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HOW TECHNICAL WRITERS CAN USE AND IMPROVE TECHNICAL RETRIEVAL SYSTEMS

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3. The Committee on Scientific and Technical Information is one of the Committees of the Federal Council for Science and Technology. The Committee's primary objective is "the development among the executive agencies of a coordinated, but decentralized scientific and technical information system for scientists, engineers, and other technical professions."

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INTRODUCTION

Computers, closed circuit television and jet airplanes have been with us for some time now and provide us with some wonderful tools for communicating with each other. Despite their ever-increasing use, the paper with its printed symbols is still our most important communication medium; I think, it will remain so for a long time to come.

Paper is the foundation on which we have built our culture. It has provided reliable communication lines between the succeeding generations. It has made it possible for us to accumulate the kind of knowledge of ourselves and of the universe which makes our survival possible.

As we expanded our knowledge, so have we increased the use of paper. Unlike the knowledge, however, which we managed to store in the highly decentralized and atomistic system of human minds, the paper, being a substance, rapidly filled our libraries and became an object of serious attention for librarians and the entrepreneurs who had to consider the required additional storage facilities.

The rapid expansion of our technology complicated not only the storage problem but also the recovery of documents from such storage. The author, the technical man, contributed to this problem by his lack of concern for the librarians dilemma and by his insensitivity to the subsequent retrieval of his own writing. But the author was also a user. As a user he soon became the victim of his own complacency, for soon he too was unable to find the relevant documents when he needed them. And so, some technical men joined the librarian and the entrepreneur in taking a look at what someone has cleverly termed the "information explosion". Many papers have been written on how to "contain" this explosion. This one is not the last one in the series.

This term "information explosion" worries some people, delights others. Some people envision all of us being hopelessly engulfed in a sea of paper in the next few decades. It certainly produces anxieties among the librarians whose collections rapidly keep outgrowing both the allotted shelving space and budgets. I suspect it delights the computer manufacturers and the film makers whose market analysis reports show only one sales trend - upward.

Between these two extremes stands an army of scientists and technologists, who have long ago given up the reading habit. Instead, they developed a whole array of informal, mostly oral, communication channels which stimulate our technological progress in spite of our formal documentation systems. The written technical material is their court of last resort.(1) In this respect they behave very much as you and I, obeying the first law of the handyman: "If everything else fails, read the instructions."

This is where you, the technical writer, come in, both as a user and as a generator of technical documentation. In discussing the technical writer and information systems, I wish to direct my remarks at your problems when you must reach for information stored somewhere in our documentation centers, when you must prepare documents that will be stored in unknown places. These problems can be summarized in three questions:

1. Where can I turn to when my own library cannot provide the desired information?

2. How do I ask for information (state my problem)?

3. What can I, as an author, do to facilitate the future retrieval of my own writings?

In the remaining time, I will explore these questions in greater detail. First, I will sketch and describe some of the facilities of the present national technical information system and systems which you as users of information can turn to when you search for information. I will try to show how they can be accessed, and point out how important are the titles, index terms and abstracts in this process. Finally, I will suggest certain criteria which you as authors can adopt to minimize the document retrieval problems.

THE NATIONAL INFORMATION NETWORK

Despite all of its shortcomings there exists in the United States a loosely coordinated set of organizations and activities which some people view as a de facto national information network.(2) These organizations are both Federal and non-Federal. Broadly, they can be categorized as technical libraries, information and data analysis centers, documentation centers and society information services, and the technical information systems and focal points of the federal agencies. Together these organizations are capable of providing documents as well as answers to specific questions on practically any topic of interest to technical people. The "network" can be roughly depicted in the following way:

National Technical Libraries
Information Offices of Federal Agencies
Data and Information Centers
Documentation Centers
Information Services of Professional Societies

Figure I

I will skip the discussion of the National type of libraries because they have been with us long enough to be widely known. The Library of Congress, the John Crerar Library, or The National Library of Medicine are the kinds of libraries I have in mind here. Similarly, I will forego the opportunity of telling you about all the services provided by such giants in technical information as the American Chemical Society, the Engineer's Joint Council or the American Institute of Physics. If you are a technical man you probably belong to one and know their services better than I. I will deal with only the remaining three groupings: the documentation centers, information centers, and agency focal points.

The Documentation Centers

The NASA Technical Information Facility, the Defense Documentation Center and the Clearinghouse for Federal Scientific and Technical Information are the most important of the national documentation centers. Of these, the Clearinghouse is the only "public" facility, available to anyone in the country. It is also the least known and, therefore, my candidate for discussion.

In all fairness I should say, that the Clearinghouse is not a completely new entity. Many of you should be familiar with its predecessor, the Office of Technical Services, which for a number of years made serious efforts to provide the public with a single point of access to the vast and rapidly growing government report literature. The Clearinghouse is simply an improved and a more glamorous model. Located in the suburbs of Washington, the Clearinghouse contained, at the end of 1965, some 430,000 titles of technical reports which resulted from research of the Federal departments and other Federal agencies. By the end of this year, Clearinghouse officials anticipate the collection to increase by some 72,000 items, while its document distribution should reach a level of some two million copies per year. These numbers should give you a rough idea of the size of the whole enterprise.

Access to the Clearinghouse is relatively easy, by letter, phone or in person. If you know precisely which document you want you will receive a response in about 3 - 5 days. If you don't know what you want, it will, of course, take longer. The adequacy of their response will largely depend on your ability to identify and describe the kind of information you are after.

What about some of the tools which the Clearinghouse provides to enable you to ask for specific documents and thus save yourself (and them) the time and trouble? The basic tools are the two indexes, one for Government documents, the other for translations, and the so-called Fast Announcement Service, a sort of selective notification system. The latter consists of special bulletins, each containing five to six items of the most recent reports in a given area of interest. I, personally, subscribe to the special announcements on data processing and information technology and find them very valuable in keeping me up to date in the general area. There are some 57 categories of science and technology included in this announcement system. It has now been automated to handle a volume of 20,000 names of individuals and organizations who are interested in receiving such announcements. The annual subscription cost is $5.00.

As an innovation in its own right the Clearinghouse Index to U.S. Government Research and Development Reports lists this year the on-going research projects, in addition to the titles and abstracts of government reports. This is a joint venture between the Clearinghouse and the Science Information Exchange of the Smithsonian Institute. The latter organization is charged with keeping the inventory of this nation's R&D efforts. The index, thus, become a source of information not only on past research but also provides a directory on "who is who" in research - a valuable aid to those who want to get in touch with the scientists themselves or for those who are interested in results before they become generally available in published literature.

In an another development, the Clearinghouse is now working on implementing the recently enacted Public Law known as the State Services Act. The purpose of this act is to promote commerce and economic growth through the utilization of Government-sponsored research findings. The Clearinghouse will be the center for evaluating, storing and disseminating technical information and generally encouraging more effective application of scientific and technical information. Just how the Clearinghouse will "evaluate" the literature is not clear at this time, but there is little doubt that the use of the Clearinghouse should be expanded if only because of the added publicity which will be generated in order to get things going.

Information and Data Centers

The mention of "evaluation" brings us then to another "component" of our system, the technical information centers. Some of these "centers" are simple efforts of compiling and updating bibliographies on given topics. Others are the organizations set up for the specific purpose of collecting, evaluating and furnishing information on a narrow area of science or technology. Although in practice the distinction between the information centers and documentation centers is quite arbitrary, the latter is capable not only of giving you relevant documents, but also of providing the answers to specific questions. The most important and distinguishing characteristics of such centers, however, is their close association with reputable research institutes. From these institutes the centers obtain the services of scientists and engineers who "evaluate" the quality of the incoming documents, and help the information specialist in providing appropriate answers. There are at least four variants of such centers.

Technology Utilization Centers

The first is portrayed by the NASA-sponsored, university-operated, Technology Application Centers. The job of these centers is to transfer aerospace-related and international science and technology data into the non-aerospace industrial sector where information about new materials, processes, techniques and products may find commercial application. The key people in such centers are application engineers and information service personnel. The engineer, drawn from the university faculty, is the man who makes the difference between comprehensively directed problem solving techniques and not-too-precise information retrieval. U.S. corporations are the usual customers of such centers.

Information Evaluation Centers

The second variant is exemplified by the Defense Information Evaluation Centers and some AEC Information Centers. Unlike the NASA variant they are not "problem solvers." The evaluation centers simply answer questions, prepare state-of-the-art reports or data tables on narrowly defined problem areas. By focusing on the subject matter rather than on being an outlet for Government reports (as is the case of the Clearinghouse), they collect, index, and retrieve the world-wide literature related to their area.

Data Reference Centers

The Data Reference Center is the third variant. The typical products are data reference tables and handbooks. The National Standard Reference Data Center at the National Bureau of Standards is the latest and most comprehensive effort to establish such service on a systematic basis. The Center is still under development and will probably remain so for several years. So far, the developers have emphasized data evaluation and compilation projects, leaving to the future the development of specific information services.

Experimental Data Centers

The fourth variant is a center which specializes in storing raw experimental data. One such center which is known as the National Oceanographic Data Center is operated by the Navy. Another one, operated by NASA, is the newly created National Space Data Center which will store and retrieve experimental data obtained from our space shots and moon probes. The uniqueness of these centers is in storing the raw, environmental measurements carried out in the past, but with a potential for re-use by future investigators. These centers are primarily in the field of geo- and space physics where the meansurement calls for sophisticated experiments and vehicles, and where the investigators need data gathered over a relatively long period of time to map out, categorize and predict the environment. Measurements of the atmospheric densities, cosmic rays, solar flares or mapping of the ocean floor are typical of data stored in these centers.

Federal Agency Information Offices

This rather sketchy overview of the national network would be incomplete without a short mention of the many information offices of the federal agencies who can help you in locating the sources of relevant information. Sometimes these points of contact are called the technical information divisions, sometimes the scientific and technical information offices or the research information offices. Usually they are the agency focal points in the business of knowing what information is produced by their agency and how you can gain access to it. Some of them will go a long way to insure that a person with a legitimate need is given all the assistance he needs.

In addition to being rich sources of information on "where to go and whom to contact" these offices are also the places where the federal information policies are considered and implemented. At the department level the heads of such offices are also the members of the Federal Council's Committee on Scientific and Technical Information (COSATI),(3) and as such exercise a tremendous influence over the direction in which our total national information system is moving.

In your hand-out(4) I have tried to provide you with a quick reference item to these lesser known but powerful sources of information. I hope you will find it useful.

ACCESS THROUGH COORDINATE INDEXING

But knowing the sources of information is only one-half of the battle.

Asking the proper question when searching through the collection of technical reports is just as critical aspect of information retrieval, and by far the most difficult. In the days when chemistry was chemistry and bionics and cybernetics were absent from our vocabularies, the traditional library classification systems served us well. Now that the traditional boundaries of disciplines have largely disappeared, and science is characterized by interrelationships rather than hierarchical subordinations, the neat ordering of documents into their proper cubicles is no longer practical. Searching for a better way of dealing with this phenomenon, the documentation people turned to "coordinate indexing," a scheme to describe the documents for subsequent computer processing and retrieval. Most of the centers which I mentioned use this scheme to control their collection of documents. You should know the essentials of this concept to be better equipped in formulating your search and retrieval questions when using these centers.

The Use of Index Terms

Unlike the traditional classification systems which rest on the idea that the universe of knowledge can be neatly subdivided into a hierarchical arrangement of subordinated disciplines, the coordinated indexing approach denies the hierarchical concepts. Instead, it rests on the assumption that each technical descriptor of a document stands alone, neither superordinated nor subordinated to any other descriptor in the collections vocabulary. Each document which enters the collection is numbered with the next consecutive number and identified with a set of such items ranging from 4-40, depending on the depth of indexing established for the system. When an individual is searching for information he selects the desired descriptors and then "coordinates" them, thereby determining the documents which have been indexed by the particular combination of terms.

To illustrate what I am saying let's consider a document which deals with the behavior of zirconium under high temperature. The document has been given a number 000 317 by the Defense Documentation Center (DDC). This is the number which DDC will not use again for any other document as long as the zirconium document is retained in the collection. The DDC indexers have described the document by these descriptors:

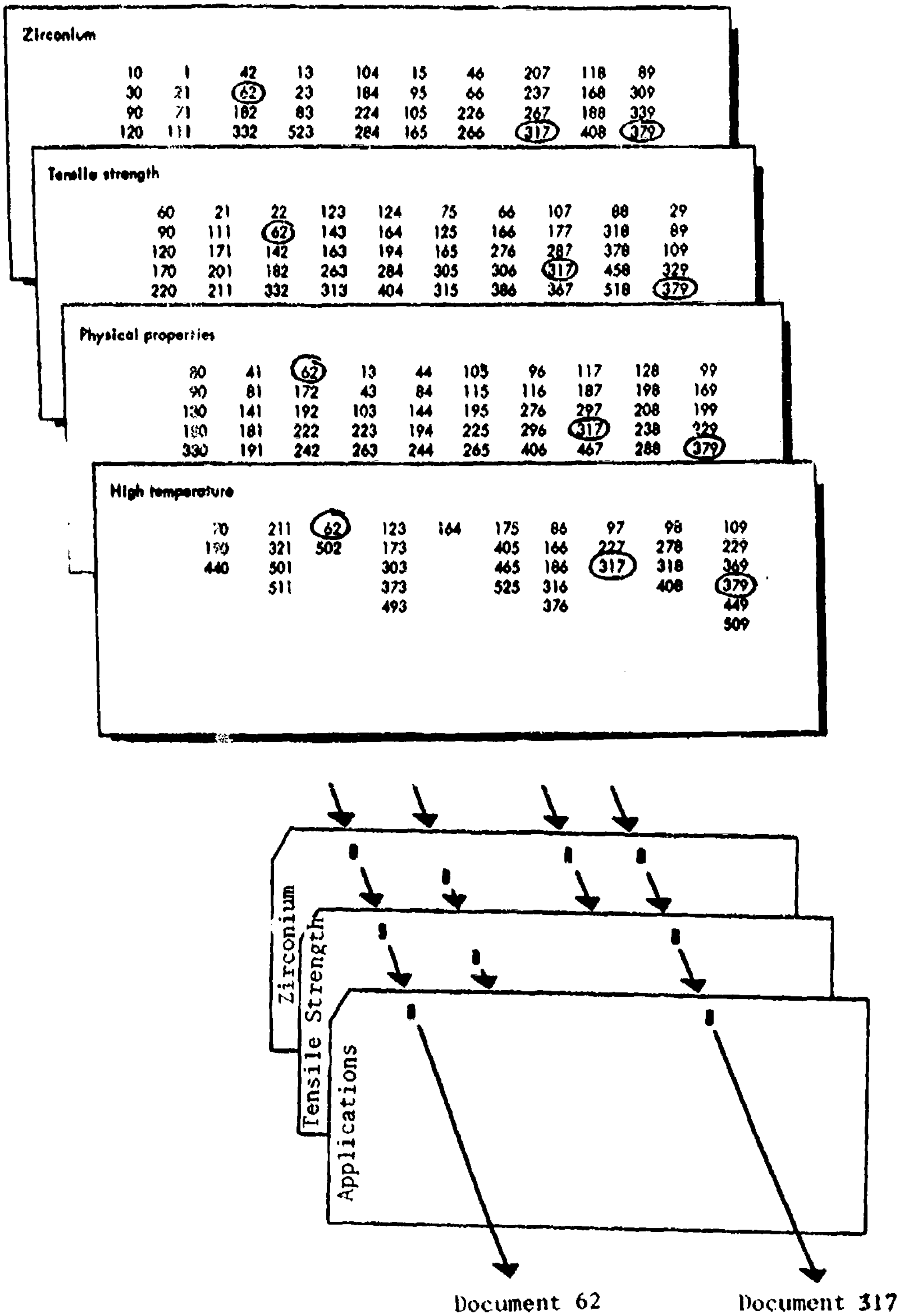
Zirconium	#000 317
Tensile Strength	
Physical Properties	
High Temperature	

Figure 2

Each of these words are represented by some unit record (a card or a storage location in a computer). The number 000 317 is now entered on each appropriate unit record. Now the document has been identified and stored for future searches.

The search consists of selecting from the alphabetical file of the term records those cards which describe the desired information. Thus, in a search for the information on the tensile strength of zirconium under high temperature one would select that document number which occurs on all three cards. (See Figure 3) Number 000 317 is then recovered, and this number leads us to the document itself.

The probability of finding a relevant document in a document collection



Position coding of document numbers. Where the beam from a light source shines through the selected cards, the hole represents a document indexed under the descriptors stated in query.

depends on several factors: the specificity of index terms and the number of terms used being the most evident. Generally, in the indexing stage the future access to the collection is facilitated by using a large number of terms (10-40) to describe the document and by a combination of generic and specific terms. This is so because here the indexer provides the future user with many points of access and from many points of view.

The recovery of documents is determined by the same factors but in a different way. Thus, the larger the number of retrieval words in a query, the smaller will be the total number of documents retrieved from storage. The use of highly specific words will further limit the number of the recalled documents. Figure 4 shows the different effects produced by the questions of varying degrees of specificity and the number of query terms.

RETRIEVAL TERMS VS RECALL
(Hypothetical Relation)

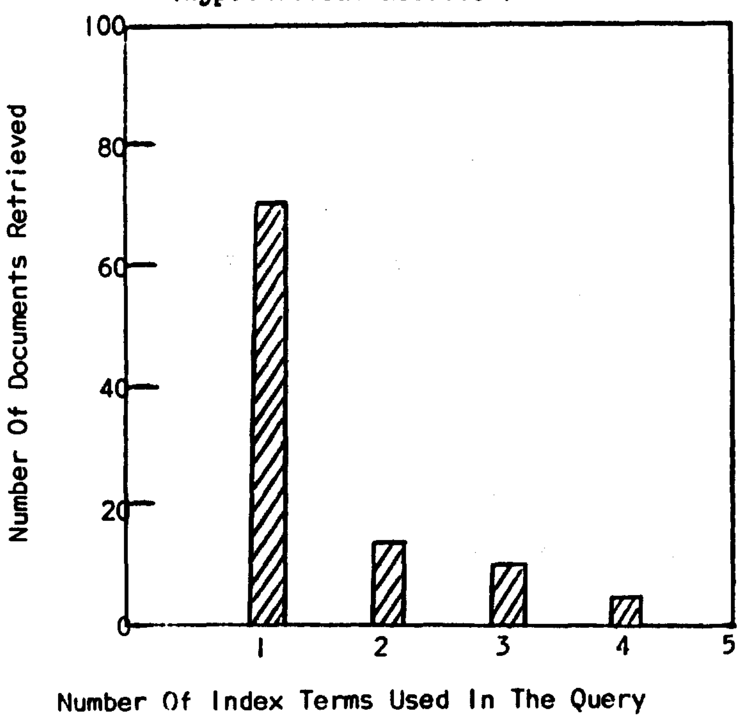


Figure 4

The Sources of Index Terms

As you can readily see, the index words are the key items in any retrieval system, and the tags by means of which you can pull out an appropriate item from storage from a collection of dissimilar material. This is probably one reason why the index terms are often called keywords or topic tags. What about the source of these keywords? How does one determine which words in some two to three thousand words of a given report are the keywords and which are not?

Ideally, the selection of the index terms should be the result of the document's content analysis. Again, ideally there should be some method, and a set of criteria to guide the contents analysts in their selection. I will have a few words on the criteria at the end of this presentation. The "real" world however is far from the ideal and a careful content analysis is not always possible. One obvious reason for this limitation is the need for the technical expertise which a documentation center normally cannot afford; another is the sheer volume of the incoming documents preclude the possibility of a content analysis based on the entire document. Under these conditions (and these are the most prevalent conditions), the real source of the keywords is the document's title and its abstract. Thus, often the whole contents analysis is in practice reduced to the scanning of titles and abstracts and extracting the technical descriptors from which they are composed; in turn the adequacy of indexing is preordained by the "goodness" of titles and abstracts.

Authors' Responsibilities

This interdependency between titles, abstracts, index terms, and the subsequent retrieval is what prompted the President's Science Advisory Committee to urge the individual scientists engineers to greater participation in the information transfer process. The Committee's 1963 report (5) asks the authors not to leave the entire process to the professional documentalist, and in particular it asks them to:

"a. Title papers in a meaty and informative manner

"b. Index their contributions with keywords taken from standard thesauri

"c. Write information abstracts."

But, to tell the authors what must be done and providing them with a form on which to do it is not enough. Authors are not abstracters or indexers. They cannot be expected to know the art of documentation as well as they know their science. If we expect them to do the work of documentalists, we are obliged to advise them about the criteria and techniques of the documentation profession.

As you probably know, my organization sponsors a good part of the scientific research in this country, which results in an annual output of some 4,000 papers. Some of these papers have meaty and informative titles; others do not. In our attempt to do something about it, we worked out in 1964 an *"Authors Guide for Technical Reporting"*(6) in which we tried to spell out the essential criteria for judging whether or not a given paper meets the standards for good titling, abstracting, and selection of keywords.

I will not bore you with all the details underlying the development of these criteria. I would like, however, to summarize for you, preferably in the form of a check list, these criteria which I believe to be generally useful.

Criteria for "Good" Titles

A report should be recognized by its title. All too often a technical paper of critical importance is overlooked because it has a poorly worded title. A good title is one that is definitive and, if possible, fully describes the subject. It is arrived at through a complete evaluation of the content of the report.

- ☐ Identify both the principal field and the specific subject under consideration.
- ☐ Be precise - avoid words which are too common or too broad for easy recognition of the content.
- ☐ Avoid acronyms, superscripts and subscripts.
- ☐ Keep the title short - ten words or less.
- ☐ Use subtitles when needed to clarify the extent of coverage, timeliness, approach used, action taken, special situation, limitations or results. (7)

Criteria for "Informative" Abstracts

An abstract should state the purpose, methods, results and conclusions of the report. All documents or papers cannot be broken down this way, but an attempt should be made to follow the procedure as much as possible.

- ☐ PURPOSE. Include a statement of goals (objectives, aims) of the research, or why the article was written. Do not deal with what is already known unless the objective is to prove or disprove an established theory or practice.

- ☐ METHOD. Tell about the experimental techniques or the means by which the results were obtained. Describe the apparatus, equipment, and material. Given the data used and, where applicable, their origin.

- ☐ RESULTS. Findings are probably the most important part of the abstract. Often there are too many findings for inclusion, and careful selection is needed. In such cases the selection should be based on one, or several of the following: new and verified events, findings of permanent value, significant results, findings which contradict previous theories, or findings which the author knows are relevant to a practical problem.

- ☐ CONCLUSION. The conclusion should deal with the implications of the findings and how they tie in with studies in related fields. It can be associated with the following aspects of a report: recommendation, application, suggestion, evaluation, new relationships, hypothesis accepted, and hypothesis rejected. When conclusions and results overlap they need not be separately repeated.

Criteria for Selection of Keywords

Important keywords often can be found in the title, abstract, table of contents, introduction, figures, tables, conclusions and recommendations. Particular attention should be given to the following:

- Specific materials, data, theories, theses, used.
- Specific properties determined experimentally or theoretically.
- Specific methods or processes investigated.
- Equipment used.
- Specific applications for materials, methods, processes, or equipment where they show promise beyond the particular experiment.

CONCLUSION

I introduced this talk by implying that there is little danger that computers and the unlimited travel budgets will soon replace the printed documents as a predominant medium of communication. Neither do I believe we will be swallowed by something which is known as the information explosion. Your presence here and the kind of studies you pursue will insure that man will continue to learn to cope with his communication problems.

We already have learned much about these problems in the last few years. For example we have learned that the problems of technical documentation are too important and too complex to be shouldered solely by the documentalists. We have come better to appreciate the duality of roles played by the technical man as he switches from being the user to his role as a writer. We certainly came much closer to appreciate the old biblical admonition "how you sow so shall you reap". This precept seems to be particularly relevant to technical documentation.

We have also learned to cope with some of the problems and to meet the demands of modern technologists and scientists. The development and growth of the specialized information centers is but one way of insuring an orderly and comprehensive collection of data and information in a critical area. Many of the present information problems do not at all stem from the nonavailability of information resources. Rather they come about because the users are often unaware of the information resources built for their convenience and use. Our little handout on information centers and federal technical information offices was assembled to stimulate this awareness.

But it would be wrong to assume that the simple build up of data centers is the government's answer to the present and future problems. A major role is also played by the agencies' offices which have the responsibility for the monitorship and guidance of their agency's technical information programs. By focusing attention at the communication processes and by finding in COSATI a platform for attaining consensus on the solution of pressing problems these insure a continuous development of a system suited to the needs of our developing technology. In the meantime these offices double up as the referral centers for those who search for information.

The existence of these centers and of the technical information offices (as well as a sizeable government R&D in scientific information) does not, of course, absolve the technical man from his responsibility of knowing his system and refraining from damaging it through carelessness. This is particularly true where the author produces documents worthy of storage and future retrieval. By considering and applying the suggestions I made on titles, abstracts and indexing, the author can do his part in keeping the system in working order.

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R&D

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

1. ORIGINATING ACTIVITY (Corporate author) Hq Office of Aerospace Research Office of Scientific and Technical Information Arlington, Virginia 22209	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

How Technical Writers Can Use and Improve Technical Information Systems

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

Management State of the Art Special

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

Alexander G. Hoshovsky

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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The distribution of this document is unlimited

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY Hq Office of Aerospace Research Information Studies Division (RRYD) Arlington, Virginia 22209

13. ABSTRACT

The purpose of the paper is to acquaint technical writers with the U.S. technical documentation network of the United States and to suggest how they can contribute to its improvement.

The network consists of national technical libraries, federal technical documentation centers, data and information centers, the information services of professional societies and the technical information officers of Federal Agencies involved in R&D. Together they constitute a de facto national system, suitable for storage and retrieval of the world's scientific literature.

Titles, abstracts and index terms (word-descriptors) play an important role in these systems. Since they are the major elements of document identification and subsequent retrieval, the authors should be particularly careful about their construction. Titles should identify principal field as well as specific subject and be precise. Abstract should convey the purpose of the report, methods of investigation, principal results and conclusions. Selected index terms should cover the materials used, properties determined, equipment used and possible areas of application.

Technical writers can help by insuring that they, and the authors whom they assist, give adequate attention to these elements of reporting.

UNCLASSIFIED
Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
MACHINE RETRIEVAL						
TECHNICAL INFORMATION						
CLASSIFICATION						
THESAURI						
TECHNICAL WRITING						
TITLING						
ABSTRACTING						
NATIONAL SYSTEM						
INFORMATION CENTERS						
LIBRARIES						
COORDINATE INDEXING						
COMPUTERS						
DATA CENTERS						
TECHNOLOGY UTILIZATION						
PUBLICATIONS						

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

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

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

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

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

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

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

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

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

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

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as *(TS), (S), (C), or (U)*.

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, rules, and weights is optional.