to most but to many studying in a field covered by NASA's interests.

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TABLE VII

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RESPONSES TO USER SURVEY

QUESTION: What is your feeling as to the dollar amount other students would be willing to pay for such service in the future?

Search No.	Responses
949	Present fee is very reasonable. Market could stand a 100% to 200% increase on initial fee. Copying rate is satisfactory.
1012	This would depend on the quantity of useful information which would be expected.
1015	\$15 to \$30.
1016	\$10 to \$15.
1017	\$10 maximum.
1018	Not very much considering the amount of time that it takes to come up with a relatively small number of useful results. Twenty dollars would be tops and ten dollars would probably be a reasonable figure.
1024	I feel that the \$5 is a nominal fee indeed. If I had to write another thesis, I would most likely be willing to pay several times \$5 for the service, now that I am acquainted with it. However, I probably would not have solicited the service initially had the price been as much as \$15.

Search No.	Responses
1025	Of course, money is not a very frequent guest in the pockets of many graduate students. However, I do not feel that \$5 was an outrageously expensive price for a \$75 job. I think any student interested in a search could and would pay that amount.
1029	\$15 - \$20.
1032	\$5.
1037	As it exists not much--if improved hard to say.
1039	More than the current fee. However, if possible the fee should be kept low as is justified.
1044	\$10.
1045	I don't feel that most students would be willing to pay over \$20 - \$30 for this service, although, in the long run it might be worth more to them.
1046	\$25 - \$40.
1047	\$5 maximum.
1048	\$5 is very reasonable and \$10 would not be above the means of most graduate students for such a service.
1049	\$10 - \$15 for the search with reprints available at extra cost.
1050	\$5 seems quite reasonable.

Search No.	Responses
1051	\$10 or less. Any amount over this would attract only a few students, possibly PhD candidates only.
1052	\$5 - \$15.
1054	Since the first step is a gamble (if you don't know how much information will be available) I would say \$5 - \$10 is about the limit.
1065	Being a foreigner I will request you to reduce some. Because \$5 is much for coming from abroad. \$2 may be alright.
1067	I would think \$10 - \$15 would be a maximum I would pay. This is more a reflection on the financial status of a married student, however, than an honest estimation of the value of the service.
1068	By such help one can save his time, and time cannot be compared with money. I do not know what other students think.
1071	\$10.
1072	Almost nothing out of pocket, which is usually empty. Somewhat more if they had access to external funds, such as research grants to their supervisors.
1073	The present cost is very reasonable, an increase could be justified for those who could expect to get the bulk of their literature from the search, but in a field with marginal coverage this may not apply.
1074	Less than \$5.
1075	Maximum of \$10.

Search No.	Responses
1077	\$5-\$10 until there can be greater confidence that the search will be of significant value.
1078	Because of the uncertainty involved, the figure should be kept low -- \$5.
1080	\$5 - \$10.
1083	\$15.
1084	\$20.
1088	The present rate would be a maximum.
1089	\$2 - \$3 for small searches; \$5 - \$10 for large searches.
1091	The very needy do not mind paying \$5. Many do backout because of the dollar amount. The amount could be made less than that, say about \$2.
1092	I cannot really estimate what others are willing to pay. It would depend upon how much the information was worth to them.
1093	At this time I have no idea. In a case such as mine, I don't see how I could possibly estimate a value.
1098	If the student is paying that with his own money, I don't think he would pay more than \$15 - \$30. I am sure that most of the students can get support for such service (I hope) from their department.
1102	No comment.
1103	\$5 - \$20.

Search No.	Responses
1104	I feel that most students would be willing to pay at least \$5 for this service.
1105	\$25 - \$50.
1107	In all sincerity, I believe that a student would be willing to pay \$10 - \$15 for the search, especially when he has an idea that he would be more successful than I was.
1112	If funds are available from a project, about \$50; if personal funds only \$4 - \$5.
1113	Would depend a lot on whether it had to be paid personally or by research contract. If personally, probably not much more than the \$5.
1114	Don't know.
1116	Present fee is fair and acceptable.
1117	Probably willing to pay a limited fee if some more useful information is obtainable.
1118	I would pay the \$15 you propose if it were useful. It is a very convenient service.
1121	\$50 - \$75.
1121	I feel they will be willing to pay for such service.
1124	I feel the amount charged now is about the maximum, however, \$10 per search.
1126	\$10 at least for a good search.
1131	Depends on coverage. If access library continues to expand at present rate, search could be worth \$50.

Search No.	Responses
1132	I do not think the student would be willing to bear the entire cost of the search. Maybe he would not mind five to twenty-five dollars.
1134	I feel most students would pay as much as \$25 total cost to themselves. Further costs should be paid for from other sources.
1136	I think most students would be willing to pay \$10 - \$15 for this service if they could find something they wanted by the search.
1137	Depends on many things, e.g., type of assistance, etc. If paid by student probably not more than \$10 - \$20.
1139	\$15 - \$25.
1145	Based on my search, \$5 is an overcharge.
1146	\$30 - \$50 (unless they're a lot richer than I).
1147	\$15 if the field is covered well enough.
1148	No response.
1149	\$5 - \$10.
1150	Approximately \$10.
1151	Approximately \$5 - \$15 since most students are supported on grants that are not sufficient to supply larger amounts.
1152	This of course depends largely on the budget available. Certainly not the full cost.

Search No.	Responses
1155	\$5 would be alright.
1156	Not more than \$15.
1157	\$100 would not be too much for an indexed very broad search.
1160	My own feeling is that not many graduate students could afford to pay over \$25 unless the cost is supplemented in some way.
1161	\$5.
1163	A student is poor and this must be taken into account. I paid \$5 for the service and I would have gladly paid twice or three times as much.
1164	Since most graduate research projects are financed under research grants from government agencies or private concerns, funds for the literature search would probably come from these grants rather than from the students themselves. I feel that \$25 would be a reasonable charge for the service.
1165	About \$25 - \$50.
1166	Minimum possible. Perhaps \$10.
1167	I feel it is more a question of what the student can afford to pay for the service. After all, although it is undesirable from a time point of view, the search could be done by the student if he had to. I feel any amount over \$25 would be stretching the budget of most graduate students unless they have contractual support.
1168	\$25.

Search No.	Responses
1169	Approximately \$20.
1170	They would probably be willing to pay the regular \$75 fee; however, they could only afford the \$5.
1174	\$15.
1175	\$10.
1176	For my case with only one pertinent article and 67 total hits, perhaps \$5 (or some minimum fee, range \$1 - \$10). But in general should be charged at a rate of so much per hit--perhaps 4¢ up to 100 and 2¢ for rest or so.
1177	For some of the wealthier students maybe \$25 - \$50.
1178	The charge should be based on how useful the search is to the student. \$50 if useful.
1181	I think most students would continue to go along with \$5 search.
1182	If the student were aware of the above limitations, I feel that \$5 to \$10 would be reasonable.
1183	In range of \$5 - \$10.
1184	It again depends on the problem or field. Generally the student would not pay anything, however, the department or the research project might be willing to pay \$20 - \$50.
1185	\$25 to \$40. Students don't have a lot of dollars.

Search No.	Responses
1186	No response.
1187	Approximately \$5.
1188	Most graduate students would not be able to pay the actual cost of the survey. However, I believe that the student could pay a portion of the expense possibly in the range from \$10 - \$25.
1189	\$10 - Twenty dollars or more would make it a luxury.
1190	I believe the amount charged for this introductory program was sufficient for graduate students. If the cost is too high, fewer students could afford to use the program. The more people becoming familiar with the program of the student level, the better the prospects for its use by them in industry where higher prices are more acceptable.
1191	Maximum of \$10 for list of abstracts.
1192	\$2.
1193	\$10 - \$15.
1194	\$15 - \$30.
1195	If the price could be held to \$5 to \$10 that would be ideal. The financial status of most graduate students might make \$25 as a top limit. Most could probably afford \$15 to \$20 easily enough.
1198	Since most graduate students are on a rather limited budget, a maximum of around \$10 would be reasonable. However, in my case the cost of the search and reprints was covered by departmental research funds, and I think this will soon be the general practice here.

Search No.	Responses
1201	\$25.
1202	\$10.
1203	I would estimate that graduate students would gladly pay from \$10 to \$25.
1204	\$5 - \$25.
1205	The present \$5 fee would be considered quite reasonable. I would hesitate to set a definite maximum figure.
1206	Don't know.
1211	Not greater than \$15 - \$20.
1213	\$10.
1214	\$5 per search.
1215	\$25.
1216	The service is worth the \$75 fee but the departments will have to subsidize because most of our students would not pay over \$25.
1217	The students I know have no funds.
1221	A \$5 fee can easily be covered out of most graduate student's personal funds. I think many students will be willing to pay \$10 - \$15 for this service.
1222	\$5 or \$10 would be more reasonable; most graduate students probably couldn't pay more.

Search No.	Responses
1223	\$15.
1224	\$15.
1225	\$25.
1226	I think most students would be willing to pay about \$25 for this service.
1229	Up to \$15.
1230	Up to \$10.
1231	The dollar amount is worth paying.
1232	It would depend on many things. Often graduate students have little money and would not pay even the \$5. Often one feels, correctly or not, that little in their field will be listed in the computer survey. I personally would have been unwilling to pay more than \$10 - \$15.
1233	Depends upon whether or not the student has a grant or is going on his own money. \$5 was quite a bargain for the work involved.
1235	\$10 or less.
1236	Certainly no more than the present rate.
1237	Less than \$50.
1239	That would depend entirely on the individual student, dependent upon the difficulty he is having finding appropriate information.

Search No.	Responses
1240	This would depend upon the area in which the work was being done by the student.
1242	It would depend upon the value of the results, and the relative importance of the work. Unless the subject be exotic, the value for a research paper might be \$10 - \$50. For a Master's thesis, if the problem is more difficult, perhaps \$25 - \$100. For a doctoral dissertation, the value might range from \$50 (if the field be popular and rapidly expanding) to \$1000.
1244	I am unable to make a guess on this.
1247	The present fee of \$5 is adequate.
1254	Not much more than \$10.
1255	\$10 - \$20.
1256	\$25.
1257	Depends very much on the quality of the search.
1259	The prices at present are reasonable.
1260	\$10 - \$15 is reasonable.
1262	Depending on the student's familiarity with the field of research. I would say up to \$25 for a student entering an unfamiliar area.
1264	This would depend on the financial status of the student. Probably most Duke University students would be willing to pay \$75 - \$100, perhaps more.

Search No.	Responses
1265	Students in a field close to that of NASA research might well be willing to pay \$10 or \$20 and profit by it. But if you raise the price, you will not attract students with a borderline interest, or anyway not as many. Personally, I did not expect much, but for \$5 one can take a chance.

Graduate Student Search Program

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TABLE VII

RESPONSES TO USER SURVEY

QUESTION: What type of employment do you expect to pursue upon completion of your degree program?

Search No.	Responses
949	Research and development with a firm engaged in the marine engineering field.
1012	Research in private industry.
1015	Research in plasmas.
1016	Teaching - Research.
1017	Teaching and experimental research.
1018	University teaching and research in Aerospace Engineering.
1024	I have accepted a job as research engineer with the Research Division of Allis-Chalmers, Milwaukee, Wisconsin.
1025	As Uncle Sam has the first claim on my body (He's not too interested in my mind, and I won't say I blame him. It doesn't march too well nor does a uniform fit it.) I expect to be at his service for a time. Assuming successful completion of that obligation, I plan to make a career in industry.
1029	Research in industry.

Search No.	Responses
1032	Research and development of machinery and power generation equipment for use in agriculture.
1037	Teaching - college.
1039	Research Engineering.
1044	Industrial or farm equipment company - Aircraft Company - Consulting Engineering Firm
1045	Micrometeorological or hydrometeorological research, most likely in the area of application to forest land management problems.
1046	Am now employed as Research Supervisor.
1047	Acoustics Engineering.
1048	Research and development work with the Air Force.
1049	Research and development.
1050	A position in the research department of an industry.
1051	Electronic control research and development.
1052	Two years with U. S. Army and then either teaching or industry.
1054	College teaching and research.
1065	I will try to get an acoustical field.

Search No.	Responses
1067	I hope to work in the area of machine design and development or in some area of research.
1068	Research in design of machine components.
1071	University teaching and research on plant physiology.
1072	Fisheries biology.
1073	I plan to do university teaching and research.
1074	Research and development.
1075	University.
1077	Industrial Research.
1078	College professorship.
1080	Undecided.
1083	Teaching and research.
1084	College professor.
1088	Either research with a industrial firm or research and teaching with a university.
1089	Biochemical Research.
1091	Research and teaching.

Search No.	Responses
1092	Not yet decided.
1093	Professor of Botany with research interests in Microbial physiology. Primary interests in teaching Botany.
1098	I intend to teach, and do consultation in statistics.
1102	University teaching and research, or industrial research in the area of human engineering.
1103	Research and teaching college level.
1104	Research and development engineering.
1105	Research and development in Electrical Engineering.
1107	I plan to seek a position at an American university at the completion of my PhD.
1112	Professor or Industrial Research.
1113	Research at either University or industry.
1114	University teaching and research -- or industrial research.
1116	Research and possibly teaching.
1117	Research -- plant physiology.
1118	I will go back home (Argentina) and teach and do research.

Search No.	Responses
1121	Teaching.
1121	Teaching or research in the field of Engineering Mechanics and Applied Mathematics.
1124	Research.
1126	Aerospace Engineering.
1131	Teaching and research.
1132	Teaching and university research.
1134	Teaching and/or research.
1136	Assistant Professor of Soil Science, Michigan State University.
1137	Teaching - research.
1139	Teaching profession.
1145	University educator and basic research.
1146	Teaching - research.
1147	Research engineer with South African government.
1148	Research and development.
1149	Teaching.

Search No.	Responses
1150	University teaching.
1151	Research and academics.
1152	Teaching or industrial research.
1155	Industrial.
1156	Work in research and development in industry or governmental agency or research and teaching in a university.
1157	Research and development.
1160	College professor.
1161	Academic.
1163	Teaching.
1164	I expect to continue working as an engineer engaged in development of mechanical components and systems.
1165	Teaching and research.
1166	Engineering design.
1167	Work for NASA in Huntsville, Alabama.
1168	Aeroengineering in industry.

Search No.	Responses
1169	Teaching with related applied research.
1170	Employment with an aerospace engineering company.
1174	I plan to pursue a PhD degree program. Ultimately I hope to teach.
1175	Academic.
1176	Industrial research.
1177	Petroleum industry as chemical engineer.
1178	Research in industry.
1181	NASA - MSC - return from graduate leave.
1182	I plan to do research in neurophysiology and physiological psychology in addition to teaching in a medical school.
1183	Research - teaching.
1184	Research and development using X-ray technology.
1185	Professor.
1186	Research.
1187	NASA - Langley Research Center.

Search No.	Responses
1188	Engineering teaching in undergraduate school or in a community college and possibly in addition to do some research and part-time consulting work.
1189	Engineering research.
1190	Research and development, Systems Command USAF.
1191	Teaching - research.
1192	Engineering in industry.
1193	Industrial research and development group in a large corporation.
1194	Electrical engineer -- probably microelectronics field.
1195	Probably something in microwave communication or radar system design.
1198	Research and development in materials engineering, or alternatively, engineering education.
1201	Research in aerospace industry.
1202	Research.
1203	I am preparing to teach aerospace engineering and do related research at Mississippi State University.
1204	Teaching on university level -- medical school -- with independent research.
1205	Research.

Search No.	Responses
1206	Power systems engineering with Appalachian Power Company of the American Electric Power System.
1211	Electrical engineering in industry.
1213	Industry.
1214	Teaching and research.
1215	University teaching and research.
1216	No response.
1217	Consultation - teaching.
1221	Industrial research in the field of physical chemistry.
1222	Industry or a research institute.
1223	Aerospace Engineering.
1224	Engineering sales.
1225	Industrial (space-related).
1226	Not sure.
1229	Research and development.
1230	Research, development, and design.

Search No.	Responses
1231	Teaching with research.
1232	Research institute or university.
1233	Research for Alcoa in Cleveland, Ohio..
1235	Management trainee with large private industry.
1236	Research.
1237	Industrial research.
1239	I plan to teach on the college level.
1240	I expect to pursue teaching on the college level upon completion of my degree program.
1242	University teaching and research.
1244	Teaching on the college and/or university level.
1247	I will most probably work for an aircraft industry for a while, after which I may teach.
1254	I don't know.
1255	University teaching and research.
1256	Teaching.

Search No.	Responses
1257	Research and/or teaching.
1259	Automobile industry.
1260	Preferably as a research engineer involved in materials problems in nuclear industries and problems of applied interest.
1262	Research in either government or private industry.
1264	Research scientist in forest biochemistry possibly also teaching at college level.
1265	Research in forest pathology and/or physiology maybe combined with a teaching position.

Graduate Student Search Program

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TABLE VII

June 30, 1968

RESPONSES TO USER SURVEY

QUESTION: Would you recommend to your future employer the use of information retrieval services such as this?

Search No.	Responses	Search No.	Responses
949	Yes, provided that employer did not already have at his disposal a comparable program in his firm.	1029	It would depend on the type problem being dealt with, but probably yes.
1021	Yes.	1032	No.
1015	Yes.	1037	Yes.
1016	Yes.	1039	Very much so; extremely valuable and time saving.
1017	Yes.	1044	Yes.
1018	Possibly; but only on a very limited scale unless many improvements are made.	1045	Yes.
1024	Yes. Most likely I will need the service several times myself as an employee.	1046	We do use a similar service.
1025	Yes.	1047	Yes, definitely.
		1048	They probably already use such a service, but if not yes.

Search No.	Responses	Search No.	Responses
1049	Yes, for specific border line of technology problems.	1075	Definitely.
1050	Certainly.	1077	Not until there is greater storage of information on chemistry, such as Chem Abstracts.
1051	Definitely.	1078	No, because of lack of need- no other reason.
1052	Yes.	1080	Yes.
1054	Yes, especially if the base of information topics was broadened.	1083	Possibly; it would depend on the subject and the employer.
1065	Yes.	1084	Yes.
1067	Definitely.	1088	Certainly.
1068	Yes.	1089	Yes.
1071	Yes, if the store of information was broader.	1091	Yes.
1072	No, existing abstracting services are still adequate for fisheries biology.	1092	No Response.
1073	This would depend on what problems I would be working on and whether the coverage would be broadened.	1093	Yes, I think so.
1074	Would know that it is available.	1098	Yes, very much.

Search No.	Responses	Search No.	Responses
1102	It would depend on the nature of my employer, e.g. if I went back to work for aerospace/aircraft industry I might; if I decide on an agricultural engineering endeavor or human engineering, I doubt that I would.	1118	No, if they are in my same field. I would enthusiastically recommend your service in engineering or medicine.
1103	Yes.	1121	Yes.
1104	Yes.	1121	Yes, certainly I will.
1105	Yes.	1124	If applicable, yes.
1107	Yes, most certainly.	1126	Yes.
1112	For government sponsored research, yes. For other types perhaps not.	1131	Yes.
1113	Yes.	1132	Yes, probably.
1114	Probably, yes.	1134	Yes.
1116	Yes, if broader literature search made.	1136	Not as now set up. Include Chem Abstracts and Biological Abstracts and I would probably recommend the service.
1117	Yes, if the scope of information available fits the requirements of the project.	1137	Definitely.
		1139	Yes.
		1145	Not in my field.

Search No.	Responses	Search No.	Responses
1146	Yes.	1164	I would recommend use of this service to my employer.
1147	Yes.	1165	Yes.
1148	Undecided.	1166	Yes.
1149	Yes.	1167	Yes. From a business point of view the time saved is most attractive.
1150	Yes.	1168	Yes.
1151	Yes.	1169	Yes.
1152	Yes.	1170	Yes.
1155	Yes.	1174	Yes.
1156	Yes, if I thought it would result in a time savings and depending on his library of NASA publications.	1175	Yes.
1157	Usually companies do not work on things they know nothing about.	1176	Yes.
1160	Yes, in the case of research contracts.	1177	Yes.
1161	Yes.	1178	If the field of his interest were covered by the material that you have available, I would.
1163	Yes.		

Search No.	Responses	Search No.	Responses
1181	I guess I better, since he paid for it.	1189	Yes.
1182	I think that the concept of information retrieval is fascinating, but this service can be no better than the scope of information programmed into the system. Therefore, my recommendation would be based on the amount and types of literature that were covered.	1190	Yes.
		1191	Yes.
		1192	Yes, if there were an improvement in the retrieval, i.e. "pick-ups" which were directly related rather than 1-2% of them.
1183	Yes.	1193	Yes.
1184	A future employer would have use of the DDC file. I understand that charges will now be applied to users of the DDC file. In such a case you could be competitive.	1194	Yes.
1185	Yes, time saving is important.	1195	Yes, definitely. The time saved would easily be worth the price.
1186	Yes, I would recommend it.	1198	Yes.
1187	No response.	1201	Yes.
1188	Yes.	1202	Yes.
		1203	Yes, this service would be invaluable in all forms of research.
		1204	Yes.

Search No.	Responses	Search No.	Responses
1205	Yes.	1226	Most definitely.
1206	Only if more pertinent and more practical data were filed in the computer.	1229	Yes.
1211	Yes.	1230	Yes.
1213	Yes.	1231	Yes, I will.
1214	Possibly.	1232	Generally, yes.
1215	Yes.	1233	Yes.
1216	Probably would recommend its use.	1235	Yes, if I thought the computer stored materials references were applicable to the research under consideration.
1217	Yes.	1236	It would depend upon the subject matter. From my one experience, this service seems to lack data in the MHD field.
1221	Yes.	1237	Yes.
1222	Yes, my current research director is interested in such a service.	1239	Yes, if he were doing research where there was limited available information.
1223	Possibly.		
1224	Yes, if the situation arose.		
1225	Yes.		

Search No.	Responses	Search No.	Responses
1240	Whether I would or would not recommend use of a service such as that performed would depend upon the area in which my employer was interested at that time. In some areas the service could be of great benefit; in others almost none.	1259	Sure, I will. But the price should be same as for students.
1242	Certainly. For non-personal research, the value of such a service is very great.	1260	As of now publications is at a state of explosion. The fastest way to get the needed information is by computer. Most industries I believe would prefer this method. I highly recommend this process.
1244	Yes.	1262	Yes.
1247	Yes.	1264	Yes. The saving in money would be significant. Starting salary in my field is about \$12 - \$14,000 yearly and a complete literature search by conventional methods takes at least 1 or 2 weeks, usually longer.
1254	Only when the subject matter can be well described by the available vocabulary.	1265	Yes, I would if the library were more general. A tremendous saving in time and effort would be realized. Efficiency of retrieval would also be increased.
1255	Yes.		
1256	Yes.		
1257	I have to compare the experiences other students made with such services before I can form a sound opinion.		

Graduate Student Search Program

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TABLE VII

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RESPONSES TO USER SURVEY

QUESTION: Do you care to make any additional comments on this program?

Search No.	Responses
949	In my particular case, the search was well worth while.
1012	Retrieval system could be refined to eliminate unwanted reports.
1015	Two passes through computer would be nice, especially in view of the state of the indexing.
1016	Very worthwhile.
1017	Would probably be more helpful if earlier information could be included.
1018	Much refinement is still necessary. Out of 506 hits only 27 looked useful and only 2/3 of these were of any value. The weighting factors used in the search should be based more on subject matter rather than on key words in titles or abstracts. For example, steam-water flow in pipe (N65-16681) has little to do with rarefied gas flow in short tubes.
1024	The attitude of genuine interest and subserviency displayed by the staff of the North Carolina Science and Technology Research Center is one to be highly commended.
1025	I feel that the program was very well executed and should be continued. Assuming any graduate students are left in this country next year, I feel that they and, in the long run, the country would benefit greatly by such a program.

Search No.	Responses
1029	No response.
1032	No.
1037	The idea of the search service is excellent. It is now too specialized. Expand it and more value would go to it.
1039	Yes, if necessary I will follow the survey with a letter of recommendation.
1044	More of the articles listed in my search will be of interest to me as I have time to broaden my knowledge of the noise attenuation area.
1045	I believe that this service could be of great use to graduate students in any field in which material was made available. However, the cost might be high for most graduate students to manage on their own. If the knowledge of the existence of this search was made known to the graduate student before they requested funds for their research projects, it is possible that they could include the cost of the search in their research proposals. I would think that it would benefit both the graduate students and the organization running a search to have the students know about the search as early as possible.
1046	No response.
1047	I recommend continuation.
1048	Felt the search itself was excellent, however, the quality of the reprints of papers received was such that they are difficult to read.
1049	I am pleased with the results.

Search No.	Responses
1050	Due to the lack of material on tube-sinking, I did not expect much from this process. However, this method would be very useful for more general topics.
1051	I recommend as broad a search as practical. I felt my particular search did not produce as much material as it could have. I would suggest you offer a second computer run at a small fee if desired by the individual having the search run.
1052	I believe that it would help if the assisting STRC engineer explained the logic statement that was used before the program was run.
1054	With the vast amount of research being done in all countries, it would certainly seem a worthwhile government (perhaps NSF) investment to improve communication by greatly expanding this program by perhaps direct input from the journals to a central information computer service for physical, biological, and social sciences.
1065	Additional comment is nothing but appreciation for valuable information and quick service.
1067	I think I would be in favor of a larger fee and with it the chance to receive, as an example, 5 of the papers which were most applicable to my field of study.
1068	No.
1071	I think that if the facilities are large enough that for a relatively little more money the scope of the program could be expanded. Ultimately I would like to see a system where for a fixed fee we joined and were apprised of work as it came out pertaining to his field. Then he would read the abstracts and order the articles. Many of the abstracts now published are good for reviewing the past literature, but something has to be done to allow the scientist to keep abreast with current research.

Search No.	Responses
1072	I understand Xerox Corp. is setting up a similar kind of service through its University microfilms branch. A pooling of resources to expand coverage and reduce unit costs might be explored. Probably the best way to serve students is to sell subscription retrievals -- initial search plus yearly updating -- to faculty members who can budget for them in their research grant proposals. The information would then be available to those working with them. Thanks very much. It was a pleasure to work with you.
1073	No response.
1074	Without knowing what titles are in the machine, I don't think I would try this method again.
1075	Please make it available again. You need to search wider selection of literature, but useful as is.
1077	A dictionary of items in storage should be given or sold to technical libraries and industrial users so that they could decide whether or not there was enough information in the system to warrant further investigation without having to make a trip to Research Triangle only to find that no useful information in the system.
1078	No response.
1080	No.
1083	No.
1084	No response.

Search No:	Responses
1088	For the search to be of maximum use, the student should have a clear knowledge of his subject and should make sure that the assisting engineer understands the topic fully.
1089	I was generally pleased with the results. For this service to be generally useful to biology students, more biological references will have to be included in the master collection.
1091	If possible an arrangement should be made which will not require students to go all the way to Research Triangle. If plain paper is used instead of ruled paper, reading would be easier. The printing format could also be improved. I had difficulty in going through the written material from the computer.
1092	No response.
1093	Eventually with an addition of listings in the many areas I think it would be very advantageous to have such a program. I can see where many people in different fields especially those related to space, metallurgy, physics, fuels etc., would benefit greatly from such a service as yours.
1098	The number of hits for the search I asked was 427. About 100 were exact hits, all the other were not relevant to what I asked. I realize that the type of title I was using was difficult to tackle down precisely.
1102	No.
1103	Experience of mine and others I have spoken with indicate usefulness is quite dependent on one's skill in choosing carefully the key words and limiting breadth of search as much as possible.

Search No.	Responses
1104	No response.
1105	No response.
1107	No.
1112	The number of public journals surveyed is quite limited. Only a very few polymer journals are indexed in the system.
1113	Would be much more useful if major journals were included.
1114	Can't understand how so many good documents were missed.
1116	Found that the method of search was entirely logical and helpful but biochemical subjects not listed well.
1117	The NASA data and literature files much too limited to base a general literature search on. Need a much larger literature coverage in biological and chemical abstracts.
1118	I think it is a very interesting and helpful program, but you cannot offer it to everybody. I do not think you have much information in some field, as for example, botany, though you can include general biology.
1121	A program should be set up so that a graduate student may obtain the computer search for a set fee, but be charged only for the papers ordered.
1121	No response.
1124	No response.

Search No.	Responses
1126	Was most impressed with the pains taken to provide good results.
1131	The magnitude of coverage (in my case) may lead to mistaken idea that field has been exhausted. Advance information on the logic technique, keyword index and standard vocabulary would help client to frame his research project better with respect to the data entries.
1132	This search was of little to no use to me. It was disappointing to see references appear in the search which contained key words that were supposed to be negated in the search program. Considering the total number of hits there were very few articles that were actually useful to me. I think more time should have been spent setting up the search program and choosing key words.
1134	For better retrieval, in addition to a paragraph about the subject, I think a list of key words by the student would eliminate most voids from information received to that available. The additional contact by telephone is also valuable.
1136	No response.
1137	No response.
1139	There must have been a misunderstanding as the search title should have been reaction of transition metal compounds with gases rather than <u>and</u> gases. Perhaps search would have been more productive if this had been the case.
1145	From conversations with others who have used your system, I gather that the results of my case are normal. Others seem to have obtained more pertinent information. It seems that the area being searched corresponded to a blank in the computer library.

Search No.	Responses
1146	I was disappointed that there were not more entries directly concerned with my research topic, but I would expect this type of situation to happen with less frequency as your library grows. I'm all in favor of having literature search functions performed by computer, as long as the searcher isn't relying solely on a group of key words selected by a third party.
1147	No response.
1148	I have not yet examined the articles in the search in enough detail to make a fair evaluation of its value.
1149	I feel it is best and quickest way to search government documents.
1150	None.
1151	I think that the code sheets used in the cross reference should be available to users of the system at some time before their interview with the STRC engineer.
1152	No response.
1155	No.
1156	Of 243 hits, 25 were really applicable and only 12 of these had not been previously reviewed. I feel that my area of interest was not well defined by me and that the search would have been more rewarding had it been accomplished 3 months later.
1157	No response.
1160	No.

Search No.	Responses
1161	Sorry for any inconvenience I might have caused you in responding late. I was away on vacation.
1163	Keep up the good work.
1164	In my opinion your computerized literature search could be a significant boom to both university and industrial research projects. I think the usefulness of the search would be increased if the number of references given were restricted to about fifty.
1165	There were only two papers which were of interest to me.
1166	Thanks.
1167	I am very happy to have been able to participate in the program. I am sure that my thesis will be notably better because of the information I have obtained in the search.
1168	I think it was great.
1169	No.
1170	I hope you continue to transfer this search program to graduate students at reduced cost. The search proved extremely valuable.
1174	No response.
1175	No response.
1176	I was not clearly informed of the extent and limits of the program until after I had subscribed. I did not have enough time to utilize the document retrieval part of the program.

Search No.	Responses
1177	I believe it is definitely worthwhile. In our case we were able to locate copies of references through our local library and didn't have to order.
1178	It is more useful to engineering and other areas of physics (solid state, low temperature) than to nuclear physics.
1181	I think the reference could be refined. Otherwise, a beneficial program.
1182	I would like to apologize for my tardiness in responding, but I have been extremely busy studying for and successfully completing, the preliminary examination for admission to candidacy for the doctor of philosophy degree in physiology.
1183	No response.
1184	If charges could be adjusted as to a base price plus a set charge for every certain number of references it might be a fairer price setting scheme in that charges would be more adapted to the value of the search.
1185	No response.
1186	No response.
1187	No response.
1188	It would be most helpful if this service could be made available to all graduate students at a reasonably low fee such that he could make use of it in checking out a number of areas of interest for possible research.
1189	No response.

Search No.	Responses
1190	The program proved to be a very satisfactory and efficient, time saving means of obtaining research references. I want to thank you for giving students an opportunity of using this system.
1191	No response.
1192	I suggest a self-addressed return envelop be included with the questionnaire; otherwise it indicates lack of necessity.
1193	The value of your services will increase as time passes. I was at first surprised that some of my best references did not appear. They were apparently published before your file was started (in '62).
1194	I was very pleased with the results and I hope it will be available at a reasonable rate to more graduate students in the future. It is the best starting point for a literature search that I am aware of.
1195	A program like this will be a necessity in the near future. Even now there's just too much material in the file on any subject for any one man to keep up with. A centralized information service using computers appears to be a good answer. Thanks.
1198	It would be more effective, in my opinion, if the listings were extended to include non-space research.
1201	No response.
1202	The idea of the program is excellent but should be expanded to include other abstracts such as Chem and Nuclear Abstracts.

Search No.	Responses
1203	I am just starting on my thesis and already your service has provided me with more reference material than I could have obtained in weeks of searching. For this, I thank you.
1204	This type program could save the investigator valuable time.
1205	No response.
1206	Thanks for your efforts.
1211	End of program came too quickly in my case.
1213	No response.
1214	Two major deficiencies: Number of papers is inadequate; publications should cover a much longer period of time (at least back to 1950). Assets: Prompt and good service.
1215	I believe that most graduate students would prefer to pay for such a service rather than spend hours in a library doing the search themselves. However, the students must be made aware that such a service exists and cost must be reasonable.
1216	Very worthwhile; we will use it again.
1217	I'd like to see it continue on larger scale.
1221	I received very courteous and helpful assistance at NCSTRC from A. W. Lockwood and B. Walker.

Search No.	Responses
1222	Yes, do it again; it was great.
1223	No response.
1224	No response.
1225	No response.
1226	No response.
1229	In most cases this service is valuable but in some it can be an absolute necessity. I was highly pleased with the personal assistance given and hope that students will continue to receive this service at low cost.
1230	Thorough survey in lesser topics than more topics with missing publication would be nice. In general very good system.
1231	None.
1232	If this question is an invitation, yes. I feel that the material I received was worth \$5. If I had paid more, \$10-\$15 for instance, I would be a bit unhappy. I know quite well that much more investigation is currently being done (and has been in the last 10 years) than what the 87 hits indicates. I would not have enjoyed reading 870 abstracts, but that is more like what I would expect.
1233	I think it should be continued.
1235	I feel that the assisting STRC engineer was uncooperative and hindered the accurate analysis of my search problem.

Search No.	Responses
1236	No response.
1237	There need be more contact between yourself and the client on the set-up for the search routine.
1239	No response.
1240	I do not feel that the search went far enough into the past. It seemingly only covered the past few years, whereas there have been several articles in the past, even as much as 86 years ago, which had much more relevance to my particular problem than all but one of the supplied articles. (Possibly more than even the one supplied article.)
1242	From the graduate students' viewpoint, older, classic references should be added. He must understand the older references completely. These references are not in general circulation and usually the only references to them give only the result with no explanation of how the result was arrived at.
1244	I hope it will be continued.
1247	No response.
1254	No response.
1255	No.
1256	Is there a literature search and retrieval system which has access to all contract reports, etc., available from the Defence Documentation Center?

Search No.	Responses
1257	No response.
1259	Is it possible to order some other documents which are not listed in the bibliography? If so, it is perfect.
1260	This program should be made nationwide and sub-directly the informations into government publications, universities publications, publishing house information; or based on government abstracts as a group, and then other kind of abstracts like Chem Abstracts, Nuclear Abstracts, another group.
1262	Perhaps it was the fault of my department, but I do not think the program was adequately advertized.
1264	I would like to see the biological and chemical abstracts added to your tapes since this would provide many more hits in the biological sciences areas.
1265	I understand that you are considering the including of Chemical Abstracts in your Library, if you could add Biological Abstracts you would increase the value of your service even more. (Maybe even Mycological Abstracts.)

ANALYSIS OF USER RESPONSES

Topic	Total Pop. (144)	Population Groups & Percentages					
		Abs/Doc Ordered		Non-Aero-space (31)		Abs/Doc Not Ordered	
		Group Total (89)	Aero-space (58)	Non-Aero-space (31)	Group Total (55)	Aero-space (33)	Non-Aero-space (22)
INTEREST AREA OF SEARCH AS DETERMINED BY TITLE & DEPARTMENTAL AFFILIATION: Mechanical design & analysis Structural design & analysis Fluid analysis, rocket propulsion, MHD, heat transfer Biological & life sciences Chemical engineering & chemistry Electronics & electrical engr. Other (Psychology, Nuclear physics Statistics, Metallurgy)	14.6	12.3	14.0	---	20.4	34.4	---
	6.9	6.2	8.8	---	9.3	15.6	---
	29.3	30.4	49.1	---	22.2	37.5	---
	17.3	15.7	---	45.1	20.4	---	50.0
	10.4	13.5	---	42.0	5.5	---	13.6
	14.6	18.0	28.1	---	9.3	12.5	---
	6.9	6.2	---	12.9	12.9	---	36.4
	18.0	23.6	27.1	9.7	9.3	9.4	4.5
	49.2	50.6	49.9	48.4	48.2	47.7	59.1
	19.4	22.5	18.3	25.8	14.8	21.8	4.5
QUESTION I. STUDENTS' IMPRESSION OF VALUE OF THE SERVICE: Very great value Reasonable value Marginal value							

Topic	Total Pop. (144)	Population Groups & Percentages					
		Abs/Doc Ordered			Abs/Doc Not Ordered		
		Group Total (89)	Aero-space (58)	Non-Aero-space (31)	Group Total (55)	Aero-space (33)	Non-Aero-space (22)
Limited or none	9.7	2.2	0.0	6.5	22.2	15.6	31.9
Not applicable	3.7	1.1	4.7	9.6	5.5	5.5	---
QUESTION II. DOES THE STUDENT CONSIDER THIS SERVICE SUFFICIENTLY VALUABLE TO RECOMMEND IT TO OTHER STUDENTS:							
Very much so	11.8	15.2	18.3	6.5	3.7	3.1	4.5
Yes (definitely, of course, etc.)	63.9	62.4	61.8	59.7	64.8	50.0	59.1
Marginal	4.2	4.5	5.3	3.2	3.7	15.6	4.5
Yes, but it would depend upon student interest area, time of search in schedule	16.7	15.7	8.8	27.4	18.5	21.8	18.3
Not to anyone in my field	3.5	2.2	1.8	3.2	5.5	0.0	13.6
Not applicable	2.9	0.0	4.0	0.0	3.8	9.5	0.0
QUESTION III. WHAT DOLLAR VALUE DOES HE EXPECT GRADUATE STUDENTS WOULD BE WILLING TO INVEST IN THIS SERVICE:							
No comment	8.3	6.2	7.0	3.2	12.9	10.5	13.6
\$1 maximum	4.2	4.5	3.5	14.8	3.7	3.1	4.5
\$5 maximum	19.4	23.6	18.3	29.9	12.9	9.7	13.7

Topic	Total Pop. (144)	Population Groups & Percentages					
		Abs/Doc Ordered		Abs/Doc Not Ordered		Non-Aero-space (22)	
		Group Total (89)	Aero-space (58)	Non-Aero-space (31)	Group Total (55)	Aero-space (33)	Non-Aero-space (22)
\$10 maximum	34.7	37.1	35.9	31.1	31.6	28.2	45.5
\$20 maximum	8.3	9.0	10.5	6.5	7.4	9.4	4.5
\$25 maximum	16.7	14.6	16.5	9.2	20.4	28.1	13.7
Greater than \$25	5.5	5.0	5.3	5.3	5.6	6.2	4.5
Not applicable	2.9	0.0	3.0	0.0	5.5	5.5	0.0
QUESTION IV: WHAT IS THE STUDENT'S FUTURE EMPLOYMENT AREA:							
Government research	13.2	14.6	14.0	16.1	11.0	8.6	18.3
Industrial research and dev.	38.2	37.1	42.1	25.8	40.7	50.0	27.2
Teaching & academic research	41.6	42.7	36.9	54.9	40.7	34.4	54.5
Business	1.4	2.2	1.8	0.0	0.0	0.0	0.0
Undecided	2.1	1.1	1.8	0.0	3.7	3.1	0.0
Not applicable	3.5	2.3	3.4	3.2	3.9	3.9	0.0
QUESTION V. WOULD THE STUDENT RECOMMEND THE USE OF AN INFORMATION RETRIEVAL SYSTEM TO HIS FUTURE EMPLOYER:							
Yes	68.0	69.7	73.6	64.5	66.0	68.3	72.7
No	3.5	3.4	3.5	3.2	3.7	0.0	9.1
Yes on condition that improvements were made, file were sufficient, etc.	21.5	22.5	19.3	25.8	20.4	21.8	18.2

Topic	Total Pop. (144)	Population Groups & Percentages					
		Abs/Doc Ordered			Abs/Doc Not Ordered		
		Group Total (89)	Aero-space (58)	Non-Aero-space (31)	Group Total (55)	Aero-space (33)	Non-Aero-space (22)
Not applicable	7.0	4.4	3.6	6.5	9.9	0.0	
QUESTION VI: INTERPRETATION OF ADDITIONAL COMMENTS MADE BY STUDENTS: Express appreciation (favorable) Express anxiety (unfavorable) Recommendation for improvement (expand holdings, improve operation procedures, etc.) Express desire for continuation & expansion Not applicable	21.5 9.0 27.8 9.0 32.7	23.6 12.4 27.0 12.3 24.7	29.9 12.3 19.3 7.0 31.5	9.7 9.7 45.1 16.1 19.4	18.5 3.7 29.6 5.5 42.7	15.6 3.1 25.0 3.1 53.2	18.2 4.5 40.9 9.1 27.3
ALTERNATE ANALYSIS OF RESPONSES TO QUESTION VI: No comment or recommendation of note No suggestion, but comments are that the student is satisfied with the results of his search	36.9 25.4						

Topic	Total Pop. (144)	Population Groups & Percentages			
		Abs/Doc Ordered		Abs/Doc Not Ordered	
		Aero-Group Total (89)	Non-aero-space (31)	Aero-Group Total (55)	Non-aero-space (22)
Suggestion to improve operation procedures, pricing structure, contacts with students	18.8				
Expand data base to include a greater breadth of holdings, such as chemical abstracts, journals, etc.	15.5				
Expand data base to increase the depth of coverage to documents and publications of historical interest	3.4				



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An appointment for a conference to plan the search will be arranged with an applications engineer.

Briefings to describe the service in detail will be held _____
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