

## Information Services for the Sciences and Technology in Perspective

### 科学技術情報サービスの展望

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#### 要 旨

本文は科学技術の分野における情報サービスのあり方について展望を試みたものである。まず情報の特性、膨大な情報量について述べ、従って科学技術者達は他からの援助なしにはこれらの情報を吸収することが不可能になってきたことを述べた後、各種の情報サービスの形態を記述している。情報サービスを行なうに当って必要な出版物情報センター、視聴覚資料センター、ドキュメンテーションセンター、コンピュータの利用、経費について略述し、また科学技術者の各種の情報要求について解説している。情報サービスの発展については、一つの機関において簡単な情報サービスを行なうものから、大規模な機関で複雑な情報サービスを行なうもの、さらには米国国立図書館を核とする地域的ないしは国際的情報システムについて論じ、かかる国際的情報システムの一例として東アフリカ農林研究機構の行なっている東アフリカ文献サービスについてやや詳細に解説している。新たに情報サービスを発足させるためにいかなる手順を踏むべきかを論じ、また十分予算措置等も調和のとれたものでなければならないことを指摘している。

科学技術者にとって実験室や実験装置が欠くべからざるものであることはよく認識されているが、これと同様に、十分な情報サービスも科学技術者にとって欠くべからざるものであることを主張している。  
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- I. Introduction
- II. Information Services
- III. Requisites for Information Service
- IV. The Information Needs of Scientists and Technologists
- V. The Development of Information Service
- VI. The East African Literature Service
- VII. Starting a New Information Service
- VIII. Conclusion

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## I. Introduction

Much has been written about information services by highly qualified information specialists for those engaged in giving these services. In spite of this large quantity of excellent literature, there appears to be a need to bring to the attention of administrators an overall view of information services for a better understanding of the role they should play in each institution whether it be educational, research, technology, or for the general public.

Every day information plays a very significant role in the life of everyone in every country. Information includes facts, data, intelligence and advice that are told, or read, or communicated, which may or may not be organized and may or may not be related. Information can be acquired through reading, study, observation and listening.

The amount of information that has been generated by the human race since it appeared on earth is tremendous. A great majority of this information in science and technology has been developed in hardly more than the past one hundred years. Less than two centuries ago the number of scientists and technologists was small and the entire body of scientific literature was so limited that a scientist could keep abreast of the publications concerning his specialty. However, during the past one hundred years science and technology have grown so rapidly that it is extremely difficult to know what is being published in any particular field and even more difficult to find the time to read it. The world's production of publications concerning any given area of interest appears in a tremendous number of languages. Very few scientists and technologists are able to read and understand more than a very few languages. They must obtain assistance or be uninformed of the advances made by others in foreign countries.

## II. Information Services

As a result of the needs for assistance to

help scientists and technologists to be informed, a large number of activities have been developed which are called information services. These include:

1. Tools for locating and giving pertinent information concerning who has written what, where and the general contents of publications. These tools include current contents, index, abstract and review journals.
2. Specialized bibliographies to bring together the references to the world literature in one source such as a book, a continuing journal or publication with periodic supplements.
3. Preparation of specialized bibliographies on demand.
4. Translations of articles published in foreign languages.
5. Photocopy or facsimile copy of scarce material.
6. Location and distribution of data, formulae, diagrams, drawings, illustrations, methods, etc. (depending upon the nature of the work of the scientist or technologist and the institution which he serves).

## III. Requisites for Information Services

All of these services are essential to help the scientist or technologist perform his duties. However, the information services require the following:

1. A center or centers of the published information.
2. A center or centers for audio-visual materials.
3. A documentation center or centers.
4. Access to a computer (depending upon the situation)
5. Adequate funding.

Each of these requirements for information services will be elaborated.

1. *Center or Centers of Published Information*: It should be emphasized that the ever-growing volume of scientific and technological information which appears as publications or in data banks or tapes of oral presentation

demands an orderly system for its selection, processing and storage as well as a highly efficient method of retrieval and dissemination in order that those who need information can obtain it promptly. Libraries have long served as important centers of information. However, the evergrowing volume of publications has made it impossible for any one library to collect all of the literature in even one field. Consequently libraries must cooperate with each other for the mutual benefit of their clients. Institutions in close proximity occasionally agree to adopt policies to compliment and/or supplement each other's collections of materials that are not heavily used and lend these through interlibrary loans. In this way a much greater volume of information is available in the area.

2. *A Center or Centers for Audio-visual Materials*: Libraries now include not only published information but also audio-visual materials which are useful to scientists and technologists. Taped recordings of scientific and professional meetings or of informal discussions in seminars and laboratories are also being made but may never be published. Many times such information can be extremely useful elsewhere and copies of the taped record can be made available to a wide number of persons interested in the same subject.

3. *A Documentation Center or Centers*: Recent years have seen developments of services for scientists and technologists which include the specialized journals such as the *Bibliography of Agriculture*, *Index Medicus*, *Abstract and Review Journals*, *Current Contents*, et al. Copies of documents can be made available, translations of articles published in unfamiliar languages can be provided, and special bibliographies can be compiled. Many of these are services which in the past were performed in varying degrees by all kinds of libraries. However, the increase in the quantity of publications and the increase in the number of languages now used have made it mandatory that more specialists be employed to handle the literature and to provide special bibliographies, translations, literature analysis for ab-

stracts and reviews and to manage the complexities of computer produced information services and the photocopy laboratories.

In some places the documentation center is a part of the library, while in others the documentation center exists as a separate entity. Regardless of where it is or how it is administered a documentation center must have access to a collection of literature. If one collection can be made to serve both a library and a documentation center, a great saving of funds can result.

4. *Access to a Computer*: Computers can be extremely useful if the range and volume of work justifies the great costs which are involved. A number of information centers are utilizing a computer not only for the production of *Union Lists* of the holdings of a large number of libraries and for many of the tools necessary for the retrieval of information but also for many of the repetitive operations which occur in the information center. Fortunately there is developing a number of highly specialized library and/or documentation centers whose services are available (for a fee). These services have been developed to give the widest possible coverage of the world's literature in specific fields. Although the services are costly, they are only a fraction of the amount that would be required to provide the services in each institution.

5. *Adequate Funding*: Obviously the above mentioned requisites for information services cannot exist without adequate funding. Also, it is obvious that once started adequate funding is essential for the continuation of the services. Information services are as essential for scientists and technologists as is a properly equipped laboratory.

#### IV. The Information Needs of Scientists and Technologists

In general scientists and technologists have the following needs for information: current awareness of the publications of their peers; answers to questions concerning day to day

work; review of the literature on specific problems; knowledge of literature in related fields of science and technology; and for general information.

1. *Current Awareness*: In the process of educating scientists and technologists they are exposed to the literature in their fields of study. This is an invaluable background for their careers. However, continued study and review of the literature is mandatory and must be done on a regular basis if the individual is to accomplish all that is demanded by present science and technology. Those who are engaged in industry face tremendous competition. Duplication of work already accomplished elsewhere is a luxury that in general cannot be supported unless it is done purposely. Being aware of the current output of research results is essential for practising scientists and technologists. They must be aware of what is being done, how it is being done and even where it is being done. The awareness of current research not only yields much specific information but also for the alert, creative reader can be inspirational in nature. The history of science is full of interesting examples, i.e., the work of Gregor Mendel with garden peas resulted in much experimental work on the nature of heredity and genetics of plants which was soon followed by similar investigations on the lower animals and finally man. With new scientific and technological discoveries there follows a fresh spate of experimentation as others check the results and/or apply the methods to a wide variety of conditions, materials, etc. As a result, new specializations develop, new techniques and methods occur, and in the field of technology new products are created. The space industry is a good example of this. In searching for suitable materials for the spacecraft, teflon was created which is a substance now widely used in the American kitchen.

Current awareness of new developments in every field of science and technology is equally important in educational institutions. Every educator of future scientists and technologists has the formidable obligation of teaching the

future scientists and technologists. Upon graduation each of them must be au courant in both the theory and practises of his specialization. It is incumbent on each teacher not only to teach subject content and methodology but also to instill in each student the importance of information and how to obtain it.

Fortunately there are now a number of journals in many fields which can give the reader an awareness of the current state of the art. Subscriptions to such journals are essential for educators, students and practising scientists and technologists.

2. *Information for the Daily Needs of Scientists and Technologists*: Those who work in pure scientific research, technology or the applied fields, teachers and students should have quick answers for daily needs such as formulae, mathematical tables, descriptions of apparatus, descriptions of materials, glossaries, dictionaries, addresses of colleagues or supply houses. The needs are legion and a nearby good reference collection, which includes the standard reference material as well as the specialized manuals, glossaries, compendia, etc. that serve the specialists, is essential.

3. *Review of All of the Literature Pertinent to a Specific Subject*: In planning a new research project or technological program a review of pertinent literature is often necessary for the planning committee as well as the individuals who will carry out the experimentation, engineering or whatever. In addition, at the end of the project there will often be a written document which will include a short historical sketch covering the pertinent literature. Access to a complete library collection in this field is imperative. Fortunately writers do not necessarily need the original publications but can use photo, microfilm, microcard, and microfiche copies or borrow materials from other libraries. Access to the collections of other libraries through inter-library loans, photocopies and microforms has greatly extended the possibilities of literature reviews for those who work in institutions or areas where libraries are limited in size and

scope.

4. *Awareness of Literature in Related Fields*: It is important that specialists be informed of the works of colleagues in related fields not only for the general information thus gained but also for the stimulation of ideas which often results. It may be a sudden spark of insight that leads to a new application of a recent discovery to another field which may ultimately result in a productive series of experimentation, or methods or equipment that can have new applications. Inspiration is a very illusive thing which needs stimulation through contact with fresh and different ideas. Reading widely can result in inspiring new ideas to those who are creative.

5. *Access to a General Collection of Literature*: A program of reading widely is essential to a balanced view for everyone. The current trend of a team approach for scientific and technological programs, both pure and applied, brings the additional obligation for scientists and technologists to have a general understanding of the background and current developments in the humanities, social and political sciences as well. This necessitates a balanced reading program.

The need for recreational reading material is not included here because such reading should be the obligation of individuals.

## V. The Development of Information Services

Information services are increasing in number everywhere. They range from rather simple services with a limited number of activities to complex systems, including networks of libraries and documentation centers.

Every library worthy of the name engages in some information service even though it may not be so called. The service may consist of assistance to readers in locating a book or journal article; the card or book catalog is in fact an invaluable information guide to clients as well as librarians; and locating needed information in other libraries and obtaining microforms or other photocopies from sources outside the

library are activities that are not only normal activities in most libraries but also are information services. A simple information service is usually maintained by the library staff. However, large institutions reach a point at which the librarians are no longer able to carry out the professional services of selecting, acquiring, processing and circulating the collection, supervising the staff and reading rooms, maintaining the reference services as well as doing the additional services of preparing special indexes, abstracts, reviews, demand bibliographies, translating articles from foreign languages to the local language, providing the clients with original documents or copies of them in microform or photocopy, maintaining a formidable mailing list which must be constantly revised.

Many large institutions, especially those which serve a national or international clientele, have had to resolve the problem of providing the clients with adequate information services despite the ever increasing bulk of information and ever increasing costs of information resources, manpower, and equipment.

The National Library of Medicine in Washington offers a good example of the gradual evolution of a system to meet the current demands for information. This library has a long history of assisting not only the medical profession of the United States but also has assisted other countries as well. It developed an excellent collection of medical and related materials. With improvements in both services and collections, the demand for more information grew, hastening an increase in the number of staff including more and more specialists, such as specialists in medical subjects, language specialists, and finally management and computer specialists who developed an information system which now includes regional centers both within the United States and a few foreign countries including Japan. The development of regional centers was necessary because of the enormous bulk of requests which poured into Washington. It was necessary to develop strong regional centers to re-

lieve the pressures on Washington for the time-consuming and repetitive requests for information which should be answered in local or regional centers. The National Library of Medicine is the outstanding center for the creation of information tools to help both librarians and medical clients everywhere. This serves not only to aid in improving the "current awareness" of medical scientists and technicians but also helps librarians in the selection of literature. With the *Index Medicus* from the National Library of Medicine available, it is no longer necessary for libraries elsewhere to duplicate the effort. The network of medical libraries offers a system which can serve the medical libraries and medical profession at the national, regional and local levels and through the cooperation with foreign libraries provides for a flow of information internationally. The significance of the system is great; every library has much to gain and is able to contribute to the system by collecting local information to put into system and assist with translations. The cooperation results in a network of co-partners, all of whom are essential for a functional system and equally important.

Other information systems occur also. There is currently a movement to develop an international agricultural system. From time to time meetings of persons who are concerned with the problems of scientific and technological information for the developing countries discuss ways in which the latest developments in communication systems could be used. It has been amply demonstrated that the use of the telephone, radio, television, telex and satellites can be employed for the rapid communication of news. Perhaps regular programs for scientific and technical information will evolve.

While dreaming of future possibilities the unpleasant facts of existing conditions should be faced. Some of these are: much more information exists than is being utilized; many scientists and technologists do not have available even a fraction of the information which they should have; and many information centers are not realizing their potential for

giving service. Even though there is little hope that some institutions can afford to develop a complex information system, there is a great possibility that the existing services could be improved and the clients stimulated to avail themselves of the existing services with the salubrious result of improved production on their part.

## VI. The East African Literature Service

An attempt to improve the literature services for the biological scientists and technicians in East Africa is an eloquent example of how improved information services can result in the widespread increase in the utilization of information, stimulation of the clients and improvement of their performance. East Africa (Kenya, Uganda, and Tanzania) covers an area of approximately two-thirds of a million square miles but in this territory there are only five well-stocked libraries, three of which are within 20 miles of each other. Of these libraries the one at the East African Agriculture and Forestry Research Organisation (EAAFRO) at Muguga, Kenya, near Nairobi, had what was considered the largest and best collection of biological literature in the area.

In 1965, the Director of EAAFRO and the Chief Research Officers of the Ministries of Agriculture of East Africa "noted that there was a deplorable lack of available scientific literature in the remote (research) centres, particularly in Tanzania and Uganda, and further that there was practically no mechanism to retrieve information from sources outside the centres where the research was being performed."<sup>1)</sup>

A study was made of existing conditions through visits to research institutes to discuss information needs for the research staff. The proposal to develop a Scientific Literature Service was met with enthusiasm.

The objectives of the service were the following:

1. To provide current periodical literature in the fields of biology, agriculture, horticulture, forestry, wildlife and veter-

- inary medicine to researchers and teachers not served by an adequate library.
2. To provide a repository library for
    - (a) data resulting from incompleting experiments which are deserving of preservation;
    - (b) research reports which constitute publications, but which have not appeared in a recognised journal;
    - (c) published works on wildlife and current research projects and reports in this field.
  3. To provide a research and abstract service as staff and facilities permit.
  4. To provide a reproducing photocopy service as staff and machine time permit.
  5. To evaluate periodically the reception of the Service and to inform concerned officials to the end that government will eventually be prepared to assume the cost of the Service after its value has been demonstrated.”<sup>2)</sup>

Later a questionnaire was sent to all users of the stations who joined the service. Over two hundred questionnaires were returned and an evaluation of these resulted in the evaluation of the service by those who were using it. The East African Literature Service began with the participation of 63 centres and increased steadily to 132 by the end of the first two years of operation. Not only Kenya, Uganda and Tanzania but also Zambia, Malawi, Botswana, Cameroun and Ethiopia were also served. “Using a xerox copier, ancillary equipment and staff centred at Muguga, the East African Literature Service provides copies of contents pages, articles and other documents to participating centres. The primary source of literature is the Muguga Library but extends, where possible, to literature held in cooperating libraries.”

“Copies of the holdings list of available periodicals in the Muguga Library are sent out so that centres may make their selection of titles. Thereafter the current contents pages are sent out in fortnightly batches and from them requests are made for entire articles, which are then supplied in photocopy form.

This work takes priority over all other routines as it is essential that scientists in the field receive the information as quickly as possible. Although the full cycle takes eight weeks to complete, the work routines are repeated each two week period.”

“In second order of priority are requests culled from the current contents pages, after which requests for older material are fitted into the work schedule. Requests for miscellaneous photocopies from other sources are only accepted as machine time permits.”<sup>3)</sup>

The East African Agriculture and Forestry Research Organisation conducted an evaluation of the services at the end of two years of service based on the answers to a questionnaire sent to all of the stations receiving the service and on personal interviews with the users. The answers revealed the following:

“Increased scope of reading. The East African Literature Service has changed the usage of literature for 77% of the questionnaire respondents, of whom 87% have read more on their particular subjects and 62% have read more on marginal subjects. One researcher reported a threefold increase in the amount of scientific literature read yearly. Users have found the literature distributed to be most useful in providing general background information. Material containing information on the results obtained from scientific experiments and field trials as well as articles describing the methods used for conducting experiments also rated very high in usefulness.”

“The main use and greatest benefit of the E.A.L.S. has been to make it possible for scientists, even in remote research stations, to be informed of new development in their own related fields of research.”

“Increased efficiency in planning and conduct of research. The material supplied by the E.A.L.S. has helped to shorten the time required to complete a project for 67 per cent of the users. Half of the researchers have found they are able to avoid duplication of work by using the Service.”

“From the personal interviews it learned that a successful experiment reported from elsewhere must often be repeated in East Africa due to the great differences in conditions (environ-

ments, soil, etc.). However, although the trials may have to be repeated, the techniques described for conducting the experiments can be effectively utilised."

"Adaptive uses. The literature has proved useful in other ways such as sources of information to assist in planning present and future work; awareness of approaches to problems in allied fields; comparison of work done by other research workers in the field; ideas on broadening and improvement of research programmes; references and latest information for teaching; help in writing scientific papers, illustrating layout and presentation; and means of keeping in touch and up to date with new scientific and technical development..."

"Future literature retrieval. While the main value of the E.A.L.S. is in providing current information, practically all (96.7 per cent) stations are filing or storing the literature received in an effectively retrievable manner. Several stations select articles for possible application to their future research projects and index the material so that pertinent information is easily available when needed."

"An interesting and important use of the E.A.L.S. by research stations was to obtain material outside their direct fields of knowledge in order to provide a background for possible diversification of their research activities."<sup>4)</sup>

The East African project demonstrates the value of a modest information program.

### VII. Starting a New Information Service

In the past information service developed on ad hoc basis. Many types of services grew often on an unplanned, trial and error basis. It is no longer necessary to repeat the experimentation of the past, if a new service is attempted. Instead the voluminous literature on the subject should be studied to determine methods or suggestions for application to the local situation. A committee should be carefully chosen to conduct a study, review and recommend action. The committee would function as follows:

1. Survey the existing situation
2. Obtain a thorough understanding of the clients needs

3. Assess and evaluate the total needs of the institution to be served
4. State the objectives of the service
5. Outline the program envisioned
6. Prepare a job analysis for the positions
7. Clearly describe the delegation of responsibilities and chain of command as well as the relation of the information service to other departments of the institution
8. Resources, equipment and supplies needed
9. Approximation of financial needs

The funding of an information service is unfortunately a critical factor in starting a new service or maintaining and expanding an old one. For this reason it is essential that those responsible for planning must thoroughly understand the fiscal problems of the institution or institutions involved and that these be carefully weighed and included in the recommendations. In other words, the information service must be in harmony with the ability of the host institution to support the service. If the program adopted cannot provide the clientele with all of its needs, then the information officers must develop cooperative programs with other institutions to attain greater coverage of information.

### VIII. Conclusion

An attempt has been made to provide administrators of institutions which are responsible for providing information services to scientists and technologists with a general view of what such services are, what is needed to achieve these, the needs of scientists and technologists, how information services develop from simple to complex services, and how an institution can start a new information service.

The examples given, hopefully, should illustrate the significance of information services to scientists and technologists. It is generally recognized that laboratories and their equipment are indispensable for the scientist and technologist. This paper has sought to stress the fact that adequate information service is



equally indispensable. Without adequate information service the individual scientist or technologist must spend an extraordinary amount of time in performing the tasks of literature search, review, abstracting, translating, etc., which would deprive him and his institution of the time which should be spent in experimentation and development programs.

- 1) East African Agriculture and Forestry Research Organization. *Report on the East African Literature Service*. The Organization, Muguga, Kenya, March 1969.
- 2) *Ibid.*
- 3) *Ibid.*
- 4) *Ibid.*