National Science Council

of Sri Lanka

Sri Lanka Scientific & Technical Information Centre (SLSTIC)

Information note on the
Activities of SLSTIC
1978

SRI LANKA SCIENTIFIC & TECHNICAL INFORMATION CENTRE (SLSTIC) OF THE NATIONAL SCIENCE COUNCIL OF SRI LANKA.

The National Science Council has expanded its Documentation and Information Division into a Scientific & Technical Information Centre. The basic objective of this Centre, which is designated the Sri Lanka Scientific & Technical Information Centre (SLSTIC) is to collect, process and disseminate information relating to Science & Technology.

SLSTIC fulfils this objective by (a) library resource development (b) coordinating with other libraries and (c) providing information and documentation services.

SLSTIC does not intend to build up a comprehensive collection of books, periodicals, etc. as it would lead to duplication of resources available in other libraries. Instead, it concentrates on subject areas which are not covered by other local libraries in order to fill the gaps in the library resources of the country. Three special subject areas have been identified by SLSTIC for information development, namely, *Science Policy*, *Science Education* and *Environment*. Apart from these collections, SLSTIC endeavours to develop a collection of reference books which are not available in most other local libraries.

With the cooperation of other local scientific and technical libraries, SLSTIC has initiated a National Science Information Network. This network helps SLSTIC as well as other libraries to exchange and transfer information and to share their resources with a view to utilizing locally available information sources in the most economical way. Hence SLSTIC's information and documentation services are not restricted to its own stocks.

Some of the current activities of SLSTIC and the services provided by it to scientific personnel in Sri Lanka are as follows:

Union Catalogue

In keeping with its objectives of coordinating the resources of Sri Lanka libraries, SLSTIC has inaugurated the compilation of a Union Catalogue of Scientific and Technical books in Sri Lanka. This is the first of its kind compiled in Sri Lanka.

At present 20 libraries send information about their new acquisitions to SLSTIC to be included in the Union Catalogue.

This Union Catalogue helps to locate locally available scientific books, promotes inter-library lending, avoids duplication of materials, etc. Additions to the catalogue are published in a quarterly bulletin (Current Science Bulletin) which is distributed among the participating libraries.

Union List of Periodicals

This is a Central Catalogue of Scientific & Technical Periodicals acquired by the libraries in Sri Lanka. Whereas the union catalogue records the book acquisitions, the union list will record the periodicals. This is being compiled and would be issued shortly.

Indexing of Scientific Literature

One of the earliest services started by SLSTIC is the indexing of local scientific literature. The main objective of this service is to record and analyse the national output of scientific and technical literature. The information is issued in the form of a quarterly bulletin – The Sri Lanka Science Index.

SLSTIC's national indexing service is designed to include all forms of published and unpublished documents, giving special emphasis to periodical articles, conference reports, research reports, newspaper articles, etc.

Reports Depository

Work on building up a national depository for scientific and technical reports has been started. This collection includes R & D reports issued by scientific and technical institutions, seminar and conference documents and reports prepared by individual research workers.

SLSTIC has received reports issued by Scientific and Technical Institutions through more than 100 Coordinating officers nominated by the Institutions concerned for this purpose.

Inter-library lending

One of the services provided by SLSTIC to local scientists is lending of reading materials. SLSTIC borrows books from other libraries, too, for the purpose of lending. Requests for inter-library loans should be made by the library of which the requestor is a member. Inter-library lending facilities have been granted to SLSTIC by more than 25 libraries.

Photocopying Services (locally available publications)

SLSTIC undertakes the supply of photocopies of Scientific documents at comparatively low rates. This service includes the location and procurement of the original document for copying. Requests for photocopies could be sent by post.

Photocopy Procurement Service: (documents not available locally)

When the original is not available locally SLSTIC endeavours to procure photocopies from foreign sources. The British Lending Library which holds a vast collection of periodicals and reports has been selected by SLSTIC for obtaining photocopies. Payments can be made to SLSTIC in local currency for this service.

Environmental Information Service

For the benefit of Scientists who are engaged in research and study on various aspects of the environment, SLSTIC has inaugurated an Environmental Information Service. A survey of information requirements to evaluate the interests of individual scientists is being carried out by SLSTIC. These scientists will be supplied with information relating to their fields of interest.

A quarterly, Environmental Acquisitions, is published and distributed among scientists in the relevant fields.

Annual Reports

One of the functions of the information centre is to maintain an organised collection of annual reports of Scientific and Technical Institutions. This collection now consists of more than 500 annual reports of various institutions.

Library Services

Apart from the above special information services, SLSTIC performs the usual library services to its members. Literature searches, compilation of bibliographies, and provision of reference facilities are some of these services.

Publications

SLSTIC prepares several occasional and regular publications. Besides the documents produced by SLSTIC, other Publications of the National Science Council are also available for sale or for reference at SLSTIC. Among them are the following:

(*a*) *Information Bulletins*

Sri Lanka Science Index (Quarterly) (described above)

Current Science Bulletin (Quarterly) (described above)

Environmental Acquisitions (Quarterly) (described above)

(*b*) *Directories*

Directory of Scientific & Technical Personnel – 1974

Directory of Scientific Research Projects 1970–73

Directory of Scientific Research Institutions in Sri Lanka – 1976.

Current Foreign Science Serials in Sri Lanka – 1975.

Sri Lanka Scientific & Technical Periodicals Directory.

Union List of S & T Abstracting and Indexing Services in Sri Lanka libraries.

Directory of Scientific & Technical Libraries in Sri Lanka.

(*c*) *Seminar Reports*

Environmental Management in Sri Lanka
Science Policy and planning
Man & his Environment
Sun-drying Methodology

(*d*) *Periodicals*

Journal of the National Science Council of Sri Lanka (Biannual)
Vidurava (Quarterly)

(12) Future Activities

SLSTIC has planned to undertake the following tasks in the future:

(*a*) *Patent Procurement Service* – to supply foreign patents and patent literature at the request of libraries and individual scientists.

(*b*) *Procurement of translations* – to obtain translations of scientific and technical articles in foreign periodicals on request.

(*c*) *Panel of translators* – to appoint a panel of translators who would undertake translation of scientific documents.

(*d*) *Audio-visual services* – the centre will collect audio-visual material which will be accessible to other libraries.

(*e*) *Training Service* – the centre will provide in-service training for library personnel.

FOR FURTHER PARTICULARS
COMMUNICATE WITH

The Librarian,
National Science Council of
Sri Lanka,
47/5, Maitland Place,
Colombo 7.

Phone: 96771

Distribution : Limited

PGI/Symp. IAC/SRL/I/1
Paris, August 1978
English only

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NATIONAL SCIENCE COUNCIL OF SRI LANKA
AND
UNITED NATIONS EDUCATIONAL,
SCIENTIFIC AND CULTURAL ORGANIZATION

Symposium on Information Analysis and Consolidation

Colombo, Sri Lanka, 12-15 September 1978

AGENDA

1. Opening by the Secretary General of the National Science Council
2. Election of chairman, vice-chairman and rapporteur
3. Adoption of workplan
4. Review of the discussions and recommendations of the first meeting of the UNISIST Working Group on Information Analysis Centres
5. Review of information analysis activities in the developed and developing countries
6. The role of the information analysis centre in the national information system and its regional and international responsibilities
7. The role of the information analysis centre in socio-economic development
8. Discussion of the "UNISIST Guidelines for Establishing and Operating Information Analysis Centres"
9. Action plan for development of information analysis centres
10. Adoption of the report of the meeting
11. Closure.

Distribution : Limited

PGI/Symp. IAC/SRL/I/2
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NATIONAL SCIENCE COUNCIL OF SRI LANKA
AND
UNITED NATIONS EDUCATIONAL,
SCIENTIFIC AND CULTURAL ORGANIZATION

Symposium on Information Analysis and Consolidation

Colombo, Sri Lanka, 12-15 September 1978

ANNOTATED AGENDA

2. Election of officers

The chairman, the vice-chairman and the rapporteur of the Symposium will be elected.

5. Review of information analysis activities in the developed and developing countries

Under this item, information analysis activities carried out at various information analysis centres and information analysis units of research institutions in the world will be reviewed on the basis of a special working document prepared for this item (PGI/Symp. IAC/SRL/I/3). Discussions following this review will focus on:

1) identification of the characteristics of existing information analysis centres,

2) identification of existing gaps in information analysis activities.

The representative of IDRC may report on their projects on information analysis.

6. The role of the information analysis centre in the national information system and its regional and international responsibilities

A working document will be prepared for this agenda item (PGI/Symp. IAC/SRL/I/4).

Under this agenda item, the specific role of the information analysis centre in the information transfer chain will be discussed. In relation to this, such topics as coordination of information analysis activities with other information services, cooperation between information analysis centres at the national, regional and international levels will also be discussed.

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7. The role of the information analysis centre in socio-economic development.

The aims of this item are to discuss on the socio-economic aspects of the establishment and operation of information analysis centres, to find ways and means of creating efficient information analysis centres with a view of serving the socio-economic development of a country, and to discuss problems in management of information analysis centres (Reference : Working document PGI/Symp. IAC/SRL/I/5).

8. Discussion of the "UNISIST Guidelines for Establishing and Operating Information Analysis Centre"

Draft Guidelines have been revised incorporating the comments received from a number of experts. This revised draft will be studied prior to the Symposium and comments on the Guidelines will be made by the participating experts at the meeting. Then the draft will be reviewed, chapter by chapter, in view of finalizing it.

9. Action plan for development of information analysis centres

On the basis of the preceding discussions, a future plan of action at the national, regional and international levels will be discussed and formulated. Among others, the following topics will be of interest:

1) sensibilization for planners and decision makers of the importance of information analysis centres for socio-economic development of a country,

2) possibility of formulating a general model of an information analysis centre especially for developing countries,

3) possibility of the implementation of a pilot project on information analysis (Recommendation 9 of the UNISIST Feasibility Study),

4) needs for a technical manual on the analysis of information and documents,

5) manpower needs and training of information analysis specialists.

10. Adoption of the report of the Symposium

The report should be drafted during the meeting incorporating problems raised, views expressed and solutions suggested by the participants during the meeting. The report may include proposals for future actions to be taken by Unesco and Member States in the form of recommendations.

MEETING OF EXPERTS ON INFORMATION ANALYSIS AND CONSOLIDATION

COLOMBO SRI LANKA

12 - 15 September, 1978

List of Participants

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Secretary for Higher Education, Vice-Chairman, National Science Council of Sri Lanka.

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SYMPOSIUM ON INFORMATION ANALYSIS AND CONSOLIDATION

Colombo, Sri Lanka: 12 - 15 September, 1978

1. INTRODUCTION

The Symposium on Information Analysis and Consolidation was held at the Bandaranaike Memorial International Conference Hall (BMICH), Colombo, from 12 to 15 September, 1978. It was organized by UNESCO in collaboration with the National Science Council of Sri Lanka. The participants were experts invited by UNESCO in their personal capacity, having knowledge and experience of the subject under discussion.

The Symposium had been preceded by a meeting of the UNISIST Working Group on Information Analysis Centres held in Paris in November 1978 set up in accordance with the recommendations of the UNISIST Advisory Committee. However, following the establishment of the General Information Programme at UNESCO into which UNISIST has now been incorporated, and the initiatives of the United Nations, Specialized Agencies and other international organizations in the field of information, it was considered appropriate that a fresh look be taken at the question of information analysis and consolidation both with a view to an appreciation of the overall situation and trends in this important field and to assessing its possible impact on socio-economic development. The meeting was therefore organized for this purpose and was expected to provide appropriate guidelines for the organization and operation of centres for information analysis and consolidation functions, and to suggest methods for activating policy makers, purveyors and users of information. At this Symposium it was expected that a special emphasis would be placed on information consolidation activities for the benefit of the rural sector, both in the agricultural and industrial fields.

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2. INAUGURATION

The meeting was inaugurated by the Honourable C. Cyril Mathew, Minister of Industries and Scientific Affairs.

Professor E.O.E. Pereria, Chairman of the National Science Council, speaking next, focussed attention on some of the striking scientific discoveries and inventions of recent times, underlining the significance of science to the improvement of human life. Access to scientific knowledge was therefore vital if present socio-economic problems were to be solved.

Prof. F.S.C.P. Kalpage, Secretary for Higher Education spoke of the vast production of scientific and technical literature and the necessity for having effective systems for consolidation. He considered that the Symposium was a timely one and expressed his appreciation to UNESCO for having given attention to this problem.

The representative of UNESCO explained that the Symposium was being held in accordance with Recommendation 9 of the UNISIST Feasibility Study and traced its link to other activities being carried out by UNESCO under its UNISIST Programme.

INAUGURAL ADDRESS

Mr. Chairman, distinguished guests, Ladies & Gentlemen,

I consider it a honour to be invited to deliver the inaugural address at this international symposium on Information Analysis and Consolidation, which is co-sponsored by UNESCO and the National Science Council of Sri Lanka. As I understand, this symposium is primarily meant to be a forum of discussion for experts in the fields of information management, with the objective of identifying and defining the needs and problems in information analysis and consolidation at policy level. This is therefore a very important Conference and the choice of Sri Lanka as the venue is significant specially in the light of assistance pledged by UN agencies to strengthen some of Sri Lanka's Scientific and Technological Information Centres to meet national and regional requirements.

Sri Lanka is a Democratic Socialist Republic and enshrined in her new constitution are the fundamental rights and privileges which her people shall enjoy. We have taken adequate safe-guards to ensure that the people of this country shall not be deprived of the freedom of speech and expression. There are also no barriers to sources of information.

In each country, the most valuable information is the information produced within its own territory, as a response to the national needs and priorities. Consolidation and dissemination of such information should therefore form a vital segment in the processes of development planning.

Like most developing countries Sri Lanka has focussed her attention on technology. Our attention has also being drawn to the question of transfer of technology and its impact on development. In this context it has to be realised that unless favourable terms and conditions exist to the acquisition of scientific knowledge and material, we cannot conceive of a process of development through adaptation of technology.

Contd.. 2/

Adaptation of technology does not mean that the processes should be reinvented from scratch, but that the creative effort has to be developed through the full utilization of available knowledge. It is therefore a pre-requisite that developing countries should have full access to scientific and technological information. In fact transfer of appropriate information should be a complementary requirement in a package deal for the transfer of a technology.

However, as it is often said, more information does not necessarily mean better information. There should be the skilled manpower and equipment for extraction, evaluation and transformation of information to cater to the needs of a variety of consumers.

Finally, we should strive to develop the means by which information could be disseminated most effectively not only to the scientists, technologists, planners and decision makers, but also to industrialists and farmers, in the form that these could be best utilized.

While hoping that the deliberations at this symposium would lead to a better interpretation of systems of information management policy, may I urge this conference to seek solutions to the problems of ensuring scientific and technological information at cut-price rates to developing countries as a means of bridging the technology gap with the developed states. I now declare open the sessions of the symposium.

UNISIST

September 1978

Working paper for items 6 and 7 (guidelines for discussion)

1. The outcome of the discussion on items 6 and 7 should be addressed to planners and policy makers both in ministries and international aid organizations, with the following three objectives :
   (a) sensitize planners and policy makers to the importance of information analysis centres (IACs) for the countries' socio-economic development ;
   (b) offer some suggestions on how to determine the need for strengthening the existing IACs or creating new ones ;
   (c) in case an action should be taken, offer further suggestions on how to start that action at policy making level.

2. The enclosed draft is a first attempt to reach these three objectives. It only presents the basics on which most experts agree today. Alternatives and complementary suggestions are to be presented by all participants. Both the draft and these complementary comments are to be discussed during items 6 and 7.

3. Among the main topics to be discussed are as follows :
   (a) in the framework of this report, a review of the main arguments which could sensitize policy makers to the importance of IACs for development ;
   (b) the place of this report among other means which could sensitize policy makers ;
   (c) the means of deciding in which socio-economic fields, support of IACs should receive priority attention ;
   (d) the means of defining what types of IACs are needed (user-oriented or source-oriented) ;

(e) the means of defining at what geographical level should IACs be created or strengthened (national, regional or global) ;

(f) the means of defining to what sort of institution (if any) should a IAC be attached ;

(g) the links between IACs, other information sources or services and users ;

(h) the scope for international co-operation

Enclosure : Role of information analysis centres in development.

PGI/Symp. IAC/SRL/I/4
PGI/Symp. IAC/SRL/I/5

UNISIST

ROLE OF INFORMATION ANALYSIS CENTERS IN DEVELOPMENT

SOME PRACTICAL IMPLICATIONS FOR POLICY-MAKERS

(summary)

UNESCO

August 1978

This brochure is addressed to national and international policy-makers who are confronted with the dispersion of useful information, and feel the need for corrective action.

CONTENTS

INTRODUCTION

1. Users of information, from entrepreneurs to policy-makers, from educators to scientists, are faced today with a considerable increase in the volume of information. Information analysis centers*1 (IACs)*2 are the organizations responsible for reviewing, evaluating and compressing relevant papers in order to provide definite user groups with concise and reliable bodies of knowledge.

2. The aim of this paper is to help policy-makers determine how IACs can be practically used to solve certain socio-economic problems. It will therefore consider the role of IACs in socio-economic development, their place in national and international information systems, and an action plan at policy-making level for their development.

3. Although IACs are of interest to all countries, special emphasis will be given to the concerns of those countries most in need of information, the developing countries. "These nations know that if they are to catch up with the more developed nations of the world, they have to bootstrap themselves by using all available knowledge ; they do not have time to repeat the past. Information is the key to rapid economic and social development"*3.

4. This paper will therefore concentrate on the type of IACs that will directly serve social and economic progress, that is, in particular, those concerned with information on management services, market research, sales promotion, and production methods in agriculture and industry. It will give special attention to practical information on how to solve problems, that is to elaborate know-how rather than basic numerical data.

5. Because of this emphasis, the whole range of the IACs' functions will not be systematically considered. So called "analysis" operations include in fact all operations allowing to express document content in a form different from the original, for example translating, indexing, abstracting, extracting, and consolidating. This paper will concentrate mainly on the key function for final application, the consolidation of information which includes two steps :
- evaluation of information, that is testing the reliability or gauging the quality of scientific and technological information ;

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1. See glossary, p. 13. 2. See abbreviations, p. 15. 3. References are presented in the full version of this report.

- compression of information, that is, merging and synthesis of scientific and technological information on a given subject in the form of handbooks, compendia, state-of-the-art reports, etc.

THE PROBLEM

6. Consider the example of highland farmers in a tropical zone who are facing the following situation. The rice crop is failing in the area, while, around this area, rice yields are doubling. The cause for the failure is low nutrient soil, so the responsible extension officer sets off to do some research on fertilizers. He finds over 600 pages spread through 70 publications written in the last two years on rice fertilizing in his area or in comparable areas. Overwhelmed with the quantity of information, he does not know where to begin, picks a few articles to study, and hopes he makes the right choice to solve his problem. What he really needs is a synthesis of the most reliable recommandations in his field. This information could be consolidated for him in one publication of probably less than 10 pages.

7. On the whole subject of rice, over 26,000 pages are printed a year : they are spread through 2,700 publications, including 2,000 periodicals. Of these, around 15,000 pages contain bits of information of interest to the rice grower. Obviously no rice grower or extension officer could possibly go through such a mass of information, the equivalent of 80 books per year (see figure 1, p. 3).

8. This sort of situation is widespread. In the USA, where the publication rate is already high, the number of science and technology (S & T) book titles published has gone from 3,400 in 1960 to 14,400 in 1974 (with a particularly sharp increase from 750 to 6,600 in the field of sociology and economics). In the world, the number of world S & T journals published has gone from 18,800 in 1960 to 49,400 in 1970. In the late 1960s. 60 million pages of S & T literature were published per year, and this amount doubles every 10 to 15 years. This enormous increase can be well understood when one recalls that 90 % of all scientists and technologists who ever lived are alive and at work today.

9. Expansion of information resources is not a mere academic phenomena. It goes hand in hand with economic development. Information, together with energy,

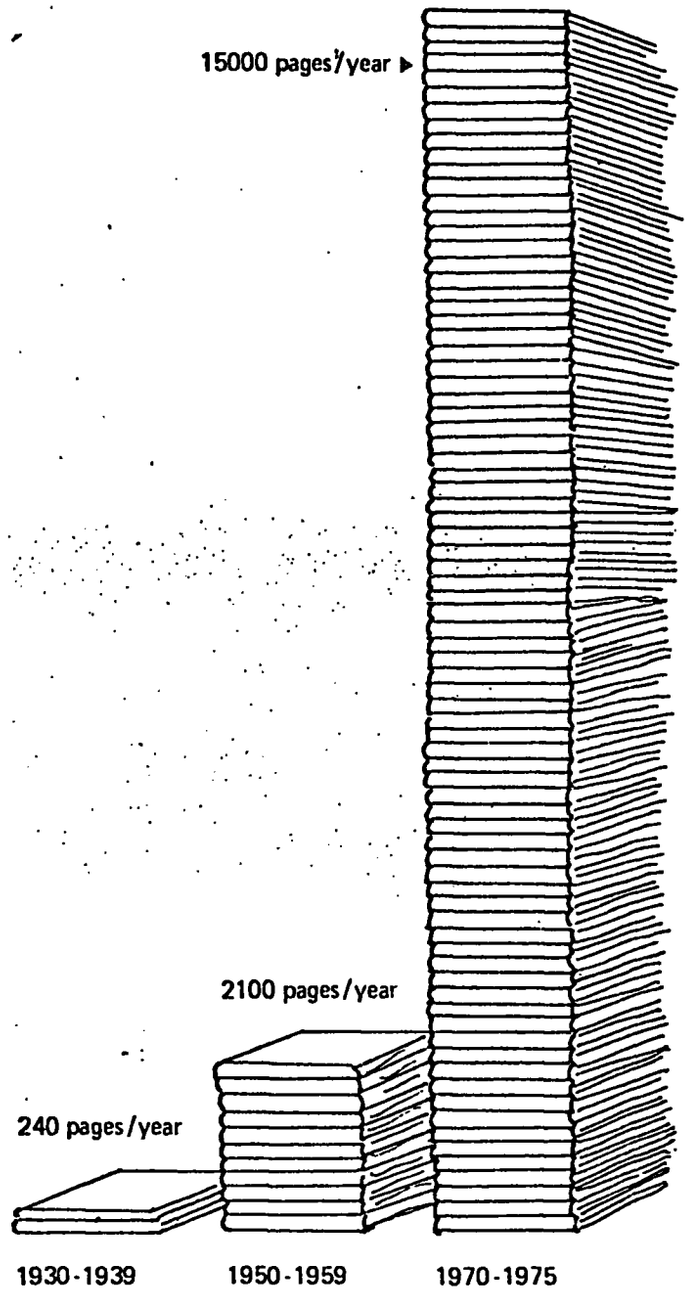


Figure 1. An example of the information explosion : increase in the volume of information of interest to the rice-grower (in pages published on the average per year).

raw material equipment and capital is now recognized as one of the five pillars of production. In 1900, the majority in the American civilian labour force was still rural ; "knowledge industries", which produce and distribute ideas rather than goods and services, accounted for 1/12 of the US gross national product. In 1980 at the latest, "knowledge workers" (professional, managerial and technical workers) will be the majority of the Americans at work ; and knowledge industries will account for 1/2 of the gross national product.

THE SOLUTION

10. In the example considered above, an extension officer is overwhelmed with the quantity of information relevant to a fertilizer problem. Let us consider the alternative. A strong IAC would be able to work on all the knowledge on this particular fertilizer problem, as well as on complementary knowledge gathered from the immediate area and from other countries with the same or similar problems. It could prepare one or several consolidated studies, for example, in the form of a handbook. The extension officer who initiated the studies would have the reliable recommendations he needed in a form he could use. This consolidation service of the IAC would have, however, more widespread effects than solving a small area's immediate problem : the results of the studies could be applied to many other areas which have, or might develop, a similar problem.

11. For practical quantitative example of what information consolidation can achieve, let us consider the results of interest to rice growers spread through some 15,000 pages, that represent the equivalent of 80 average books. The content of particular interest to farmers could be reduced through information consolidation to about one average book.

12. The analysis of this example allows to outline three aspects of the role of information consolidation in development.

13. The first aspect of this role is to facilitate the introduction of innovations, in particular through avoiding the possible confusion due to a variety of recommendations. The economic benefits obtained can be due to one or all of the following changes :

- the start of a new production line ;
- an increase of current production levels ;
- a reduction of production costs.

14. The costs of introducing the innovation must of course be subtracted from these benefits. Social effects, whether positive or negative, should also be taken into account.

15. The second aspect of the role of information consolidation is to save the time which highly educated professionals spend searching for information. It is usually recognized that these professionals spend at least 20 % of their time searching for the information they require for research, advisory work, production or policy-making, etc. Less than one sixth of this time will be spent over consolidated information.

16. The third aspect of the role of information consolidation is to replace large expensive collections of primary literature through smaller collections of consolidated information. It allows countries with limited resources to avoid buying most of the increasingly expensive primary literature. This aspect, however, has only a limited economic impact.

17. To achieve these benefits, IACs could be set up to serve several developing countries with similar needs. The minimum staff for effectiveness would be approximately four professionals, preferably recruited from the countries served. Depending on regional fluctuations in costs, routine operations could be covered by 60,000 to 200,000 US dollars per year.

18. The profitability of a IAC serving agricultural and industrial enterprises must be determined for each individual case. One general prediction can be made however, based on experience acquired in developed countries. Information consolidation can be highly profitable whenever the two following circumstances are found :

- a large under-producing sector of small and medium enterprises ;
- the necessary national infrastructure to promote the use of consolidated information.

19. Already today, information consolidation is playing a particularly vital role in agriculture and industry where valuable information exists, but needs to be gathered, evaluated, compressed and put to practical use. From 1960 to 1970, information consolidation, among other factors, helped to attain a 30 % rise of rice yields in the Philippines, and a 100 % rise of rubber yields in Malaysian small-holdings.

PLACE OF INFORMATION ANALYSIS CENTERS IN NATIONAL AND INTERNATIONAL INFORMATION SYSTEMS

20. Information can be compared to a manufactured product. It has to be produced, stored, processed, packaged and distributed before it can be of use. Figure 2, p. 7, is a graphic representation of how the main information functions and institutions would appear in analogy with a large manufacturing enterprise.

21. The function "information consolidation" corresponds to processing in a traditional manufacturing enterprise. Consolidated information is the condensed product prepared for information wholesalers such as researchers or chief extension officers. It is "repackaged", that is rearranged into pamphlets, films, radio-programs, etc., to answer the requirements of retailers such as the extension agent, or end-users such as the farmer.

22. Information consolidation is usually carried out by scientists, closely assisted by documentalists and librarians. In the agricultural and industrial fields, the consolidation function is usually scattered throughout research organizations. It was only recently that specialized institutions, called IACs, were established to undertake the information consolidation function in combination with other "analysis" operations.

23. Approximately 200 autonomous IACs, who fully answer the definition indicated in the glossary, exist in the world today. A large number of them are located in the USA and serve advanced scientific communities. Recently, IACs of special concern to developing countries were established in various part of the world. The Cassava Information Center in Colombia and the International Irrigation Information Center in Israel are examples of this trend.

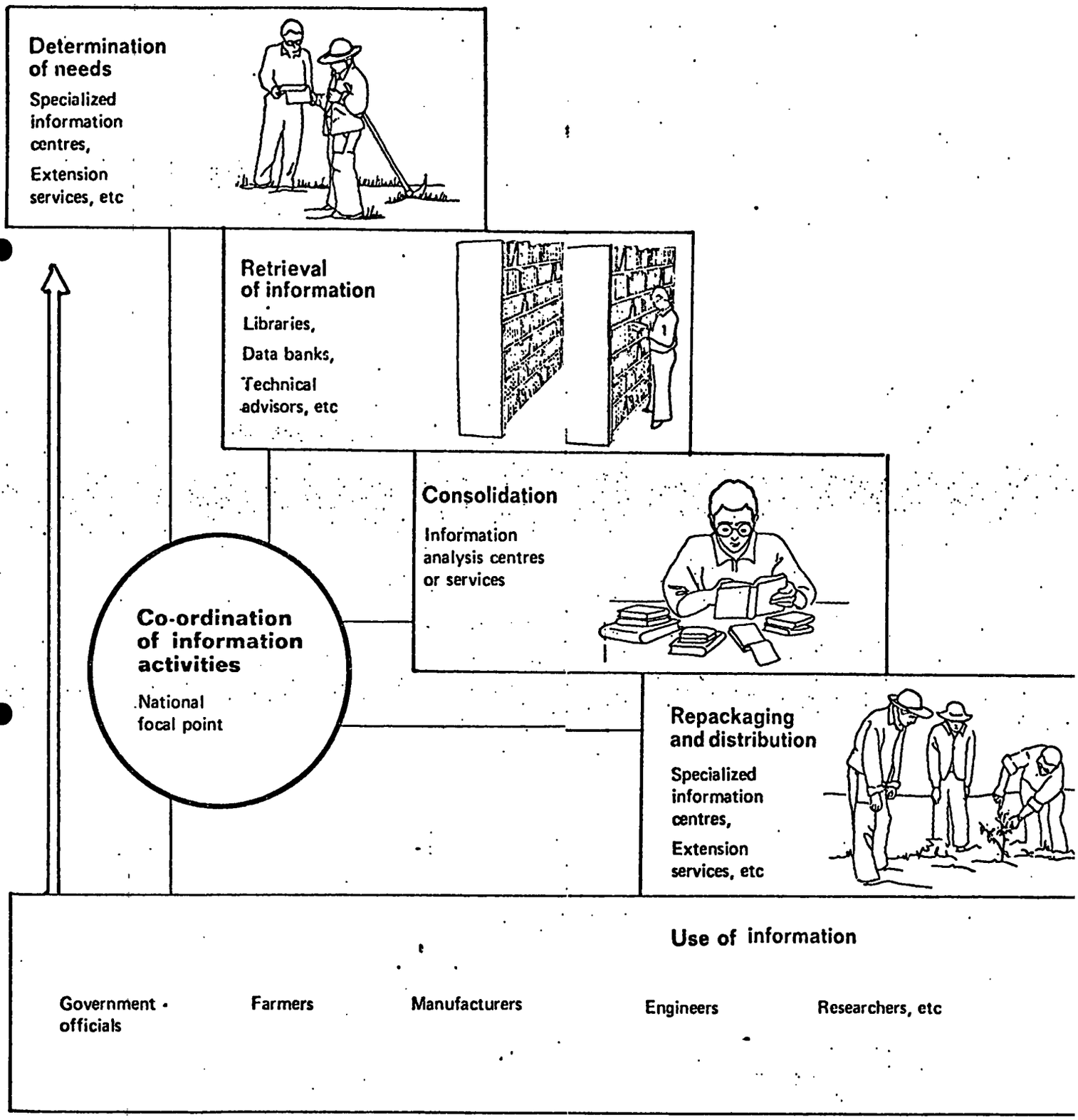


Figure 2. Place of information analysis centers in a national information system (for a more accurate and precise representation, see p. 10-12).

24. Besides there are a considerable number of "dependent" IACs scattered throughout research institutes, professional technical centers and extension services. Unfortunately, in these dependent IACs, the consolidation function usually remains an ill-defined and temporary function.

SUGGESTED PLAN OF ACTION FOR THE DEVELOPMENT OF IACs

25. The need for information consolidation is felt in most economic and social sectors. Unfortunately, the structures for implementation are rarely existant. Policy-makers are therefore usually the ones to explore the potential of information consolidation for given sectors of their country, and to initiate action.

26. Their first step will normally be to appoint the national authority that has the best knowledge of the technological needs of end-users, and if possible, of the country's research and information resources. In case of doubt on the best course of action, policy-makers may prefer to first ask assistance through international or bilateral aid (see paras. 29 to 32).

27. The appointed authority will determine the measures best adapted to link the country's resources with existing IACs, or, if necessary, to develop a IAC in cooperation with other countries. He will usually operate in the framework of the national system's focal point (see figure 2, p. 7), whenever this focal point has been established.

28. More detailed information on how and where to begin is presented in the full version of this report.

ASSISTANCE IS AVAILABLE

29. At national and international levels, UNISIST, the intergovernmental program within Unesco for co-operation in the field of scientific and technological information, promotes the development of the information consolidation function, and therefore of IACs. This is being implemented through comparative studies on existing IACs, through the development of generally accepted guidelines for the establishment and the running of IACs, and through advice and cooperation on specific IAC projects.

30. A first need of all countries is to know where to obtain consolidated information. UNISIST may promote the creation of an updated file of all IACs, which could become the basis for the world referral centre on IACs.

31. If no IAC is available, United Nations agencies can assist in developing regional or global IACs in their respective fields of competence. For example, FAO, with UNDP financial assistance, can help with the development of a regional IAC assisting agriculture. In the same way, UNIDO can help in the industrial field.

32. Sources of foreign assistance can also be found through bilateral aid, international organizations and private foundations. The International Development Research Centre (IDRC), for example, has already assisted with the establishment of IACs directly serving developing countries.

ANNEX 1. THE INFORMATION TRANSFER CHAIN

There is a great variety of information flow patterns presented in the literature. This variety is often due to the fact that the different authors are refering to information flows belonging to various fields. Within a given field, information flows follow rather consistent patterns. What may differ from one country to another is the degree of development of the various functions that lead to the users' satisfaction (in some cases the function, and even the awareness of the function, may be missing). The names of the institutions in charge of performing the various functions may differ. But, whether performed or not, the basic steps within a given field are always the same.

These basic information patterns, whose sum compose the national information system, are presented in tables 1, 2, and 3. We are here in the ideal situation where all basic steps are well differentiated, whatever is the field. Such a situation is rare. In many countries, some functions may be missing in a number of fields; this is often the case for function 1 (determining users' needs) and 3 (consolidating available information). There is also the situation where the function is performed informally by an individual or a group of individuals, and not by a specialized institution; this is often the case for function 3 that, today, usually does not involve the interference of the specialized institutions called information analysis centers.

The specialized information systems described in tables 2 and 3 are coordinated at national level by the so-called focal point of the national information system (see table 4). Here again, we have described an ideal situation. Number of the coordination functions may be either missing or informally performed by an individual. In 1978, countries had officially designated their national focal point. UNISIST, the intergovernmental programme within Unesco for co-operation in the field of scientific and technological information, assists the coordination between national information systems, international information systems and international organizations.

TABLE 1. MAIN FUNCTIONS OF A NATIONAL INFORMATION SYSTEM*1 (see corresponding institutions in tables 2 and 3)*2

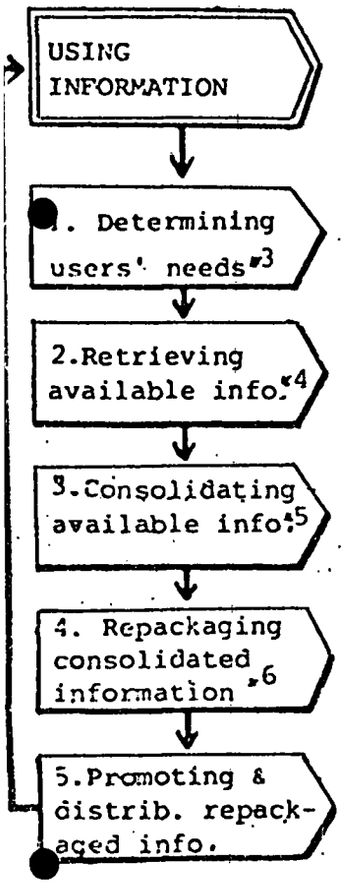


TABLE 2. MAIN INSTITUTIONS OF THE AGRICULTURE INFORMATION SYSTEM (see corresponding functions in table 1)*2

End users	Intermediary users		
FARMERS	POLICY-MAK. PLANNERS	RESEARCHERS SCIENTISTS	STUDENTS EDUCATORS
Extension services	Institute statistics	Scientists	Schools
Libraries	Libraries	Libraries	Libraries
Info. analysis centers	Info. analysis centers	Info. analysis centers	Info. analysis centers
Extension services	Institute statistics	Scientists	Schools
Extension services	Institute statistics	Scientists	Schools

TABLE 3. MAIN INSTITUTIONS OF THE HEALTH INFORMATION SYSTEM (see corresponding functions in table 1)*2

End users	Intermed. users
COMMON MAN	(see table
Doctors	
Libraries	
Info. analysis centers	(see table
Doctors	
Doctors	

1. Most specialized information systems of the national system will follow the model of table 2. In some cases, the end user may be a professional man as in the industry information system for example. In others, he may be anyone, as in the meteorology information system for example.

2. To simplify tables 1, 2 and 3, the various aspects of the coordination functions have been represented in another table (see table 4) .

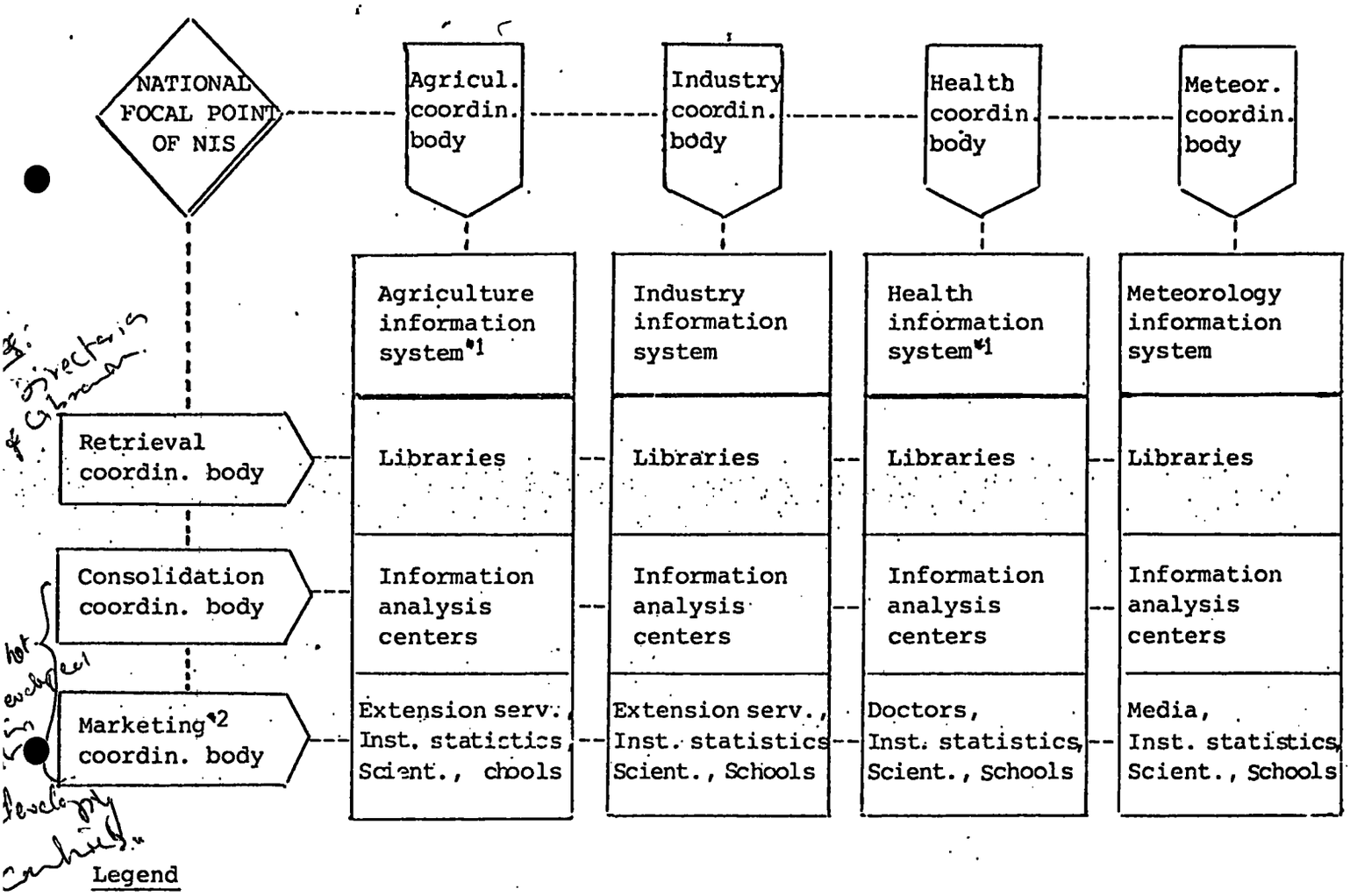
3. Accompanied by the function "evaluating the results of the information operations", once a first cycle 1 to 5 has been completed.

4. Preceded by the function "storing, indexing, and abstracting information from various sources, particularly research institutes", and accompanied by the function "storing information on users' needs".

5. Followed by the function "storing consolidated information".

6. Followed by the function "storing repackaged information".

TABLE 4. COORDINATION BODIES OF A NATIONAL INFORMATION SYSTEM (NIS).*1



Legend

coordination bodies of the specialized systems, that is the mission-oriented systems (following the vertical columns)

coordination bodies of the function-oriented systems (following the horizontal lines)

focal point of the national information system (NIS), that is the overall coordination body.

----- coordination links

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1. To simplify table 4, only a few of the specialized information systems coordinated in the framework of a national system have been represented, and their representation has been summarized. The detailed functions of these systems can be found in table 1, and the detailed institutions of the agriculture and health information systems in tables 2 and 3.

2. The term "marketing" covers the following functions: a) determining users' needs; b) repackaging; c) promoting and distributing.

ANNEX 2. GLOSSARY

Warning. Technical terms are used in this report in their most simplified acceptation. The original definitions, most of them from the UNISIST glossary or publications, are therefore sometimes adapted without ever changing the basic meaning.

1. Compression : the merging and synthesis of scientific knowledge on a given subject (see consolidation).

2. Consolidation (as applied to know-how) : the use of evaluation and compression to produce compendia, state-of-the-art reports, handbooks, etc., of considerably less volume than the original literature (in the proportion of at least 60 to 1, reaching often 400 to 1), without losing relevant substance ; scientific articles include partial consolidation as they take into account previous works on the same research topic. A consolidator working for agricultural extension officers, for example, will evaluate the various scientific articles that contain information of practical value to farmers, will select the reliable ones and will deal with contradictions and duplications.

3. Consulting firm : any company or organization which makes a business of giving professional advice to specific groups of users.

4. Documentation center : an organization that : 1) selects, acquires, stores and retrieves specific documents in response to requests ; 2) announces, abstracts, extracts, indexes documents ; 3) disseminates documents in response to requests for documents or for content (Unesco).

5. Evaluation : testing the reliability or gauging the quality of scientific information and data (see consolidation).

6. Extension service (also called liaison/advisory service) : body of professional people who, working under or in cooperation with the government, provides technical advice to specific groups of users on a non-remunerative basis (government officials, technical experts from universities, etc.). Extension officers are also called liaison/advisory officers, or information officers.

7. Focal point : the coordinating body of any set of interrelated information institutions and men.

8. Information analysis center.
- 8a. Summarized definition : the organization responsible for the combined use of translating, reviewing, evaluating and compressing to provide definite user groups with consolidated bodies of knowledge.
- 8b. Detailed definition : formally structured organizational unit, specifically (but not necessarily exclusively) established for the purpose of acquiring, selecting, storing, retrieving, evaluating, analyzing and synthesizing a body of information and/or data in a clearly defined specialized field or pertaining to a specified mission with intent of compiling, digesting, repackaging, or otherwise organizing and presenting pertinent information and/or data in a form most authoritative, timely, and useful to a society of peers and management.
- 8c. Extended definition : any unit, independent or within an organization, carrying out the function of an information analysis center (see 8b).

9. Library : an organization which collects, stores and makes available for use books, periodicals and similar materials.

10. National information systems : the specific sets of existing interrelated institutions and men which provide users with the data and know-how relevant to their changing needs and activities, in accordance with national goals (these sets can be mission or function-oriented) ; used in the singular, the expression "national information system" refers to the total of all interrelated institutions and men dealing with information in the country.

11. Primary form : knowledge in primary form is usually contained in the original research reports. Its main value is for the researchers. It has normally to be extracted, consolidated with other pieces of knowledge, and eventually repackaged before it can be applied by entrepreneurs or policy-makers (see "secondary form", para. 13).

12. Repackaging : a rearrangement of information materials obtained from different organizations into information services or products tailored to the requirements of special need-groups. A repackager working for illiterate farmers, for example, will transform consolidated material into cartoon strips, radio programs or films, that will appeal to the end users.

13. Secondary form : knowledge in secondary form is built from knowledge in primary form as described in para. 11 ; handbooks are a good example of such consolidated and repackaged knowledge. Knowledge in secondary form is useful to all categories of knowledge consumers (entrepreneurs, policy-makers, etc.), and not only to research men.

ANNEX 3. ABBREVIATIONS

1. FAO : Food and Agriculture Organization of the United Nations.
2. IAC : information analysis center.
3. IDRC : International Development Research Center.
4. UNDP : United Nations Development Programme.
5. Unesco : United Nations Educational, Scientific and Cultural Organization.
6. UNIDO : United Nations Industrial Development Organization.
7. UNISIST : United Nations Educational, Scientific and Cultural Organization.

SURVEY OF INFORMATION ANALYSIS INSTITUTIONS AND ACTIVITIES IN THE DEVELOPED AND DEVELOPING COUNTRIES (STATE OF THE ART REVIEW)

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INTRODUCTION

Information analysis centers represent a relatively new type of information handling agency for science and technology. Although its roots are embedded in the tradition of certain nineteenth-century scientists who attempted to bring order in the ever-growing flood of data, this new approach of evaluating and and making the results of research conveniently available to colleagues or the interested public, appeared formally only during the last twenty years.

The centers keep changing their methods of operation and exhibit wide differences among each other. The ultimate format probably has not yet been reached, as the center did not reach the level of maturity of other links in the information-transfer chain, such as the scientific journal or the abstracting/indexing service. In particular, the rapidly developing computing technology affects deeply their methods. However, in spite of this variety of expression, the information analysis centers present certain common characteristics. The concept is misunderstood primarily because these common characteristics are overshadowed by technological improvements.

The term *information analysis center* has indeed been used fairly loosely and it may designate a variety of services. The first thing that comes to the mind of people is a telephone information service which does deliver rapidly a highly specific information, the telephone number of the desired person, culled from the list of possibly millions of subscribers. Another common meaning of the term is the railway or airline central office which supplies information about departing and arriving trains, types of service and cost. These centers often exhibit the trappings of modern technology: at certain larger railway stations in the Federal Republic of Germany the inquiring passenger is invited to type in the place where he wants to travel, whereupon the central computer prints out all information about the trains departing within the next three hours, indicating where he has to change

for another train, and giving him the cost of a one-way or round-trip travel. Wheather bureas maintain an around-the-clock service, advising inquirers whether there is sufficient snow for skiing, whether the atmospheric conditions are suitable for flying or taking out a small craft; they stop short telling the fishermen whether the fish is biting that day.

All these agencies provide a necessary, often ephemeral information; they fulfill an important mission but they do not satisfy the criteria for an *analytical* center: they do not analize the data. One of the chief characteristic of an information analysis center is that the material entered into the system is not necessarily the same as the output: it is not enough to have sophisticated machines which find in a flash the desired phone number, the weather forecast or the availability of a tourist ticket for a given flight, as entered into the system previously; rather, in the case of a true information analysis type of activity, there is a stage, at which the material is evaluated by an expert. His contribution may be negative: the output might be an evaluated bibliography which could be much shorter than the list automatically retrieved by the search program; similarly, the abstract prepared by the abstract eliminates most of the verbiage or unimportant portions of the paper. The eliminated portion may vary according to the mission of the paper: an experimentalist user of the material is not very much interested in theoretical derivations or in the economic justification to management concerning the work performed.

I do not want to imply that the above-mentioned services are not important but would like to emphasize that an information analysis center and its special form, the data center, rquires the work of a "human" expert to evaluate the material before transmitting the findings to the inquirer. It is also assumed that the human expert is guided by the highest principles of scientific impartiality: an "information center" established by a chemical plant or a power station for the purpose to entertain or to "educate" the public about the beneficial effects of that palnt or station on the environment that it shares with its neighbors, cannot be classed as a true information analysis center because its motives and its scientific independence may be questioned.

Admittedly, the boundaries are not always clear. During the compilation and editing of the *Directory of the Federally Supported Information Analysis Centers* [1], a listing of the centers established with the direct or indirect assistance of the federal government of the United States, considerable discussion arose among members of the editorial board about the suitability of centers proposed for inclusion. Persons who opposed the designation of a given center as a true analytical center, emphasized the lack of human effort, the absence of subject specialists (as opposed to information experts, programmers, microfilming technicians or just plain management people) in the preparation of the output. The difference of opinion, which according to the popular saw makes horseracing possible, was very obvious and for that reason, the number of centers which would satisfy all the judges of a strict admission committee would be rather small. This is the reason why the boundary is deliberately kept unsharp. Many information-handling agencies covet the recognition as an information analysis center.

The importance of a specific delimitation of the field of an analytical center has been recognized by C. Schäfer, author of the UNISIST study report on the role of information analysis centers [2]. I do believe that such sharp distinction is justified and desirable but various external pressures force the compilers to disregard occasionally their own criteria.

INDUSTRIALIZED COUNTRIES

Economic Problems

In the industrialized countries the information analysis center concept continues to receive attention from both the technical communities that the centers serve and also from the funding agencies or host organizations ehich provide the practical means for their existence. Although the literature does not reflect disappointment with the overall technical performance of the centers, financial considerations became more important during the last few years.

In collaboration with J. D. Cape, I examined the economic problems of information analysis centers in light of the then prevailing budget restrictions [3]. It was concluded that the actual cost of the output, especially that of "custom-made" material, such as selective dissemination of the listings, answers to individual requests, etc. should be charged to the first requestor and made available later to eventual subsequent users at a reduced rate. However, in calculating the price to be charged for the product, the input costs should not be taken into account because they represent the primary

information transfer function, the raison d'être of the center and should be considered as the center's contribution to the discipline that it serves.

The economic problem continues to remain alive and to attract increasingly sophisticated treatment. In their article, R. M. Mason and P. G. Sassone [4] describe an economic modeling method to evaluate the costs and benefits which are associated with providing information services by means of information centers; a framework was developed for integrating the demand for technical information with basic economic principles. The resulting models make it possible to estimate the lower bound on benefits and to calculate net benefits (benefits less costs). The same authors were also among the research contributors to a National Science Foundation study project on the same subject [5]. In the final report of that project, it was recommended that the information analysis center managers continue to review their accounting systems and to ensure a meaningful and consistent allocation of major cost items, including professional staff time, to particular service or product outputs. Additional research should be devoted to the development of an improved understanding of the perceived benefits and values attributed to the services of the center. The mathematical formulation of optimum service levels indicates two optimal solutions: one from the soicety's, and one from the manager's viewpoint. There is potential incompatibility between incentives for the information analysis center manager andsocially ideal investment in the center's services.

Economic scrutiny of information-handling activities actually became increasingly important at the beginning of this decade. Some people argued that it is not possible to assign a realistic cost to information; others held that information is a utility that should be generally available and paid for as an overhead item. The reason for this interest in economics was the tightening of the budgetary situation on one hand, and the increasing involvement of information processing with the expensive computer hardware, on the other hand. Even after the purchase of capital items, operation of the complex systems requires continued outlay of funds. The early attention focused on this problem is reflected by a document authored by W. H. Veazie, Jr. and T. F. Connolly [6], in which it is pointed out that factors, such as sponsorship, subject area or mission specialty, contractual requirements, etc. affect the manner, in which the services are rendered or products are dis-

tributed by the centers. Of course, the overriding goal of the centers should be to overcome barriers to the flow of information and to make a high-quality information product available to interested parties when they need it, instead of simply markeing the products as merchandise.

In the United States the economic question was considered important enough to serve as the subject of a special meeting, providing an opportunity to economists to exchange their opinion with information center managers and with information entrepreneurs from the growing private sector of the information industry [7]. The previously mentioned market structure models were examined at this conference. Three approaches were considered: 1. Information is a commodity which should be left to the market forces, as indicated by the tradional supply-and-demand approach; 2. Information is a public product which should be strongly supported by government funding; and 3. Information is a natural monopoly and should be treated like a public utility, such as electricity or water supply. It is of interest to note that the concept "information for sale" is gaining ground: the number of information retailers has grown considerably during recent years. Pricing of the information product is a difficult problem; the cost-plus approach most often used by the entrepreneurs is not always indicative of the true market value of the services. *

Statistical Indicators

Scientific communication in general became the subject of rigorous mathematical treatment during the recent years. In an important series of reports D. W. King and coworkers [8] pointed out the need for statistical indicators in this field because *communication of scientific and technical information is clearly the most important aspect of scientific research, for it is this process that leads to its widespread use and ultimate benefits.* The growth of the scientific and technical literature is scrutinized by examining the technical book literature, the journal literature, the technical report literature, technical library and secondary services activities and also the growth of the information activities of scientists and engineers.

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* I am indebted for the description of the presentations and discussions at this conference to Ms. Bonnie Talmi, Program Planning office, Oak Ridge National Laboratory.

Management Problems

The role and the operation of information analysis centers has been examined in a paper by R. A. Jensen [9], in which he reviewed the collaboration between the U. S. federal government, the Engineers Joint Council and the abstracting service, Engineering Index. Creation of the new edition of the authoritative Engineering Thesaurus is an important product of this collaboration. The study indicates the great need for engineering data whicch are typically acquired from local sources. The author examines how the analytical center serves the engineering user, citing specifically the Water Resources Scientific Information Center (of which he is the maneger) as an example. In order to fulfill its role of disseminating pertinent information to the water resources community, the Center had to establish information input sources by making agreements with the water resources research institutes and similar agencies. Literature centers and related information analysis centers were used to assure full coverage of the field. On the basis of the experience thus gained, it is concluded that establishment of an adequately funded and staffed organization, with proper authority covering all areas for which there is a definite user demand and no existing service, is the best way to solve the information problem. The information analysis center concept has been found useful in the United States and it may be useful elsewhere.

The importance of management and economic problems in the operation of the information analysis centers is reflected in the collection of papers published by the American Society for Information Science [10]. The topics considered by the individual authors include management, performance measurement and costing techniques, user studies, networking, library cooperation and functional integration of technical libraries and information analysis centers.

The economic viability of the centers is further studied in a paper presented at the 36th annual meeting of the American Society for Information Science [11]. According to the author, introduction of a "cost reduction" contractual implement resulted in a marked change in the center's economic environment, resulting in cost savings.

The American concept of information analysis centers has been described in papers published in Europe, for example, in an article by R. Abbel [12], in which the increasing role of the centers in the scientific communication network has been emphasized.

Networks and Computerized Techniques

In addition to concern with the economic aspects of information center management, the main trend during the last few years centered on the inccreasing use of networks and computerized techniques. Generation of machine-readable data bases received great impetus lately. They do not belong to the scope of information analysis centers as such but the centers with their concentration of information specialists and subject experts, are expected to make better use of this convenient modern medium than individual technical people. The International Directory [13] lists about 3000 institutions and companies in almost 100 countries, while the new edition of the Encyclopedia of Information Systems and Services contains 21,750 entries from 31 countries [14]. The encyclopedia is more specific than the first mentioned compendium: itlists more selectively the data base publishers, SDI service centers and networks.

The well established INSPEC (Information Service in Physics, Electrotechnology and Computers) data base has been the subject of several studies [15]. New search algorithms were developed; they are expected to improve the search efficiency of the INSPEC data base. The field of medical information also received close attention. It was found that both major data bases of the field, the American MEDLARS and the Dutch Excerpta Medica are necessary for comprehensive coverage [16].

International Cooperation

Considerable effort was spent in various countries of the industrialized world during the last few years to develop national scientific and technical information systems. Many of these national and intergovernmental system were found to duplicate each other; cooperation between them was not always harmonious. The various forces at work, economic considerations, international pressures, the growth of the "for-profit" information sector in the United States have been well summarized in the lead article of the 1975 issue of the Annual Review of Information Science and Technology by A. A. Aines and M. S. Day [17]. The authors describe existing and proposed nationwide

systems, such as the European Information Network of OECD. The French approach to network organization involves decentralization of the centers, keeping them independent but pooling their capacities. The planners in the Federal Republic of Germany seek to integrate library holdings, maintaining close liaison with the educational system of the country. Japan's NIST (National Information System for Science and Technology) calls for a coverage of all technical and scientific fields, including agriculture and medicine. It contains many subsystems in the government agencies and in the private sector; close international cooperation is emphasized. In the Soviet Union, VINITI inaugurates its integrated information system which will be compatible with existing Soviet and foreign systems. It is planned to provide it with a capacity to handle 2.5 to 3 million publication per year, ten times the capacity of any integrated system in the world. In the United Kingdom, instead of elaborate national planning, the trend is toward consolidation and improvement of information programs and processes. In the United States, the National Commission on Libraries and Information Science (NCLIS) has prepared a major report how to improve the national library and information services. The secondary services move rapidly toward mechanization; they have demonstrated their ability to work as a community through organizations, such as the National Federation of Abstracting and Indexing Services, with the goal to reduce unnecessary duplication and to improve efficiency.

Intergovernmental organizations, such as UNESCO, and nongovernmental ones, as represented by FID, are the usual media for international cooperation in the transfer of scientific and technical information. A very interesting form of collaborative effort is found in the field of nuclear data: a worldwide network of four institutions has been developed to cover numerical data in neutron physics. The cooperative groups are sponsored by the Obninsk Research Center in the Soviet Union, the International Atomic Energy Agency in Vienna, the OECD in Paris and the Brookhaven National laboratory in the United States. The centers collaborate closely on the input side of the work and each of them is assigned to service users in specific areas of the world.

The field of information on nuclear science and technology in general is an excellent example of successful multinational collaboration. The International Nuclear Information System of the International Atomic Energy Agency follows the principle of decentralized input, each country being in charge of entering material generated within its jurisdiction into the system - and centralized processing and output. The success of the service

made it possible to dispense with the publication of Nuclear Science Abstracts in the United States; that abstracts service has been widely used previously throughout the world. INIS has recently published the latest revision of its well-known thesaurus [18], originally based on the Euratom thesaurus but greatly modified since its first edition in 1970.

In the field of agriculture, another UN agency, the Food and Agriculture Organization cooperates with other international agencies and a non-governmetal group in the development of AGRIS, the Agricultural Research Information System [19]. The emerging international information-handling systems have been described by J. Tocatlian.

Examples of Information Analysis Centers

A rapidly developing area of science or technology is best served by an information analysis center. Such a fast growth may arise when a new aanalytical or experimental technique is developed and then adopted in a variety of technical fields which otherwise have little contact with each other. The new center serves as a focal point, making sure that reports, journals and other information transfer products are effectively brought to the attention of all interested parties. There are also certain technological situations which cut across conventional disciplinary lines, in order to fulfill the goals of the mission which may be also well served by an information analysis center. Two relatively recent cases illustrate how an information center may be sueful to scientists and engineers with various backgrounds but with a common interest in a specific area.

The information service at the *Institute of Offshore Engineering* at the Heriot-Watt University in Edinburgh, Scotland [21] serves as a technological research group for the many small firms involved in the North Sea oil exploration effort. These firms often have no background in marine environment and must cope with unexpected and unusual problems. The Institute's staff is drawn from eleven departments of the University but it maintains its own consultants. The disciplines covered include oceanography, petroleum technology, instrumentation, navigation, diving, pollution control, hydro dynamics, communication systems, corrosion science, underwater construction, geotechniques, naval architecture and safety engineering. In its activity,

the Institute must occasionally consider also questions in the field of occupational medicine, international law, economics and energy problems. The information officer of the Institute coordinates the inquiries received from participating companies by phone or letter and answers them with the help of experts.

A completely different but just as multifaceted information center is the *Center for Short-lived Phenomena* in Cambridge, Massachusetts, USA [22]. That center collects information an reports on them concerning geophysical, astrophysical, biological and man-made pollution events. Typical examples are: *a finback whale stranded in Connecticut, volcanic eruptions in Alaska, meteorite fall in Missouri, a major fireball event in India, floods in Mindanao, a 16,000-gallon sodium hydroxide spill in Alabama and a chlorine fire on the west coast.* Because of the very nature of the phenomena it covers, the center maintains, in addition to its permanent staff of five, a network of more than two thousand scientists and engineers scattered in 144 countries, and is thus able to keep abreast of unexpected events nearly everywhere. Earthquakes, volcanic eruptions, mud slides, red tides, fish kills, insect infestations, peticide contaminations, radioactive releases and major oil spills are among the phenomena the cnter covers. It notifies intersted experts by shortwave transmitter, telephone lines and teletype circuits. Thus the center has a unique field, *recording events which are unusual, unpredictable, pernicious, arbitrary, unforeseeable and occasionally, unexplicable.*

DEVELOPING COUNTRIES

The above short summary indicates that information center activities and creation of modern data bases and information transfer media make good progress in the industrialized countries. Many of the data bases are made available to users possessing their own terminals. Thus, an increasinly large portion of scientists and engineers has convenient access not only to the recorded knowledge of earlier generations, as available in libraries but also to recently generated information.

The technical person in the developing countries has a different "environment as far as his information supply is concerned. A few years ago I had an opportunity to observe this problem in various locations within an advanced

country, the United States. At that time I started my work for the International Cancer Research Data Bank project. One of our first concerns was to determine how practicing physicians obtain the latest and most authoritative information that they need to detect and treat the disease. The situation in large urban areas and near established research hospitals was well known: the doctors were aware of the information sources that they needed and they had their own network of specialists and consultants who were experts in their field. Our project management wanted to find out the actual situation prevailing in small towns and isolated rural areas and a team of us was sent out to interview practioners in two Western states. Our visit to the physicians offices and to the university hospital clinic where monthly lecture series for the benefit of outlying districts were organized, were revealing. Without going into details, suffice to say that even within a strongly industrialized nation, such as the United States, we have found prfound differences in the flow of information to this particular group of users.

Similar differences prevail in the information environment surrounding a scientist or enegineer ina developing country. It might of interest to examine his relation with this information environment: his colleagues and his profession.

Of course, the mere smallness of the country or the limited number of practioners of the profession does not preclude the development of specialized technological expertise. It is of interest to note that at the beginning of the Second World War, the two European countries whcih did not become involved in that conflict, became the foremost experts in the development of anti-aircraft guns. The Swedish Bofors and the Swiss Oerlikon guns were superior to the weapons of the belligerents.

A relatively undeveloped country may also excel in certain areas because of certain features in its environment: experts in tropical medicine must obtain their experience in the tropics; volcanologists must be where the volcanoes are.

Scientific leaders

Brilliant scientists arise in otherwise mediocre surroundings. Experience shows that such an outstanding individual finds himself slowly alienated from his local colleagues. He might occupy a teaching or administrative

position at a local university or research institution but if his expertise and prominence gaines him entry into an "invisible college" of his specilaty, he is probably more often encountered at scientific symposia held in Western Europe, the Soviet Union or the United States than lecturing to undergraduates in his own country; he probably feels more at home with the small group of experts in his specialty than with scientific colleagues at his institute. There are, however, cases when such a luminary focuses his attention on his homeland and his presence there helps to attract br-lliant students from elsewhere.

LOcal Factors

Thus, like the above-mentioned physicians in a remote corner of the United States, scientists in developing countries present a special case. Their information needs cannot be taken care by simply duplicating the information-handling systems developed elsewhere, even if those systems performed well under the original conditions. Designers of information analysis centers and of specialized systems catering to technical persons in a developing country must take a variety of factors into consideration; they include: the local linguistic background, prevalence of knowledge of certain major languages, geographic location, contacts with regional neighbors and specific area of local prominence.

The latter factor may exert a positive or negative influence.An information analysis center may be established to take care of a bothersome medical problem, to study a disruptive environmental or geographic condition (typhoons or earthquakes) or to assist manufacturing or agricultural enterprizes which are important to the economy of the country.

As far as the basic information supply is concerned, it is desirable that resources available from other sources be examined closely and if found suitable, acquired, instead of duplicating them locally. As discussed above, tremendous advances have been made in the field of international collaboration, obviating the need to recreate everything; in addition, there are at present many "information brokers" who are ready to offer the desired material in a specially prepackaged form, for example, in a language understood by the local users. Regional groups often find it advantageous to exploit the foreign-generated information supply conjointly. National prestige is better served if the developing country's resources are focused on areas, in which local expertise is preeminent.

Examples of Information Analysis Centers

As mentioned above, meteorology and other environmental sciences offer an excellent opportunity to a center in a developing country to become a member of a cooperative network. For example, wind velocity or air temperature data, information on oceanographic processes, are required from all parts of the world. Standardized environmental data require a minimum of verbiage for understanding and a person who knows the Universal Decimal Classification is able to locate easily items of natural phenomena in any part of the world, regardless of the language of the journal, in which the data are published *.

Information centers which satisfy some of the above requirements are represented by the International Rice Research Institute of the Philippines [23] and the information services of the Rubber Research Institute of Malaysia [24]. They relate to information analysis center type activities, being attached to a research organization whose goal is to study the production and basic research problems of an agricultural product of major importance to the country in question, to the region and to the whole world.

The Rubber Research Institute of Malaysia has eighteen divisions and sections and operates two experiment stations. The scientific work is carried out in several disciplines, including analytical chemistry, crop protection, microbiology and even fundamental chemistry and physics. The library and information services of the Institute had to consider the linguistic aspects carefully when they supply th researchers with the needed information and when they answer questions received from consumers of natural rubber from all over the world.

A completey different aspect is presented by the information unit of the *Hajj Research Centre* which provides much needed information not available from conventional sources, providing integration with sociological problems

* This is the reason why Malcolm Rigby, longtime editor of Meteorological Abstracts has championed the use of UCD for weather data compilations.

[25]. The Center was established in 1975 at the King Abdul Aziz University in Jeddah, Saudi Arabia, to study the environment of the annual pilgrimage to the Holy City of Mecca, known as Hajj. The relatively small city of Mecca receives a very large influx of pilgrims - about 1.2 million in 1977; provision of food and accomodation for them represents a great problem. The Hajj Research Centre studies the changes in the number of the pilgrims and of the modes of transportation as a function of time, in order to determine the best and most flexible way to accomodate them. The information unit collects all the data needed by the other components of the Centre: the modeling unit, the media unit and the independent studies unit. One of the functions of the information unit is to disseminate information to the pilgrims; this made it necessary to determine the best way to transmit information in a country without of a strong infrastructure of science and technology. In addition to the usual collection of documents and journals, the Centre's staff makes aerial surveys and conducts interviews with the pilgrims. For the sake of simplicity in the storage and retrieval system, the technical material, mostly in English, is separated from nontechnical items, such as sociological studies, theological texts, accounts of the pilgrims' journeys, the history of Mecca, etc. which are stored also in other langueges, including Arabic and Urdu. The results obtained during the short lifetime of the Cnetre are satisfactory: the existence of the information unit was very helpful to the research team. An information specialist in this rapidly developing country must be ready to accept a great variety of job assignment which normally would be outside of his field.

International Activities

In the previously cited volume of the Annual Review of Information Science and Technology S. Adams and J. A. Werdel review cooperative efforts in the developing countries [26].

Experts from South-East Asian countries met in Sri Lanka [27] in 1974 to promote regional collaboration in information policy development. The organization of American States also supports cooperative information programs among Latin-American countries. The Inter-American Center for Documentation and Agricultural Information has been proposed as the focal point of a regional network. Cooperative programs are under consideration also by the Inter-American Association of Agricultural Librarians and Documentalists. The East African Literature Service is concerned primarily with the coordination of agricultural and veterinary information programs.

Such regionalization of the cooperative activities appears to take place also among the industrialized countries, as illustrated by programs sponsored by OECD, the Commission of European Communities which created EURONET, and the International Center for Scientific and Technical Information in Moscow. A nongovernmental organization of data-base operators, EUSIDIC (European Association of Information Dissemination Centres, a counterpart of the American ASIDIC group, performs a useful function in Europe.

COOPERATION BETWEEN CENTERS

Information centers are often found in a laboratory environment; in the case of multipurpose laboratories, several centers may collaborate closely, sharing expenses and obtaining support from each other and from "benchworker" colleagues. Such an information analysis center environment has been described by H. M. Weisman [28], who pointed out that *no one person is a complete expert; the presence of others provides symbiotic and synergistic benefits*. In an earlier report I have described my practical experiences derived from the presence of fifteen centers within one institution [29].

There are several examples in the United States concerning large information complexes within one host agency, for example, Battelle Columbus Laboratories, the National Institutes of Health and the Oak Ridge National Laboratory. I believe that establishment of a group of information analysis centers within a similar organization might be beneficial. Universities, technical schools and specialized research laboratories would make ideal hosts for the centers. The previously indicated regional agreement woudl be helpful in providing the necessary backing to the centers to obtain the needed materials for carrying out their analytical function.

Another method for facilitating the establishment of information analysis centers in developing countries would be to take advantage of the "sister laboratory" concept, which has been used successfully in the field of technology transfer. Organizations with experience in the operation of information analysis centers would send an expert for a few months to the sister institution; alternatively, a key individual from the proposed center could spend time in an already established center, observing the problems as they arise and as they are solved.

Many of the developing countries have their share of true giants of science. The name of Raman is known to every chemist and physicist and in the discipline

in which we are currently engaged, S. R. Ranganathan is one of the great leaders. It is my belief that that the information center concept would receive a great impetus in the developing countries , if such great scientific leaders could be convinced to lend the prestige of their name and devote a part of their time to the promotion of this type of information transfer medium, serving the interest of their countrymen and neighbors.

This approach is supported by A. M. Weinberg, well known in information circles as the author of the *Weinberg Report*, but also as a scientist, administrator and philosopher. He has examined [29] the role of the theoretical physicist or chemist as a "compactor" of the literature. He cites a few examples: after Mendeleev, chemists did not have to memorize a large body of esperimental facts because Mendeleev's periodic system simplified the complex correlations between the elements; Bohr's insight represents a further compaction of the data. The theorists use the inductive - the information analysis center does a similar work, amassing and systematizing the data. In the old days a single person could do this task; now we need all the modern tools to help the great minds to carry out their theoretical studies. Using the great minds present in a given region as a "crystallization center" or as a catalist, it might be possible to attract a high-level team of experts to solve the burning problems of our day.

I am hopeful that new information centers and similar institutions will be created soon in many of the developing countries, collaborating with existing agencies in the data collection and evaluation field, devoting their efforts to the solution of special interest to the region and perhaps opening new insights into the mysteries of nature.

In this connection I would like to touch on a seemingly trivial point. As an amteur linguist, I examined certain features of the new nuclear language and have been very unfavorably impressed with the mass of acronyms that I find ; they designate experimental devices, projects, reactors, instruments, etc. The early pioneers of this field have been much more imaginative - they have used terms like *cutie-pie* for a health physics instruments, and *scram* for the emergency shutdown of the reactor. E. Garfield, the father of *Science Citation Index* complained some time ago that journal names are awkward and usually too long. He suggested that journals should avoid names, such as *Journal of the American (British, French, Russian, etc) Association of Whatever-you-are-ologist*; by contrast, he admires titles like *Lancet*.

Therefore I would like to suggest that the organization that will be established, choose a name that is expressive, carries a certain punch and can be easily remembered. I prefer the name of *Palais de la Decouverte* of a science exhibit in Paris to the more pedestrian *Museum of Science and Energy* in my home town.

CONCLUSIONS

In conclusion it can be stated that the information centers have survived a period of budgetary restriction and are slowly spreading to many parts of the world. The efforts of the operators of the centers will be greatly facilitated by the advent of a large number of on-line information services which will render easier the acquisition of needed background material.

I was interested to find that the recent Pugwash workshop on the 1979 United Nations Conference on Science and Technology for Development [31], held in Rabat, Moroccoon 20 to 22 April of this year, considered specifically the problems involved in the transfer of technology from the developed to the developing countries. This implies first of all the availability of functioning information transfer agency in the recipient countries. The information analysis centers are an important link in the information transfer chain and may serve the role of the gatekeepers, as did those who controlled the irrigation in the Indus Valley in ancient times.

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UNISIST GUIDELINES
FOR ESTABLISHING AND OPERATING
INFORMATION ANALYSIS CENTRES

Prepared by F. Kertesz
under Unesco contract

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UNISIST Guidelines for Establishing and Operating Information Analysis Centres

TABLE OF CONTENTS

1. The Evolution of the Information Analysis Center Concept

The information analysis center is considered a relatively recent tool of scientific and technical information handling. Actually, its roots go back in time to the librarians of antiquity, who were not only the custodians and the handlers of the books entrusted to them but, as scholars in their own right, they understood the texts they cared for and made their own contributions to their chosen field.

At the start of modern science in the sixteenth century as a clearly-delineated field of human endeavor, communication between its practitioners was of a personal nature. A letter from a scientist to his colleague on a current subject was highly specific and relevant information of great interest to the recipient. Books were carefully written, as they represented the culmination of decades of work.

All this changed with the advent of the scientific journal. The ever-increasing number of articles made it difficult for the scientist or engineer to keep up with the literature in his own field. In recent times, the situation has become even more complicated, as specialized government agencies and large, private industrial laboratories in the highly-industrialized countries acquire the habit of publishing internal reports which describe the research or testing activity carried out under their sponsorship. At present, the combined total of scientific and technical journal articles and limited-circulation reports published throughout the world exceeds the one million per annum mark.

With the exception of the few leaders in various technical fields who were still able to maintain personal contact with their peers, (1) scientists and engineers in the post World War II period became increasingly frustrated by their inability to obtain and to absorb the needed information.

The emerging "information science" took care of some of the problems. There were no sudden developments, but in recent years, information tools already in use were modified to take care of the requirements. Some of these tools are discussed in the following paragraphs.

The oldest method of making organized knowledge conveniently available is the library. Traditionally, as the result of their education, librarians were interested solely in books; only recently have they become interested in other media. In order to better serve their users, modern industrial libraries adjusted their collections to the narrowly-defined requirements of their specialized clientele.

Such a "special library" contained a much larger percentage of material of interest to its clientele--researchers, development engineers and management--than a much larger national or university library, in which the pertinent material was submerged in the large volume of seldom-consulted publications. Such a library remains a valuable and necessary tool; it is usually supervised

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(1) By means of an "invisible college", described by Derek de Solla Price in his book: "Science since Babylon".

by a person who knows how to organize and procure the material, but in most cases is not an expert in the subject matter.

A related information tool is the "document center". The so-called "documents" refer to the above-mentioned publications issued by specialized government agencies and industrial laboratories. Originally, circulation of these reports was restricted by government policy of secrecy or by proprietary interests. In principle, a large portion of these reports is freely available today, but in actual practice, they are not widely read, because they are circulated outside of the customary channels. In order to improve access to these publications, which are of great importance in certain fields, document centers have been established.

The document centers became an important complement and helpful tool of the special libraries. Although usually not subject to the judgment by peers which often motivates scientists to publish in certain prestigious journals, the report literature presents many advantages. It is published more rapidly than the journal article; it is less subject to space restrictions and therefore it usually contains more graphs, tables, formulas and equations. Document centers have been established by the sponsoring national or international agencies, thus ensuring that depository libraries within the home country or in various parts of the world will have a complete collection of the holdings.

Another tool of scientific information adapted to present-day requirements to assist technical men besieged by the flood of journal articles and reports is the abstracting and indexing service. In existence for over a century, the abstracting and indexing organizations, which have been organized according to primary disciplines, have been supplemented in recent years by a growing number of mission-oriented services which cover only a clearly-defined area of the technical information spectrum.

As an illustration, one could mention a library covering a specific, albeit area: the library of the International Atomic Energy Agency in Vienna. A variety of disciplines are covered but the "mission" of the agency - application of nuclear energy, nuclear power plants and safety aspects represented the guiding principles in the organization of the library. In view of the world-wide activities of IAEA, nuclear problems in a variety of geographic areas including local power requirements, safety features of nuclear power plants, environmental considerations, training of specialists and related questions are better covered in that Vienna library than anywhere else, although the collection of course does not include all scientific journals of the field.

As an excellent example of a library devoted to a whole discipline, the U.S. National Library of Medicine which with its computerized services reaching far out of its headquarters in Bethesda, Maryland, a suburb of Washington, represents an institution where an interested user can find answer to a broad gamut of questions - for example from professional catalogs about gynecologists in Geneva, Switzerland, statistics about the incidence of certain type of cancer in Iran to detailed evaluated information about toxicological problems.

These relatively recent developments--the special library, the document center and the abstracting journals with a narrow scope--were indeed helpful to fulfill the information requirements of scientists and engineers. However, they were primarily "wholesaling" services : they assured bibliographic control over the material. It was necessary to develop a mechanism which would serve individual interests and not only whole disciplines or major projects. The information analysis center--designated as IAC--fulfilled this strongly-felt need. Let us see how they arose and what they are.

Information analysis centers were not discovered suddenly; whithout going back to antiquity as mentioned above, in their present form, their history can be traced back to the last century, when German chemists started to examine systematically the information relating to specific areas of their discipline. Started by farsighted individuals such as Gmelin or Beilstein, the activity now requires large staffs to continue the work. Today's IAC represents the most intellectually sophisticated information handling process : providing information and not only its physical embodiment, the article or the report. This has been explicityly stated in the authoritative Weinberg report : "...But retrieval of documents is not the same as retrieval of information; a technical specialist really needs the information contained in the published literature, not the published literature itself." (2).

The center makes use of the previously-mentioned services; in some cases, it even assumes some of their functions. However, there is a basic difference that distinguishes an information analysis center : the report, the article, or its surrogate, the abstract, are filtered through a human brain before delivery to the inquirer. Subject specialists read the original input and evaluate it, extracting everything that falls within the clearly-delineated confines of the center. The answer, which might be based on the output of automated searching techniques, is similarly scrutinized. The service thus provided is that of an information "retailer" who caters to a highly-specialized audience.

The objective of the information analysis center is not to provide a detailed bibliography of a given subject. That is an important task, requiring the complete bibliographic control of the published literature, but it is of primary interest not to the working scientist but to a limited group of individuals, such as the writers of review articles, and to historians of science and technology. The IAC aims to preserve and to spotlight the new increment of knowledge contained in an article, and to make it available to the technical community in a convenient form. This often requires a synthesis of scattered results and a critical examination of the claims made by the author. The staff scientist of the center, being a working subject specialist himself, can discern if some conclusions of the author are not supported by evidence or if the precision claimed in the numerical results simply cannot be achieved by the instruments used for the experiment.

Thus, the primary goal of the center is to relieve its users from the arduous task of working up tons of gangue for a few grains of gold. As it fulfills its mission, the center makes use of the above-mentioned techniques developed by information science; its technical staff is supported by expert indexers, abstractors, translators, computer programmers, librarians and

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(2) "Science, Government and Information," The President's Science Advisory Committee, January 10, 1963.

clerical personnel. However, it should be emphasized again : the main characteristic of an information analysis center is the fact that the material is scrutinized by subject experts.

The problems encountered in the start-up, operation, staffing and eventual shutdown of the centers, the organization of their input and output activities are outlined in the following chapters.

2. Classification of the Centers

a. Analysis Centers

It is obvious that the centers cannot always be divided into sharply defined categories. The very concept is not yet universally understood in the same way everywhere, and currently, there are many centers in a transitional stage which hopefully will reach the "analysis" center level in the near future, without satisfying as yet all the (more or less arbitrary) criteria. As a new organization, the information analysis center cannot be as explicitly defined as, for example : "LIBRARY--a place in which literary, musical, artistic or reference materials are kept for use but not for sale," by Webster's New Collegiate Dictionary.

Several definitions have been advanced to describe an IAC. Let us consider the criteria of one expert (3), according to whom :

> "An IAC is a formally-organized group of technical men for handling scientific and technical information in great depth within a narrow, well-defined field in a timely and efficient manner, primarily for their peers."

It is of interest to note how this definition restricts the concept, excluding certain related activities. An IAC is a "formally organized" group; thus, an ad-hoc assembly of experts meeting for dinner at a Conference does not qualify. Indeed, an IAC must have a charter describing its activities and defining its scope; in addition, the organizers should include a tentative budget and a description of the center's organic relationship with other agencies.

To be sure, in the past, many centers were started in an informal manner; their existence is due to the fact that a devoted scientist analyzed the often-contradictory statements of the current literature and attempted to reconcile the differences. However, the designation of information analysis center should be reserved today for a formally-established organization, even though it might be staffed only by a single individual and supported by modest means.

The IAC concept lends itself to any field of human activity--social, economical or political sciences, law, education, etc.; however, up to now, most of them covered an area of science or technology (including medicine, agriculture and mathematics), and the following will take this bias into consideration.

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(3) G.S. Simpson,Jr. : "Scientific Information Centers in the United States"--American Documentation 13 (1), January 1962.

The fact that the information analysis center handles "in great depth" the problems that it encounters in the course of its activity eliminates from consideration many organizations which serve their public by providing casual answers to the questions. An IAC is more than the reference department of a public library; its interest goes beyond deciding the winner among the bettors by looking up the facts in an almanac or yearbook.

The fact that the IAC operates "in a narrow and well-defined field" is also important. As it is supposed to be staffed by subject specialists, it can cover only subjects within their competence and, in view of the complexity of modern science and technology, such an expertise is clearly limited. There can be no IAC in "biochemistry" but one can easily see one in the "Structure of Nucleic Acids".

The requirements of a "timely and efficient handling of the information" excludes many scholarly committees which would otherwise qualify for the designation of information center, but take a long view of the problem that they consider. Their output--often in the form of a detailed review article--usually requires a long time period before it becomes available to interested users. As a rule, these groups do not formally organize their input and their interest is very narrowly focused. However, the members of such groups should be considered as potential advisors or staff for an IAC which includes their field.

Finally, the last restrictive clause is also important. By stating that the staff of an IAC deals with its peers, it is intended to eliminate teaching institutions, in which a professor-student relationship prevails primarily between the providers and the recipients of the information. However, in some cases, the IAC might fulfill a certain didactic function. There are centers which collect and analyze advanced research engineering studies, making the new techniques available to skilled technicians and operators.

A similar situation may arise in other areas; for example, in a specialized field of medicine, such as cancer. New developments in biochemistry, clinical research, medical physics, etc. must be examined by the experts of a medical IAC in order to assist the practicing physician or medical technician who is not interested in continued research but wants to be sure that he is using the best available knowledge on behalf of his patients.

An authoritative definition was issued in 1967 by COSATI (Committee on Scientific and Technical Information, and agency of the U.S. Government) Panel 6 on Information Analysis Centers :

"An information analysis center is a formally-structured organizational unit specifically (but not necessarily exclusively) established for the purpose of acquiring, selecting, storing, retrieving, evaluating, analyzing and synthesizing a body of information in a clearly-defined specialized field or pertaining to a specified mission with the intent of compiling, digesting, repacking or otherwise organizing and presenting pertinent information in a form most authoritative, timely, and useful to a society of peers and management."

Three years later, a panel of the Scientific and Technical Information Policy Group of OECD further broadened this definition :

"An Information Analysis Center (IAC) is a unit consisting perhaps of only a single subject specialist--perhaps as many as fifty--concerned with a well-defined area of science or technology, which gathers together the world literature and other information sources in that area, organizes, indexes and stores it; then, using this as raw material, the subject specialists in the unit select relevant portions for critical examination and evaluation, and prepare critical reviews, data compilations and other outputs based on sophisticated intellectual analysis."

To simplify matters, it should be emphasized that the chief characteristics of an IAC is that its output is not the same as its input. For example, as an information-handling agency, it might generate a bibliography on the basis of a computer program. A true IAC will assign a staff specialist to check the items found by the program, eliminating those which are not pertinent or simply unimportant.

It should be therefore emphasized that an IAC does not simply collect, index, and if needed, recall the documents it has acquired and stored, but submits them to human scrutiny. The above-mentioned critically-evaluated bibliography is the product of human intervention and evaluation and thus is superior to a computer-generated product not reviewed by a knowledgeable expert.

Care must be taken not to deprecate the contribution of the computer programmers, indexers, abstractors and of other information-handling experts, but to stress the main criterion which differentiates an IAC from all other, often mechanically more sophisticated, information-handling activities.

b. Data Compilation Centers

In addition to the above-described typical analytical centers, one can distinguish other types of centers, such as data compilation centers and data banks. They satisfy the above definition but, because of their special nature, deserve to be examined individually.

The data compilation centers extract new numerical information from the published articles and reports. They attempt to reconcile apparently contradictory values by critically examining the experimental methods used and applying their own personal judgment as to the quality of the work.

The numerical "best values" are not a simple arithmetical mean of the data published in the literature. Data evaluation requires considerable knowledge of the experimental techniques and a discerning mind. Several of the compilation groups acquired high prestige, and the published tables are often referred to as the authority. It is generally recognized that a high level of technical competence is needed to make a discriminating choice among the reported values.

Up to recently, emphasis was laid on the generation and rapid publication of new values; the evaluation efforts lagged behind. Establishment of many new data centers has partially remedied this situation. In many fields, the experimenters do not start a new run without checking with the data evaluation center and receiving guidance from it concerning the latest situation.

An interesting example of international collaboration is found in the field of nuclear cross section data. Groups in the Soviet Union, at the International Atomic Energy Agency, at OECD and at the Brookhaven National Laboratory work closely with each other to ensure their input will indeed cover the world's literature; they have divided the areas they serve according to geographic convenience.

c. Data Banks

Data banks (the term has not yet received general acceptance) represent another kind of organized collection of numerical data. Modern instrumentation techniques applied to environmental sciences, such as meteorology, oceanography, or space research, resulted in the acquisition of a very large body of numerical values. Quite often, the data are collected more rapidly than the ability of theoretical scientists to use them. The original data usually have been evaluated by the scientists who designed the experiments and who drew conclusions from them. However, unfortunately many data are never evaluated, especially when improved instrumentation makes the material rapidly obsolete.

However, this "raw data" must be preserved in order to enable future theoreticians to revise formulas and to check secular events in nature. Maintenance of such data collections requires knowledge of the reduction of "raw data" into evaluated ones, the effect of the various factors and of the use to which the data will be put.

The goal of this costly effort, involving the collection and maintenance of a large body of unevaluated and partially-evaluated numerical data, is to develop universally-applicable equations which can be used to fulfill the ultimate goal of science : to predict the future on the basis of the knowledge of all pertinent conditions.

Many attempts have been made to derive such a formula to calculate tides on the basis of water level measurements at ocean beaches, near estuaries, closed seas under various astronomical relations between the Earth, the Moon and the Sun. More recently, the existence of the Van Allen belt was ascertained from the many observational data yielded by satellites.

Once a recurring natural event can be calculated with sufficient precision by refining the equations derived from earlier data, the need for maintaining the data bank in that field and to carry out new measurements will largely disappear. However, the very complexity of the environmental and space phenomena and our inability to control all factors will probably make it necessary to maintain data banks for long periods yet.

It is true that modern science is based on quantitative values. For example, chemistry became a science in today's meaning of the word when Lavoisier weighed the reagents and reaction products and expressed the reaction in quantitative terms, instead of simply describing the observed phenomena. However, a large portion of our knowledge cannot be reduced to numbers. For this reason, many centers must be prepared to handle both numeric and textual information. The centers cannot always be forced in sharply outlined categories; there is often a gradual intermixing of the types, making clear-cut classification impossible.

d. Centers with a primarily educational function

It has been emphasized that in most cases the generators of new information, the organizers of this information in question - the staff of the center - and the users are equal members of the profession even though their expertise might lie in slightly different areas. However, there are some well established agencies, not necessarily called "centers",

the main mission of which is to reorganize the body of accumulated knowledge, keep a sharp eye on new development and transmit to the practioners of the field whatever they can employ in their daily work. (This description might fit a teacher but for simplicity's sake, formal educational activities which lead toward a certificate or an academic degree will be excluded from consideration, see page 5).

In many countries, the agricultural agent's work present a good example for this type of activity. Agriculture is an important part of the national economy, especially in the recently emerging parts of the world. Tilling the soil is a historical, often tradition-bound profession. The governments of the new nations face the necessity of feeding a fast-growing population and therefore must educate their farmers in methods and techniques developed in sophisticated agricultural stations; they must also make sure that the instruction will be understood *. Thus, the field agent helps the farmer in the selection of the proper crop, suited to the climatic condition and the soil composition of the area and he may also point out certain economic problems which might induce the farmer to choose a crop better suited to the market.

The situation in the industrialized countries is quite similar. The continued flight from the countryside toward the cities means that an ever decreasing population must grow sufficient food for the rest of the people. Those who remain at the farm must be advised in the proper methods of agriculture and home economics. The work is usually accomplished by means of discussions, lectures and demonstrations and not by the formal report or journal literature.

Similar agencies serve craftsmen and artisans in a variety of fields. Although these organizations do not satisfy all the criteria of an analytical centre, they should be mentioned because in many countries they are more important, than their more formal and more scholarly counterparts.

3. Establishing a New Information Analysis Centre

a. Start-up criteria

Information analysis centers are not established at random; even a cursory examination of the currently-operating centers reveals that they share some of the following characteristics :

1) the fields they cover had undergone a relatively sudden rapid growth, making it very difficult to keep up with the

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* The importance of the proper language, suited to the educational level of the intended public cannot be overemphasized. In a large store catering to a rural population in a certain area problems were encountered with shoplifting. Somebody pointed out that the big sign "Violators will be prosecuted" did not mean anything to that public. The sign was changed to read : "If you steal, you will be put to jail" and the message was understood.

literature. There are more projects and active workers and an increasing interest by "outsiders", such as granting or supporting agencies.

ii) the home institutions of the researchers were scattered; and contact became difficult.

iii) there was a time barrier between the users and the articles. Occasionally, language barrier also presented problems.

iv) pertinent papers were published in government or company reports with restricted circulation.

All this caused feeling of loss of contact with the fast moving field among the researchers. This was remedied in a few cases by the tireless efforts of a few individuals who devoted appreciable portions of their professional activity to the analysis of the work of other contributors to the field. As active workers, they were aware of the contradictory claims which necessitated special study. Their work was a labor of love which, in most cases, was not formally sponsored and chartered. A senior scientist of repute, most often a university professor succeded to obtain the necessary clerical assistance; his personal reputation was usually the most important asset of the center.

A formally-chartered centre, with its own budget and staff, can be established only if there is a good probability that it will be used by the technical community. The centre must respond to a definite need. This means that an effort must be spent to convince management of this need. This concept cannot be easily measured or expressed numerically; thus, a certain amount of subjective reasoning must be used to justify the establishment of a new center. At the birth of each centre there was a crusader or at least a super-salesman.

Today, the formal establishment of a centre must be preceded by a well-reasoned justification to a potential sponsoring agency--such as a research laboratory, government agency or scientific society. In addition, the potential user group must also be identified. The following criteria have been found useful in providing evidence for the need and for identifying the expected clients :

b. Sudden interest or need for progress in the field

This criterion may apply to an IAC in a specific area of applied science or to a field that acquired a sudden economic or political prominence. The technical management of a laboratory or its sponsor recognizes that, in order to bring a new project to fruition, a certain kind of material must be available or a new process must be developed. Space research made imperative the use of a variety of hitherto unknown materials, such as liquid or solid rocket fuels, alloys with novel properties withstanding extremes of temperature, instruments operating reliably when exposed to a variety of radiation fields, etc. Accidents with children who drank household poisons may cause an outcry and result in the establishment of a poison centre or a political leader's sickness focuses attention on that particular condition.

A well-staffed and organized IAC can be of great help to project management and to the researchers by bringing diverse but pertinent research efforts to their attention, pointing out technical difficulties and identifying promising approaches. As a general rule, any major technological programme, such as solar energy which captured the imagination of the population in a short time may be considered a potential sponsor for a new information analysis centre.

c. Methodology-related centres

New chemical, physical, instrumental, etc. techniques are often applied in a variety of fields which may be quite remote from the primary activity of the initial inventors or discoverers. Mass spectroscopy, gas chromatography, to cite two examples, are of interest to analysts, biochemists, physicists, biologists, industrial chemists; activation analysis is used with great success by criminologists, etc.; therefore, specific applications of the technique might be described in widely-scattered journals, many of which are not regularly scrutinized by all people interested in the further development or novel applications of the technique. Thus, study and detailed evaluation of such newly-developed methods or techniques--or even novel applications of classical methods, such as mathematical analysis based on Markov chains, used in many areas--can best be carried out in a specialized centre. A specialist in such an area who realizes that the problem of coping with the literature is beyond his means, even if he takes advantage of the available tools of information science, would be well advised to consider the establishment of an IAC to further his goals.

d. Recognition of a special feature

Data are mishandled and valuable information is lost because a specific and very important property feature has not been correctly identified. Solid state physicists were surprised at anomalous tensile strength values of certain materials, until it was found that the extreme purity of the tested materials was responsible for unexpected physical properties. In order to correlate information in this field, the Research Materials Information Centre was established, restricting its field of interest to materials of extreme purity or with controlled, small amounts of impurity "doped" materials).

This Centre rendered great services to researchers by carefully selecting papers which described measurements carried out with very high purity materials from the voluminous literature of materials research. It was thus possible to recognize that the occasionally reported anomalously high strength of certain materials was due to their purity. In addition, the centre provided additional help to students of high-purity materials:

i) it identified the producers of these materials ;

ii) it collected their method of preparation (the preparatory technique is often not included in a scholarly paper, but it is important for the success of the preparation);

iii) it maintained a listing of the availability of samples.

Thus, identification of a specific characteristic is a good reason for initiating an IAC.

e. Staff assistance

Government agencies sponsor complex research programmes in the pure and applied sciences, but often, their headquarters does not possess the expert personnel to supervise the technical progress. An IAC, established primarily to serve the "peer group" involved in research in the field, could also provide staff assistance and overall expertise to its sponsor. This represents an additional justification of the centre's existence with respect to the sponsoring agency.

This assistance can be exercised in many different ways, taking advantage of the knowledge of the subject field at the IAC : checking progress reports, awarding contracts, comparing proposals, organizing meetings, etc. The assumption of such an additional function could justify the establishment of a new IAC which would benefit of both the technical community in general and the sponsoring agency in particular.

4. Steps to be taken before initiating a new Information Analysis Centre

After a general agreement has been reached between management and the interested "crusader" to start a new IAC, it is desirable to examine objectively the potential contribution, the anticipated activity and the "constituency" of the proposed organization. The purpose of these steps is to ensure a realistic operation, indicating the probability of success or failure to those who have to make the ultimate decision to approve the centre.

Such an examination process could be a protection against biased judgment. While in most cases, in the past, the personal interest and initiative of a strong and respected individual were the prime movers for the creation of a centre, such personal interest and initiative are not sufficient for starting a new IAC. Public scrutiny of new services and the shortage of qualified manpower require detailed justification for the proposed activity. Of course, it must be kept in mind that it is not possible to ensure against failure and success cannot be guaranteed even if all care has been taken.

Certain steps must be taken before the centre is formally established. In order to avoid any possible, even an subconscious bias, it is recommended that the preliminary survey to justify the creation of a proposed IAC be awarded to individuals who are not interested in operating the centre once it is established.

a. Survey of the growth rate

As mentioned earlier, the rapid growth of a critical technological, sociological or scientific programme is the most important criterion for establishing an IAC. The directly involved "insiders" know that there is a great activity within their field, but they must be able to support this intuitive feeling with quantitative figures. The most convenient figures are based on a survey of the budget and personnel of the subject matter in question, supplemented by a review of the pertinent literature. It is desirable to seek the advice of some of the more prominent potential users.

Analysis of the data obtained from these studies allows to determine the probable number of users, and what is more important, their rate of growth.

The literature survey can be fairly easily carried out in the case of a "mature" subject which has a well-established terminology and thus can be followed easily by means of conventional abstract journals. However, this situation does not arise very often. The truly new subject matter is often submerged in a large mass of extraneous literature and is not easy to identify. The standardized, automatic retrieval techniques tend to slow down the introduction of new keywords into the thesauri and thus new concepts are identified only belatedly.

The time factor is also a key element to be taken into account. An up-to-date review must be based on truly current publications, and delay due to the preparation of abstracts and the publication of the indexes makes it necessary to consider the original literature, especially for the current year. Some other secondary tools, such as Science Citation Index and permuted KWIC (key words in context) indexes*, which are more closely related to the original paper and are subject to shorter publication delays than the indexes of conventional abstract journals, have been found very useful for the preparation of the survey.

In order to indicate not only the number of publications but also the growth rate, the survey should cover several years. The investigators of the survey should determine whether the research activity which generates the papers is widely scattered or whether it involves only a few specific locations. In the latter case, it is useful to identify the laboratories or institutions which are particularly active in the field. Occasionally, the study is made easier, if the research activity in question must rely on the availability of a relatively rare piece of equipment, such as a special particle accelerator, a telescope, etc.

It must be recognized that the literature does not fully reflect the activities at a narrow but rapidly growing area, especially of technological disciplines.

Papers delivered at specialized meetings of societies or foundations are representative of the research and development trend because of the shortened time lag between completion of the work and presentation to the community. Programmes of meetings are a valuable source of information ; specialized compilations of papers presented at meetings and summaries in the trade journals of general membership journals of learned societies should also be consulted. However, industrial or governmental secrecy, patenting requirements, etc. may be interfering with the publication of new material and may distort the picture . Whenever possible, these negative factors must be examined and explicitly identified.

The information derived from a retrospective literature search permit the forecasting of probable growth of the field for the next three to five years. Such a forecast is very useful in determining the required level of acquisitions, the anticipated size of the document collection, the space requirements and the needed funding for the proposed IAC.

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* The Science Citation Index, published by the Institute for Scientific Information, provides access to authors and papers cited in the worldwide scientific literature. The KWIC indexes allow to search for each meaningful word in the title of an article.

It is important for the prospective sponsor to know that the new activity can be housed in two rooms and will not require additional building space for the next few years.

b. Financial support of the subject activity

An article in the open literature represents research work initiated about eighteen months to two years earlier. Therefore, a survey of activity in fast-moving areas must also take other factors into account, in particular, the financial support of the subject field and its rate of growth.

In many countries, research programmes can be frequently identified by means of official indexes. For example, in the United States, the Science Information Exchange of the Smithsonian Institution is an effective tool for identifying current research activities, although coverage of non-governmental research is not complete. The computerized files of SIE contain a short description of the work in progress and indicate the level of funding. International compilations of ongoing research are now in various stages of planning and operation.

Publications of national and international scientific societies which habitually sponsor research projects usually publish surveys on the status of the individual programmes. For example, the International Union against Cancer identifies the status of many aspects of cancer research. These surveys represent another useful source for identifying the subject matter within a narrow discipline and thus can be used to indicate the rate of growth.

c. Determination of the location of research activity

The degree of dispersion of the pertinent research activities is another factor that has a bearing on the establishment of a new IAC. In rare cases, i.e., when the new work is carried out or is supervised by a single institution - i.e., not dispersed - the project management itself may be considered to be functioning as an information analysis centre. On the other hand, publication of a fundamental paper on a novel process or technique may excite a widespread response throughout the world, a "breakthrough" experiment may be repeated in several locations under a variety of new conditions or a new technique may be put to new uses. Such factors contribute to the rapid growth of new research areas in unrelated areas. In other cases the location of a new project depends on the availability of an expensive or highly specialized research tool, such as a telescope, a special kind of particle accelerator or a specific measuring instrument.

The management of the future IAC must be aware that it must monitor five or fifty or five hundred sites. The size of the financial and personnel requirements depend greatly on the number of research sites that must be kept under surveillance. For example, research on high polymers may be carried out in many industrial and university laboratories, but by the very nature of the subject, nuclear criticality studies are restricted to about a dozen laboratories throughout the world where the needed equipment is available and certain experiments on high energy particles can be carried out only at CERN in Switzerland, at Dubna in the

Soviet Union or at Stanford University in the USA.

Should the preliminary survey indicate that the activities are indeed widely scattered, the new IAC might decide to organize periodic conferences for the purpose of providing liaison between the researchers.

d. Funding sources

Determining the reliability of financial support for the proposed IAC is another important facet of the study recommendations, in order to prevent the creation of an ephemeral organization, unable to survive long enough to become self-supporting.

It should be recognized that the establishment of an information analysis centre is an expensive operation. The IAC is basically not a profit-making institution; in particular during its initial period of operation its success depends on the cooperation and support of technical experts. When investigating the potential for financial support of a new centre, the main argument in the request for funds should not be aimed at the prospect of a prosperous new enterprise (although there are examples of financially successful centres), but that of an absolutely necessary supporting organization.

It should be kept in mind that the chief beneficiaries of the IAC are the individual technical users who represent a diffuse community and can rarely give effective voice to their needs.

Funding is the most critically important but often neglected subject, which deserves closer examination. It has been generally accepted that interaction between scientists and recorded knowledge - the literature and the various links of the scientific and technical information transfer system - is an integral part of the research process. Ideally, information activities should be more or less directly included within the research funds. Acceptance of this concept is necessary for the existence and viability of information analysis centres.

It follows therefore that the most appropriate source of primary support for an IAC is an agency whose mission or role covers the proposed field of activity of the new centre. This agency may be a department or ministry of a national or regional government, an academy or other scientific society, an international professional organization, a trade association, a university or a research institution. For example, the USSR Academy of Sciences, the US Department of Energy, the OECD and IAEA all support information analysis centres.

Frequently technically-or scientifically-oriented private companies undertake the sponsorship of an IAC. As a matter of fact, large chemical, electronic, pharmaceutical, engineering, instrumentation, etc. companies usually maintain a special centre which satisfies most of the criteria defining an information analysis centre. An industrial or private IAC does not serve all interested scientists because it desires restrict access to its functions to persons within its organization..

A request for the support of a new IAC should be accompanied by a proposed budget for the first three years of operation. It is appropriate

to estimate the anticipated rate of growth of a new IAC. As the newly-created organization matures, its manpower requirements and other expenditures will increase; the proposed budget should reflect this.

The budget should take into account that the start-up may necessitate some extraordinary, non-recurrent efforts, including the evaluation of the backlog and the training of the personnel. Because of the almost guaranteed existence of this backlog the new IAC will require six months to a year of professional activity before it becomes an effective server of its users' needs. Beyond this period, the original budget should indicate the anticipated steady-state level of the activity.

e. Statement of the scope

A very important preparatory step in establishing a new information analysis centre is the careful description of the scientific or technical field to be covered, and of the service to be rendered. Although in actual practice, the indicated boundaries of the area of interest are often expanded or reduced after the initial period of operation, it is important that everyone connected with the center--the staff, the sponsor and the users -- realize that it covers a clearly-limited field; in particular, it should not be confused with an information wholesaling-type organization, such as a large, discipline-oriented abstracting service. For example, Physics Abstracts, INIS or the various sections of the Bulletin Signalétique are very valuable information - handling services but they do not cover too broad a field to fulfill an analytical function.

Topical areas which are specifically omitted should also be explicitly mentioned in order to avoid any misunderstanding. For example, the previously-mentioned centre devoted to high-purity materials (the Research Materials Information Centre) clearly indicates the amount of impurity in the compounds that it includes in its coverage, it also states that industrial materials, even though they might possess high purity - such as silver used in photography - are not considered.

On the other hand, the experience gained during the operation of the centre revealed that the users are interested in the technique of preparation of these materials and in analytical testing methods answered conveniently. Thus, the boundaries of the coverage may be changed during the operation of the centre but all changes must be clearly indicated.

The description of the scope of a new centre represents its "charter." Like a constitution, such a document can be amended, interpreted and even misinterpreted; its very existence indicates interest in certain areas.

The management of the new centre must be aware of other centres which operate in related areas. The user public cannot be expected to be informed about the details of coverage, and therefore, inquiries are occasionally addressed to the wrong organization. Instead of simply returning a misdirected inquiry to the sender, it is preferable to send it to the proper centre whence an answer can be obtained.

f. Staffing problems

As in most human endeavors, quality of the staff determines the success or failure of an IAC. Efforts should be made to obtain the services of highly-qualified people, preferably of individuals who themselves have made contributions to the field in question. As scientists and engineers usually do not want to give up active work in their chosen field, part-time employment is often a good solution, assuring that the staff members will retain their intimate contact with on-going work.

The senior scientist or technical specialist who devotes part of his time to an IAC activity or serves as a consultant must be supported by a competent staff to provide assistance in information-handling areas. This staff may include other subject specialists, information experts and clerical assistants. Although at the time of the start-up, usually only the senior person's participation is assured, the presence of competent junior professionals and assistants who handle the routine chores can make participation in a centre more attractive to the vitally needed senior professionals. The latter are usually happy to do the scientifically challenging analysis but may be reluctant to commit themselves to time-consuming or uninteresting literature searches which can be done more efficiently by the supporting personnel.

g. Pre-start-up activities

There is a variety in the operational methods and specific services of the IACs; an a priori choice is often difficult. Sponsoring agencies usually are interested in details of the proposed and anticipated activities. To satisfy this need and to organize the centre on a solid practical basis, it is recommended that the centre be operated "experimentally" on a small scale before submitting a formal proposal. Practical attempts to develop an adequate storage and retrieval system and actually inputting a small amount of material, plus a determination of the most needed services, will indicate whether the appropriate information system has been selected. The experience thus gained will be useful in preparing a realistic request for funds.

This approach has been used by senior scientists already engaged in research in that field. Frequently such a person is in a position to divert a certain percentage of his own time for a short period; considering such "bootleg" IAC-type work as another facet of his own research project.

Trial operation of the centre before its formal start-up yields benefits in the form of practical experience and a more acceptable proposal to the sponsoring agency, although this approach cannot be practiced in every case because of the impossibility to obtain the necessary human and material resources.

To extend this line of thought, during the first period of actual operation of the new centre, its management should be ever watchful to determine whether the best-suited information handling techniques have been chosen. Development of a data base requires large sums of money and unsuitable storage and retrieval methods could be retained because it is difficult to overcome the inertia of the system. Often, the already-encoded material represents such a big investment that the management does not want to abandon it. This inertia and resistance to change in existing large information systems is illustrated by the long and difficult negotiations involved in the efforts to standardize national and international abstracting and indexing services. Even minor differences, such as the use

of initials instead of full first names of authors, cause serious problems. It is therefore important to avoid during the start-up period of a new centre a premature freezing of the system in a potentially unsatisfactory form.

5. Location of the New Centre

Experience gained with a number of information analysis centres has revealed that operation of a centre in the form of a physically-separate and administratively-independent unit is not a good solution. Centres have been established in an office building, without having any neighbors with activities related to the centre's work. Results were, in general, rather unsatisfactory. Staff morale was low and the quality of the service suffered.

This observation does not apply to large IAC's with many technical men and women working together. It is obvious that in most-- although not necessarily all--technical and scientific activities, there is a latent but nevertheless real "critical mass" of manpower; a staff size smaller than this figure results in inefficient operations. This applies to many scientific activities: for example it has been observed that it is not easy to carry out original research in a small college, where the professor is not in regular contact with an expert colleague of his own field. In certain scholarly disciplines this principle does not apply, and many creative people in other fields--poets, composers, writers--prefer working alone, but in the natural and technical sciences, remoteness from working colleagues is not desirable. This has been found to be true for IACs: centres operated in isolation have been moved to a laboratory and it was observed that the centre's operation improved after transfer to a location where intermingling with colleagues was facilitated.

When seeking the physical "home" for a new IAC, the site selected should be, in the words of the Weinberg Report, an institution "where relevant science is flourishing". Other potential sites include libraries, document collections and editorial offices of scientific journals, but these institutions, although they are important links in the information transfer chain, do not represent the best location for a new centre.

The most promising location for a new IAC would be a large, multi-disciplinary research institution, a university or a specialized industrial laboratory, providing an opportunity for the centre's staff to meet with their colleagues working on advanced projects. The host organization would also benefit from the presence of the centre on its premises.

This is a good opportunity to emphasize the difference between the host and sponsor, even though, on occasion, both functions could be assumed by the same agency. Although an IAC might receive its financial support from a government department or ministry which wants to promote progress in the subject field which lies within its jurisdiction, it has been found advantageous to locate the centre at a university laboratory or another place where pertinent research is carried out and the necessary auxiliary facilities are available.

In some countries, scientific societies and national or regional academies of science maintain research institutions which could assume the dual role of sponsor and host. The same applies to certain international research institutes, which bring together leading experts from all over the world. These organizations would profit from the stimulation provided by the presence of the IAC and would not only generate new information but would help to organize all available knowledge within the subject field.

The sponsoring agency which initiates the establishment of the new IAC should carefully survey the major institutions which carry out pertinent research in order to be aware of sources of information. Obviously, such a list does not remain static, as new researchers enter the field. The local availability of specialized services (to be discussed below), such as library, computing facilities, reproduction or photographic departments, etc, should also be reviewed during the first period. The final location of the new centre will be decided by scrutinizing and comparing the material submitted by the interested institutions, followed by a personal inspection of the most promising ones.

6. Input Operations

As mentioned earlier, the information analysis centre is characterized by the presence of subject specialists, who analyze the information and make it available to the technical community in a condensed and improved form. Even a negative action, removal of a part of the material, satisfies the above definition. A critically-evaluated bibliography, containing only worthwhile references and free from routine or unimportant material, is of greater value than a complete and unwieldy listing whose bulk makes it hard for the user to handle and absorb.

On the other hand, people who evaluate the literature sometimes need a pertinent bibliography; authors of review articles must locate and retrieve the pertinent material and other users of the centre may be interested in original papers. Thus, after the scope of the centre has been defined, one important task of the new management is to decide how to maintain control of the literature that must be consulted. This leads to a consideration of the input techniques.

a. Acquisition

The centre must develop an aggressive acquisition policy, to ensure the availability of all papers, reports, books and other items of interest needed by the experts responsible for the output. In addition, the centre must assume, on occasion, the functions of a document centre by circulating directly to the users some of the less easily accessible material.

In many respects, this aspect of the centre's operation is not unlike that of a special library. When selecting the material to be acquired, the first items must include a carefully-screened list of basic reference materials covering broader fields than the centre itself. Although the host institution may provide access to its own central library, the physical distance of the library from the centre and interference with the

use of encyclopedias, handbooks and general technical journals by the library's own customers make it desirable for the centre to collect its own copies.

If the central library subscribes to a large abstracting service, there is little need to maintain a duplicate set; however, the centre must have its own copies of the "fertile" journals, which are expected to contain several articles of interest to the centre in every issue. In order to economize, items of peripheral interest should be collected by the host institute's library.

If the new IAC's scope has been clearly delimited and kept sufficiently narrow, the number of "fertile" journals to be obtained by direct subscription usually can be kept to a dozen or less. Care must be taken not to create an image of a new special library.

In addition to the usual subscription, other less conventional acquisition methods may be used to obtain pertinent articles at a minimum cost. The centre's own periodic publications, such as journals, newsletters, monthly or quarterly reports, etc. might be offered in exchange for the desired journal.

As the centre builds up its collection, the names of authors who publish pertinent articles become known. These authors can be invited to send preprints of their articles to the centre; this reduces the time lag between the completion of the research and the appearance of its description in the literature. This approach works remarkably well because authors are flattered by the recognition of their creative work and are anxious that their latest results be duly considered in the reviews, data collections and other output of the centre.

IACs must energetically collect other, not easily accessible, material of interest to them, such as internal technical reports and memoranda issued by government agencies and private companies, patents, standards. A technical man often ignores the existence of such reports and even when he learns about them, he is often at a loss as to how to procure them. During recent years, many countries established a central clearinghouse to facilitate access to this valuable source of information. As a rule, reports are published more rapidly than journal articles; authors often send them to colleagues as reprints. They are more detailed than the papers covering the same research published later in the open literature.

The centre must pay special attention to specialized papers within its sphere of interest which are somewhat outside of the mainstream of the usual publication system. As an example, the Nuclear Safety Information Centre maintains a complete collection of the large variety of reports submitted to the regulatory agencies by electric power companies which intend to build a nuclear power plant. These voluminous reports are public documents but, because of their specialized nature and limited interest to the general technical community, they are not regularly acquired by libraries. These reports and the formal response of the regulatory agencies are very important for engineers who study the safety aspects of reactor operations and even for interested citizens and therefore the centre makes every effort to ensure that they are acquired within the shortest possible time. Each analysis centre must identify such specialized sources of information which then must be cultivated to ensure a complete coverage of the field.

In this respect, an IAC operating within an area of pure science (for example the Thermophysical Properties Research Centre) has an easier task because its input is restricted nearly exclusively to articles published in refereed journals. On the other hand, such centres must acquire copies of papers presented at scientific meetings, because they anticipate formal publication by many months and must be in contact with regular contributors.

Centres covering a field within an applied science must keep track of the patent literature. This entails a coverage of patents issued in several countries and an examination of patent applications as soon as they are made public. In certain cases, the trade literature must be scrutinized also; technical advertising and press releases about new products and processes contain occasionally worthwhile new information.

Thus, one of the first tasks of a new centre is the identification of the sources of needed material. As much as the budget allows should be acquired directly, maintaining control over the rest through convenient surrogates, such as abstracting services. The IAC is an information "retailer"; just like in commerce, it must know the best "wholesalers" of the material that it needs, taking advantage of their services instead of duplicating them unnecessarily.

However, duplication is not always wasteful. Papers often contain information outside of their stated main scope; for example, an article discussing primarily questions of chemical structure might describe a method of preparing the compound, or a medical article on the clinical use of a radioisotope might include hitherto unpublished information about the biological half-life of that isotope in the organism. The specialist learns where to look for this hidden information which is usually not mentioned in the published abstract and index. In such a case, it is justified to prepare a new abstract because the paper has been scrutinized from a different point of view.

Acquisition is among the most important activities of the centre; without raw materials, the centre would be unable to fulfill its mission.

b. Indexing

The acquired material must be brought under bibliographic control. This does not require novel operations : the techniques generally used for information handling are employed, although they must be adapted to the specific purpose of the centre.

In view of the fact that the IAC operates within a narrow field but covers it in great depth, the available thesauri, prepared by abstracting and indexing agencies, may not be totally suited for indexing, although they can be used as a starting point.

The specific requirements of the centre may make it necessary to adopt an original approach. It must be kept in mind that the purpose of indexing is not a scholarly organization of the material but a scheme to facilitate its retrieval. Solution of the problem is made easier by the fact that the users of the system are primarily the staff members of the centre who can be trained in the specific features of the index. Indexing practices can be easily communicated because the generators and users of the index overlap to a large extent; this facilitates the search and retrieval. Lack of such continuity presents serious problems for large organizations which covering broad fields, such as a section of the

Referativnyi Zhurnal or the Bulletin Signalétique : the indexers must try to anticipate the thought processes of a user in a faraway country who, several years later, will attempt to find the items he is interested in by using the index.

As the indexing work is performed by subject specialists who are not experts in information science, a central "authority", responsible for making changes in the system, must be established. This individual or group will supervise the indexing technique and collect special technical terms used in the articles of interest for the centre; this could form the basis of a specialized glossary.

c. Storage and Retrieval Methods

There is a great variety of information storage and retrieval systems which can be easily adapted to the particular needs of an information analysis centre. Of special interest are the various microfilm storage systems based on either individual standard microfiche or on 35 or 16 mm. film cassettes. In one system, the storage and retrieval features are combined, making it possible to eliminate a time-consuming intermediate step of physically retrieving the material, once the bibliographic reference has been obtained. Microfilm systems present the advantage of reducing the space requirements; in addition, many original documents may be obtained currently in microform at a reduced cost. Commercially available hardware allows the convenient enlargement of the whole text or the desired portion only : thus several people are able to consult the collection conveniently without affecting its integrity. The frustrating notice that the looked-for documents have been loaned out or are simply "missing" is not encountered. Microfilm systems are also of special interest for storing blueprints, architectural or engineering drawings, circuit diagrams and other odd-shaped or bulky items.

During the last few years, great progress has been made in computerized retrieval techniques. Whenever the host institution has a suitable computing facility, the use of an automatic retrieval system must be seriously considered; the great variety of currently-available peripheral equipment makes even on-line operation quite convenient, even in connection with a remote, time-sharing commercial computer centre. However, many IAC's have a relatively small data base, and in such cases, their ease of handling and low cost may render some of the manual systems competitive. It has been found desirable to start up the centre with a manual system that can be easily converted into a computer-based operation should the size of the collection exceed a certain level, usually about 10,000 to 20,000 items in the active file.

The active file can be kept to a manageable size by restricting most of the search and retrieval operations to a reasonably short time period. With the exception of a few special cases, such as the preparation of a historically-oriented review article, there is little need to retrieve every single item on the subject. The IAC staff member is usually interested in the increment of new knowledge contained in an article, not in the article itself. If the new knowledge is of lasting value, it will be incorporated in a more recent article, obviating the need to retrieve the original, except for giving credits to whom it is due.

In most cases, the time span covered in a retrieval operation can be conveniently restricted. In fast-moving research areas, the "half-life" of publications is relatively short; on the other hand, in some fields, old data conserve their usefulness for long periods. An archeologist and a rocket designer differ widely in their attitude toward their respective literatures.

The size of the file can be further restricted by evaluating the rate of obsolescence of the data base. Removal of unneeded items helps to optimize the cost of storage and retrieval operations and improve relevance/recall ratios without eliminating desirable material. The weeding-out operation--removal of articles which have outlived their usefulness--is as important as correct input; however, it is an expensive function, carried out by a subject expert. The IAC should restrict its holdings to articles of real current interest.

7. Supporting Services

In chapter 5 the problem of large laboratory acting as host to an IAC was examined, emphasizing the importance of a congenial surrounding to the technical staff. However, in addition to this psychological reason, there are also some specific, economic arguments for locating the new centre at a large institution.

Although the IAC has its own well defined activities, some of the input and output operations are similar to those of other information-handling agencies. Great savings may be achieved by avoiding wasteful duplication of facilities which can be more efficiently operated on a large scale.

a. Library

The technical staff of the IAC often needs references from various fields of science outside of its highly-specialized interests. Only a certain limited number of textbooks, handbooks, etc. should be included in the holdings of the centre, avoiding economically wasteful acquisitions. It is therefore desirable for the centre to have access to a well-managed technical library. The library also could provide the centre's staff with the means to keep up with the latest developments in neighboring fields.

The cost of organizing and maintaining even a modest library is relatively high; this expenditure can be justified only if the library serves a large body of users. Establishment of a library for the IAC would seriously drain its assets. However, if the staff members of the centre are employees of the sponsoring organization, access to the library is justified.

If the library is located relatively close to the centre, its premises may be used to store most of the centre's own collection; however, as mentioned before, the IAC should have its own copies of "fertile" journals; otherwise, the heavy use of these journals by the centre's staff would interfere with the services expected by the library's generale clientele.

Such a symbiotic relationship between an IAC and a library offers other advantages. Librarianship includes many special skills, not always possessed by the IAC staffers who are primarily technical subject specialists. The librarians expertise could be valuable in managing the centre's private collection--subscription to foreign journals, cataloguing, etc. In turn, the IAC could provide special technical assistance to the library.

b. Document collection

Cooperation between a document centre and the IAC also presents mutual benefits.

Handling of the non-journal literature requires special knowledge. Although procurement of documents became easier in many countries during recent years, it is still not always a simple matter to locate the supply source for reports and to find out how to pay for them. The experience of the document centre's staff can be valuable to the IAC.

In some isolated cases, the staff may want to consult documents, the circulation of which is restricted for various reasons. In that case, the document centre could serve as a depository for the IAC, simplifying greatly the physical handling of the papers.

Thus, a conveniently available library and document centre are used primarily for consulting books, journals and beyond the narrow limits of the IAC and to take advantage of the special skills of their staff members in certain areas, such as procurement.

c. Computer centre

It should be emphasized that the IAC, although a creation of our time, is not automatically wedded to computerized storage and retrieval systems, although the use of such techniques is wide-spread. As pointed out before, if the holdings and the growth rate of the centre exceed a certain critical level, the use of a computer-based system should be seriously considered.

Proliferation of peripheral equipment makes it possible even for the smaller centre to take advantage of a great variety of tape services prepared by the large discipline or mission-oriented information handling agencies and by private companies. The centre's own holdings may be manipulated in a batch mode or on-line by an outside and often remote computer facility. However, it is preferable to have direct access to a computer centre, staffed with programmers and information specialists. The availability of such a centre is an important factor in deciding the location of a new IAC. It should be also kept in mind that charges for in-house services of programmers , input and output operation and costs of access to the computer are usually considerably lower than those of commercial computer centres.

In these days of continuously changing hardware, the operating programmes cannot be kept constant. The centre's own employees must know how to use efficiently the established systems but they cannot and should not spend their time on the novel features of recently-introduced equipment and on the development of new programmes; this work can be much better carried out by the staff of the computer centre.

d. Editorial, Graphic Arts and Reproduction Services

The output of the centre, which will be discussed below, consists primarily of technical articles, reports, data collections and critically-evaluated bibliographies. The authors, being primarily technical specialists usually do not know the details involved in the preparation of a manuscript for publication, of the needed illustrations drawings, graphs or photographs and lay out for reproduction.

While the printing is usually entrusted to an outside printing firm, the centre should retain control of the preparation of the final manuscript, illustrations and correction of proofs, in order to ensure close collaboration with the authors. The IAC is usually not sufficiently large to be able to operate its own specialized service, but it could become an important user of the existing editorial and graphic arts departments of the host institution. If the volume of publications is sufficiently large, it could justify the operation of an in-house reproduction facility.

Preparation of a "camera-ready" copy is facilitated today by the availability of modern equipment, such as magnetic-band typewriters with automatic margin adjustments, eliminating the need for highly-skilled composing and reprographic craftsmen. If the volume is small, as it would be during the start-up period of the centre, the typing, editing, proofing and reproduction functions may be merged with the conventional office operations.

8. Output Operations

Establishment of the centre, its staffing with experts, organization of the input, selection of a proper storage and retrieval method have only one purpose : to solve problems of science or technology lying within the scope of the centre. The IAC's goal is to provide assistance to individual scientists and engineers with problems that its staff is competent to handle. The means used to achieve this vary from case to case but most centres use some or all of the methods described below.

a. Abstracting service

As a general rule, information services tend to "compress" the literature. In some cases, this compression is quite literal : the large volume of articles, reports, book chapters, etc. which occupy so much space on library shelves is reduced in size by means of various micrographic techniques. Even though we have not reached the utopian vision of Vannevar Bush *, the current methods are sufficiently advanced to enable a user to have instant access to selected reference materials.

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* In his visionary book "Endless Horizons", published three decades ago, Vannevar Bush pointed out that the methods used to transmit and to review the results of research are generations old. He foresaw the wide application of modern techniques - microphotography, computer-based systems, etc. His predictions, many of which have been fulfilled, served as guidelines in the development of the present information-handling technology.

Microforms are useful to keep the space requirements of the IAC within reasonable limits. Expenses can be further reduced by taking advantage of the needed microfilming equipment and trained personnel of the host organization. Although microfilming is basically a routine operation, it requires close adherence to the carefully developed techniques, especially when very high reduction rates are used.

However, information science uses also intellectual, rather than mechanical means to reduce the volume. The user is supplied with an abbreviated surrogate - the abstract -, which contains the most important features of the original paper.

The abstract presents the gist of the basic information contained in the article. An abstract prepared or used by an IAC should contain the data and the basic conclusions of the original. The size of the abstract cannot be clearly defined because it depends on the size of the original; it may exceed 300 words but, in most cases, it is able to fulfill its information transfer mission in about half as many words.

The abstract used in an IAC shoudl be truly informative, not only descriptive; i.e., it does not simply mention the subject of the article but gives sufficient details to obviate recourse to the original. The major abstracting services have different criteria than an IAC. Their goal is to bring the pertinent literature under bibliographic control, taking the availability of the original journal and the language it is written into account. Occasionally, this approach may yield surprising results. An article of obvious value, written in one of the major scientific languages and published in a well-known journal with a wide international circulation might be represented with a shorter abstract than an article of lesser merit, published in an obscure journal and written in a language understood by a small percentage of potential users. Editors and abstractors must make deliberate decisions to ensure access to the world literature by most interested parties.

If the original article is complex, covering a variety of subjects, as in the case of progress reports, the abstractor has little choice but to limit himself to a descriptive abstract. Even so, the publication has at least been brought within the information transfer chain by being abstracted and indexed.

An IAC has an easier task than an abstracting and indexing service because it has no aspiration for universality; it is free to consider only the section of the report that lies within its scope. For example, if the field of interest of a certain information analysis centre involves a special type of alloy, no attempt would be made to cover all sections of a space vehicle development project which contains references to the physical properties of that alloy, determined under a variety of conditions. Instead, the abstract would deal with only the few pages of the report which relate to the subject area of interest of the centre, listing the physical properties and the experimental conditions and ignoring the rest of the report. A metallurgist might be looking for different information when studying the phase diagram of an alloy than a nuclear engineer who must examine the isotopic distribution and the absorption cross section of the component elements.

The same reasoning applies to the use of an abstract prepared by another organization, such as a major abstracting service : when an existing abstract fulfills the needs of the centre, it should be used, instead of preparing a new abstract*. The abstracting agencies have competent abstractors, but they follow the rules developed by their sponsor. The centre's interest might be slightly different, and this difference sometimes justifies the preparation of a new abstract, even when an otherwise acceptable abstract is already available, even if it has been prepared by the author himself. Therefore, the same article is often abstracted differently by a chemical, physical or biological abstracting service.

b. The extract

Preparation of an abstract is a time-consuming operation : it requires a careful reading of the original article. It usually contains a summary restatement of the purpose of the work, the method employed, the actual findings and the conclusion. This process can be simplified by taking advantage of the text prepared by the author himself.

Many centres use the new tool--the extract originally proposed by G.S. Simpson of Battelle Memorial Institute. It is prepared by a subject expert who browses through the document and underlines or brackets portions of the text which carry new information, thus weeding out the introduction and certain details of the text which are not important to him. The underlined portions are then retyped and stored, thus "compressing" the article with a minimum of editorial effort.

Admittedly, the technique is not perfect; the result may be somewhat jerky as the passages have been lifted out of their immediate context. However, it should be kept in mind that the extract is used primarily by the staff of the centre and less frequently by other technical peer groups. Its value is judged primarily by the information it contains and not by its stylistic elegance. It is capable of delivering more information for less money and its use should be seriously considered.

Extracts are especially important when dealing with foreign-language articles that the staff cannot read and wants to have translated. Preparation of a translation is more time consuming and expensive than that of an abstract, and therefore, it is desirable to limit the material to be translated. In that case, a knowledgeable technical linguist must collaborate with the subject expert. The results is a cheaper and more objective product, obtained more rapidly.

The concept of extracts is under serious consideration as a new approach for rejuvenating technical journals. High prices are forcing the technical community to drop individual subscriptions, thereby shaking the foundations of the present information transfer system. The solution should be a dual publication : the shorter, less expensive version would contain only extracts and summaries, while the "archival version", to be sent to libraries, would include the whole article. The so-called synoptic journals represent a similar effort. The Soviet publication "Atomnaya Energiya" made pioneering efforts in this field.

The staff of a newly-established centre should examine the arguments for and against the use of extracts when establishing the basic operational technique for the data base. The extracts may be merged with an existing collection of abstracts.

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* It is assumed that the abstracts are an internal resource of the IAC and are not scheduled to be published; therefore, the thorny problems of copyright will not be discussed here. Some IACs use abstracts and coordinate indexes for their sponsors.

c. Evaluated Bibliographies

The starting point of an information-gathering activity involves usually the preparation of a bibliography of the subject matter. Bibliographic data such as authors, titles and journal references of the pertinent papers are assembled and organized by a variety of search-and-retrieval techniques. These lists are very useful for people who want to be initiated in the subject, prepare a review or need background information to carry out their own research.

Most bibliographies are prepared on the basis of indexes. It does not matter whether the actual retrieval is carried out manually or by computer; the index term, assigned by an indexer in the past, is actually the "handle" that allows the system to pull out the item. It must be kept in mind that indexing is not an exact science and the limits of the meaning of a term are not necessarily perceived in the same manner by the indexer and the user who is separated from the former by time and space.

Certain "hard" concepts can be defined sharply; e.g., papers dealing with a certain element or compound can be easily recognized if the subject matter is indeed the compound in question. On the other hand, a more vague concept, such as "operational hazards" "protection of the environment" might be hidden in the article and only an alert indexer would recognize it and tag it for retrieval.

Because of differences in indexing, the cited items in a complete bibliography do not present the same interest. The user may experience the same disappointment as the reader of a large encyclopedia who finds a number of references in the subject index, only to discover that most of them do not actually treat the subject, but simply refer to it superficially. An excessively conscientious indexer thus helps to retrieve items which do not contain worthwhile and truly new contributions.

The "evaluated" bibliography eliminates this shortcoming. The centre's experts do not simply check whether an individual article carries the indexing terms required by the search strategy but read the papers carefully to ascertain that they contain pertinent and worthwhile new information. Evaluated bibliographies indicate review articles which are of special interest to newcomers in the field, and state-of-the-art papers which describe recent progress in the field. This type of bibliography represents an important tool not only to the staff of the centre, but also to external users.

Although the bibliographic entries are usually selected from the indexes of the large abstracting services, the literature references in certain papers are used occasionally as a valuable source. The cited papers have presumably already been closely examined and found to be worthwhile by experts. Current reprints obtained by active workers in the field from their colleagues by means of personal exchange have often served as the nucleus for a critically-evaluated bibliography.

Originally, the bibliography did not attract scientists, but in recent years it has developed into an important tool both for bench scientists and the information handling community. Many information analysis centres found, to their surprise, that their published bibliographies had become "best sellers".

d. State-of-the-Art Reports

The state-of-the-arts report is a new type of technical paper that has been developed primarily since the advent of the information analysis centre. It is basically a review article, without, however, the latter's all-encompassing scope and historical orientation. It emphasizes timeliness; therefore, it describes a current, or at least a very recent situation when it reaches its audience, while a review article which might take a year to prepare and an additional six to eight months to be published, represents a scholarly discussion and is not timely enough to be used as a current-awareness tool. In order to maintain this timeliness, the state-of-the-art report must be published by informal means and not in an "Annual Reviews" type of book.

The state-of-the-art report is used mostly in technological fields. Quite often a variety of factors must be taken into consideration when describing the current situation of major projects; therefore, it is not unusual to draw on the knowledge of several experts in the preparation of the report.

A well-written state-of-the-art report is very useful because it obviates the need to consult a number of articles in a variety of fields. In addition, it consists not only of a collection of summaries or abstracts but represents a true synthesis.

In order to maintain the high standards expected in the scientific literature, the state-of-the-art reports frequently are subjected to review by outside experts. Requirements of printing, distribution and other technical factors make it necessary to establish a fairly rigid time table for the completion of the first draft, edited copy, reviewers' comments, etc., in order to achieve the promised regular periodicity of the publication.

A special but important case of state-of-the-art reports consists of a periodic tabulation of licensing, construction, operation and similar activities related to major projects such as space research, energy generation, etc. The general technical public is unable to distill this information from the mass of individual reports, and these listings often become authoritative reference manuals.

e. Topical reports

In addition to the state-of-the-art report, the centre must devote a certain portion of its resources to the examination of individual, non-recurrent problems within its scope. Research at the forefront of science cannot be completely chartered; while formal engineering projects follow a preset programme, new concepts and developments may arise unexpectedly in the course of research as a result of a chance discovery or new insight on the part of a researcher. They are followed up and examined by means of a topical report which is usually not periodic in nature.

The experts who regularly scan the literature are in good position to decide at what point the work carried out on a specific subject deserves to be scrutinized more closely by means of a topical report which is only slightly less ambitious than a monograph. Occasionally, it is the information specialist of the centre who alerts the subject expert, advising

him that the sudden increase in the literature references indicates a strong activity in the field. The majority of active workers do not have full access to the voluminous literature and even if they have the papers, they usually do not have the time or the inclination to examine them with the care that they deserve. This intellectual work of synthesis is carried out for their benefit at the IAC by the author of the topical report.

f. Selective dissemination of information (SDI)

This service is currently a very popular product of computer-based information systems, enabling busy scientists and engineers to keep up with the literature pertinent to their interest without devoting excessive time to browsing. Many executives, administrators, educators and others, not directly engaged in research who want to be kept informed about the latest developments with the least possible waste of time are also using such services. An IAC with a computerized storage and retrieval system can easily adapt its programme to fulfill the SDI function.

The programme is similar to that used for retrospective searching. The "interest profile" of the individual scientist or of the whole research group is determined by selecting the proper keywords, combined in the usual "and", "or", and "but not" modes of Boolean algebra. If the input is subdivided into specific categories, the user may select one or several categories which are closest to his own field. At regular - usually weekly or monthly - intervals, this profile is compared with the keywords or category assignments of recent entries into the systems; the items which satisfy the preset requirements are selected automatically; the abstract or bibliographic reference of the "hit" is printed and mailed to the user, whose address is stored together with his interest profile.

Thus, the user is able to scan the new literature pertinent to his field without wasting his time by browsing through a large number of journals, searching for the one or two articles of interest to him.

Although this type of service is also offered by several abstracting organizations, libraries, etc., it has become a popular service of the IACs. The centre already has carefully delimited the field; its indexing is more refined and the terms used are closer to the specific interest of the user than the broad keywords and category indicators of the large information-handling organization. In addition, the centre's staff is available to redefine the profile if the user receives too many unwanted items or if his field of interest changes with time.

The SDI service has its "human" predecessor. Large organizations used to, and occasionally still do, assign to a knowledgeable staff member interested in the scientific literature the duty of following articles published in selected journals in order to identify papers covering a field close to work in progress within the organization. If he finds something of interest, this "literature monitor" alerts his colleague, advising him to read the paper in question. As a variant of this, researchers of many laboratories organize "journal clubs", dividing the journals in the library among each other and alerting their colleagues whenever they find articles of potential interest to them. This practice is especially widespread in the field of biological sciences, in which the material of interest is likely to be scattered in a large number of journals.

The SDI simplifies this task by mechanizing the selection, although the human mind remains the ultimate judge of the pertinence and value of the paper. It should be noted that SDI is a custom service and as such, it adds to the internal operating cost of the centre. It should be regarded therefore as a potential service-charge item.

g. Journals

Although the original articles in technical journals represent a main source of input for the centre, some IAC's publish their own journal as a medium for their output. There is a logical basis for this. An IAC, with its established reputation, serves as a focal point for its field; its staff members are recognized as colleagues by the researchers. People working in a narrow, highly-specialized field which became suddenly active, might find a shortage of journals in which to publish their articles; this could cause delays in the publication. Such a situationcould justify the establishment of a specialized journal by an IAC, especially in newly-arising, interdisciplinary fields, such as environment studies which fall outside the scope of established technical journals.

In some cases history followed an opposite course. The editorial board and the reviewers of the journal represent a concentration of specialized knowledge. For administrative reasons, the journal editors often maintain a list of contributors (authors), bibliographic cross references, etc.; to facilitate indexing, they prepare thesauri, keyword lists, glossaries and other pertinent collections. The journal is thus a logical starting point for a new centre.

Regardless of whether it came first or was created after the establishment of the centre, the technical journal is considered a most valuable asset of the IAC.

h. Newsletters

Journals containing original articles or review papers transmit primarily basic technical or scientific information. However, science and engineering are not an abstract concept but represent a human activity with its own distinct social aspects. Research is not done in a vacuum; it is carried out by individuals who are promoted, rewarded, transferred, retired etc.; projects are proposed, authorized and terminated. All this generates a mass human, financial, economic and other non-technical information which is of great interest to the community involved in the activity.

The IAC can satisfy this human interest by publishing a specialized newsletter and circulating it among the participants. The newsletter carries information about forthcoming meetings and recent achievements, describes new services of the centre, list personal news, and in short, covers all the non-technical, ephemeral aspects of the subject field.

This is not a negligible question. It should be kept in mind that recognition by peers represents the highest accolade for scientists. Publication in technical journals is the primary medium for this, but news about awards, honors, elections to fellowship in learned societies and similar "human-interest" stories help to cement the relationship between the centre and its users because they are read with interest by the community.

The Newsletter serves also as a medium for polling the users, to determine how they like the services and to advise them about changes, improvements or new activities of the centre. A well-edited newsletter can create a bond between members of a technical fraternity. The editorial work is usually a part-time duty of a staff member of the IAC.

1. Organization of Conferences and Meetings

Primary and secondary technical literature--original articles, review papers, abstracts, etc.--is a most important information resource of an IAC. However, as has been pointed out above, the role of the human element in the development of science and technology cannot be neglected. Scientists do not only write articles; they also like to meet each other face-to-face. Important developments are often communicated during meetings and conferences because the waiting time before it becomes widely known is reduced. Acceptance of an article at a national meeting of an important society confers a considerable prestige on the speaker.

The large congresses of the major national and international organizations which attract thousands of participants have only a severely limited time available for delivering the talks, and for the discussions. These meetings often degenerate into a parade of speakers, who occupy the podium for 10 or 15 minutes and instead of serious discussions, are asked only one or two perfunctory questions. In such a case, the speakers' interest is "archival" : they want to be listed in the programme and in the transactions of the conference.

The information analysis centres and several other institutions, such as international agencies, have been organizing another type of meeting. They bring together a few active workers in a narrow, fast-moving area of science, providing them with a forum to describe their work and to discuss recent developments with their colleagues. Such meetings help to render more "visible" the famous "invisible colleges" of science.

The type of meeting that an IAC should organize is illustrated by the topical meetings of the International Atomic Energy Agency and by the Gordon Research Conference in the United States. Although these meetings are announced in the technical press, they are open only to specially-invited experts and a few others whose competence in the subject matter of the conference has been established. The number of participants is kept low enough to enable them to get in contact with each other. Sufficient time is set aside for discussions; often, the speaker does not present a formal paper but only outlines the status of the subject and serves as a discussion leader. In addition, a substantial portion of the time is left completely free from formal schedules in order to facilitate the discussion of originally unforeseen topics.

Admittedly, this does not always work out perfectly; the being only human "in" group is not always objective and contain unpopular concepts could be kept from the agenda.

The staff of the centre could act as the secretariat of this type of conference, taking care of logistics and general arrangements. Through their study of the literature, the IAC staff members are aware of the "burning questions" of the day; they know who the active workers are, and are thus in a good position to draw up the list of participants.

Topical conferences can also include

a) workshops in which new data-gathering experimental techniques are presented in a laboratory environment, actually demonstrating the new techniques, and

b) data-hanling workshops, in which retrieval, analysis and manipulation of the data are performed.

These topical conferences are helpful to bridging the gap between the bright young researchers and the established experts. The informal conferences give an opportunity to discuss minor but nevertheless valuable experimental details --instrumentation, special techniques, materials, etc. which are often deemed unimportant by editors and are usually not included in the written publications.

The staff of the IAC also draws profit from these conferences : they will become personally acquainted with the subject specialists whose expertise might be needed to prepare state-of-the-art reports or for the consultations described below.

It should be emphasized that these conferences are costly and their organization requires considerable experience.

j. Individual problem-solving consultations

It has been mentioned earlier that the primary concern of an IAC is technical content and not systematic filing and retrieval of documents. Of course, a well-run centre takes advantage of recent advances in information science, such as the computerized handling of documents which facilitates considerably routine housekeeping operations. Progress in indexing, searching and retrieval techniques makes it easy to obtain articles which satisfy the request as interpreted by the information specialist. This requires a search strategy based on the knowledge of the indexing system and an understanding of the question. As it is not possible to achieve a 100% relevance, the material obtained must be examined, in order to eliminate the items which are not responsibe to the question.

A general perusal of the literature is useful a tool but some people are searching for a specific answer. It is satisfactory to provide background information for an article or to describe the prior art to an inventor and his attorney, interested in all material on the subject. A technical man assigned to work in a new, less-familiar field finds it also convenient to study the pertinent literature.

However, the recorded literature cannot provide answers in every case. It is incorrect to assume that there is a specific answer in the literature to any question that may arise, even if we limit ourselves to existing knowledge and we cannot assume that lack of success is simply due to a wrong search strategy and further improvement in indexing and retrieval techniques will eliminate the need for human intervention. Therefore, consultation with specialists is one of the services that an information analysis centre can provide because the centre combine the best minds in the field and an efficiently-stored and easily accessible specialized literature system.

A certain portion of the questions raised by an IAC are of foreseeable, routine nature. An alert management which scrutinizes the requests can easily identify the types of question which crop up fairly regularly; they may be handled by preparing suitable brochures which are sent out in answer to the inquiries.

There are, however, questions which cannot be satisfied by foreseeable answers or by bibliographic reference lists. They must be handled on an individual basis by the subject experts of the centre, because no document contains the specific answer to the question that the user wants. The expert might simply locate a hidden numerical value that cannot be unearthed by the usual search procedure or present a solution of the problem for him. Of course there will be occasions when the answer will be simply that the present state of our knowledge precludes any solution.

The following inquiry, submitted to the Nuclear Safety Information Centre (5) illustrates a question requiring close personal analysis:

"In analyzing a hazards report for a normal nuclear power plant of about 500 MWT, with a conventional Westinghouse-type pressurized water reactor, a doubt has arisen concerning the production of argon-41 from cooling the biological shield with air. We would like to know what is the normal production of that nuclide in the above-mentioned operating reactors".

It should be pointed out that this approach to information retrieval--"asking the man who knows"--is the oldest one. Mankind has traditionally relied on authority : the child asks the parents, the student relies on the professor. The "authority" is not necessarily always right, but it is assumed to know more on the subject than the inquirer. However, it must be recognized that no agency or organization can be expected to be the sole possessor of knowledge. Even the academies consisting of members of the recognized elite of science and technology are considered at times as a collection of people who are unable to change their thoughts.

The problems submitted by the users are examined and if possible solved by the IAC staff member, who draw on their expertise to provide an answer. However, the centre should not limit this type of work to its own specialists but must maintain a list of experts in the various areas within its scope. Fellow workers at the host institution are a good source for such consultants.

(There are organizations which maintain general listings of experts, indicating their areas of competence; however, these "referral centres" do not attempt to provide answers to questions - they only bring together the two parties, just like a general medical practitioner who refers his patient to a specialist).

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(5) J. R. Buchanan and Wm. B. Cottrell : "A Summary of NSIC Activities, 1963-1967" ORNL-NSIC-46, September 1968, page 31.

Organization of a problem-solving activity presents personnel and financial problems. Sometimes it is difficult to induce researchers and other experts to stop their own work and devote their time to the solution of somebody else's problem. This management problem can be solved by the proper policy, outlined in Chapter 4f. Time spent in IAC activities should be charged against the centre's account, making it clear to the individuals involved that participation in the IAC activities, including occasional problem-solving consultation will be taken into account when evaluating the performance of an individual.

Although such individual problem-solving and consultation activities are not as visible as the physical output, such as journals, reports or bibliographies, they can enhance the prestige of the centre. Answering questions and solving problems can become a time-consuming activity; therefore, the financial aspects must be carefully examined. Some centres do not charge for handling questions which require less than 30 minutes and charge a certain hourly fee plus overhead for complex questions requiring more time.

Some of the problems may be efficiently handled by telephone or by personal contact. Again, this should be carefully scheduled by clerical personnel to ensure that the part-time consultants will not be unduly disturbed in their own activities.

k. Handbooks and Data Compilations

Since Lavoisier made chemistry into an exact science, physicists, chemists, engineers and even researchers in the life sciences have made an ever-increasing use of numerical data. Atomic weights of elements, basic thermodynamic values, astronomical and space information and basic knowledge of our universe in general are expressed in numbers. As new measurement techniques and computing methods become available, the precision improves and the numerical values change.

The current literature may contain a whole range of numerical values for the same property. This bewilders the potential user, who often does not understand and is not interested in the problems of measurement techniques but needs a best approximation for his own work. A structural engineer may want information on the strength of materials used for construction; a shielding expert needs the latest cross-section values; heating and air conditioning technicians must have access to authoritative thermophysical data--without being involved in the intricacies of the determination.

To satisfy the requirements of such users, specialized IACs, called data centres, evaluate the large mass of numerical values in the literature and publish the findings in tabular form. These tables have become very important in their field of science or engineering; some widely-used tabulations have been reprinted in commercially-published handbooks. The International Critical Tables represent an early example of such a data compilation.

Occasionally, the generators and users of the data belong to the same group and need each other's latest results before starting new experiments. In certain fast-moving fields, the experimenters do not even await formal publication of the tables but check with the data centre before starting a new experiment.

That data centre expert does not simply compile and average out the most recent data; instead,he examines the experimental technique used to obtain the reported value, the limit of reproducibility and accuracy of the instruments, and even considers such imponderable factors as the reputation of the researcher. The data centre thus becomes a true authority and acceptance of a researcher's reported value becomes an accolade, a mark of acknowledgement.

9. Cooperation between centres

The information analysis centre is a new tool; its value to the scientific community is recognized but at present, the IACs represent only small spots on the map of the sciences. It is hoped that in time, these spots will increase in size and, ultimately, they will coalesce as they become a clearly-defined, separate stage in the information transfer activity. Before this stage is reached, wide areas will not use this new method, but certain fast-developing, "hot" fields of science and engineering will generate many centres in related fields.

Clustering of new IACs has taken already place and is expected to continue to occur. The four centres, sponsored by international organizations and two separate national groups, which are active in the area of nuclear physics, serve as a good illustration. If a new IAC is established without considering this phenomenon, the sphere of action of the centre may become excessively fragmented, resulting in a wasteful duplication of the available human and financial resources. Therefore, before starting a new centre, the existing IACs and other information-handling organizations (abstracting services, document centres, special libraries, etc.) which already function in adjacent areas should be closely examined, delimiting the scope of the new centre with due regard for the coverage provided by the centres operating in the adjoining fields. At the same time, centres located within the same institutions should try to cooperate closely with each other even if their fields of interest are not related in order to reduce the operating costs for all participants. This type of collaboration is outlined below.

a. Pooling of services

Centres established within a large institution, as outlined in Chapter 5, are in a good position to establish common operation, thereby reducing their operating expenses.

An IAC requires a considerable amount of routine operations. They include conventional, library-type activities, such as procurement of journals and reports, and the storage and retrieval of the desired items, and also operations which are more specific for information analysis centre : browsing through the literature for the purpose of selecting articles within the scope of the centre and assigning the chosen items to the subject expert within the centre. Scrutinizing a number of journals is a time-consuming effort, as very few journals contain more than two or three pertinent articles in an issue.

On the other hand, an IAC with a slightly different scope could be interested in covering many of the same journals. In the absence of a cooperative arrangement, the journals are scanned in a wasteful manner by information specialists of several centres. It is logical for several

related centres to appoint a joint staff member who goes through the titles and the summaries of the articles, and would identify the papers which are of interest to two or more centres, assigning the individual articles to the proper subject specialists of the cooperating centres. (Admittedly, this is an "ideal" proposition : the same argument could be used for the well established abstracting and indexing services who waited until recent years to start such cooperative efforts).

This arrangement is especially convenient if the centres are located in a large institution. In that case, as the centres are physically new to each other, other information-handling activities may be similarly pooled. Even though the examination of the subject matter requires expertise in a specific subject, procurement of books and reports, subscription to journals, microfilming and storage of the material, and clerical assistance for carrying out the day-by-day operations could be handled in a cooperative manner.

The same argument applies to more sophisticated activities. The development cost of a suitable computer program can be reduced by adapting a programme, which has been found to operate satisfactorily on the available equipment, to a similar use in another IAC instead of starting the programming effort from scratch.

Care must be taken not to go too far with such cooperative schemes; otherwise, the whole concept of the information analysis centre may be jeopardized. Indexing, for example, is a more subject-specific activity than procurement of journals, as may be illustrated by the difference in the indexing philosophy of two major agencies, Chemical Abstracts Service in the United States and Physics Abstracts in England. The main entries in the first case are substances--elements, compounds, in other words, "things"--while the modifiers indicate the properties, such as specific weight, heat of evaporation, solubility, etc., in order to describe the subject of the paper. The Physics Abstracts uses the opposite approach; one must look up a physical property; e.g., paramagnetism; the individual paramagnetic materials are indicated as secondary entries under this main heading. The difference is due to the differing interests of chemists and physicists : the former are primarily interested in the matter and the latter in the physical or other properties.

Similar divergencies are encountered between the interests of the various centres; the basic concept and the narrowness or broadness of indexing varies from centre to centre. For this reason, the indexes of several centres should not be merged into a single one to create a union list, so well liked by librarians. A common list of the holdings of all libraries within a given geographic area makes good sense; it is a useful tool to locate needed items. However, this bibliographic list consists of identical items, such as authors' names, corporate authors, titles, journal references, etc., while the index of an IAC may include discordant elements which do not lend themselves to merging.

It should also be pointed out that separation of the items in separate records represents "work" in the physical sense of the word, just like the separation of the components of a mixture or compound. It does not make sense to spend work to separate all the isotopes of mercury and then to mix them together again. Still, it has been noted that when

several information analysis centres are located in the same institution, the demand to combine their indexes or thesauri is raised in the name of operational efficiency. This is seldom justified and should be resisted. On the other hand, it makes sense for the cooperating centres to establish a joint referral system to indicate to the user which centre is best qualified to provide him with an answer to his question. The IAC concept is still fairly new and therefore the potential users might not yet be aware of the existence of a specific centre.

A common translation service, especially covering languages which are not widely known in the country of the IAC, is another potentially fruitful area of cooperation between centres. Such a service is well qualified to compile glossaries of special terms in the areas of interest of the centre.

b. Exchange of input

The input cost represents an important burden for an IAC; any reduction helps to increase the viability of the centre. When their scopes are fairly close to each other, the centres may take advantage of the bibliographic entries and computer cards or tapes derived from them, as developed by a related centre. These entries might be put to different ultimate use by the subject specialists of the centres, but they thus have been made available to each of the participating organizations at a reduced cost. This type of cooperation requires some preliminary effort of standardizing formats or selecting a suitable one developed by various national and international organizations. The previously-mentioned cooperation in computer programming is a great help in this respect.

A cooperative input service is useful for obtaining internal reports, government documents, patent applications, and other technical papers outside of the mainstream of the journal literature, which, while basically in the public domain, are not easily accessible. A centre which, because of its geographic location or field of interest, is able to obtain such items more easily, can supply them to other centres and profit from a similar assistance in turn.

c. Division of geographic areas to be served

Cooperation between centres is aimed at avoiding duplication of effort and pooling routine questions, as outlined above. Further savings can be achieved by centres operating in overlapping fields by dividing the area to be served among them : assigning responsibility to each centre for requests originated by users within a specified geographic area. As the answer to a question often requires consultation between the querier and the centre's staff, it is advantageous to have the centre within a reasonable distance to allow personal visits or at least less expensive telephone contacts.

Some IACs with a partially-overlapping scope can help each other by taking care of inquiries from users located nearer their own headquarters. Development of a mutual assistance network would enable each centre to help out its partners in areas in which it is more competent.

Geographical division of service areas presents the additional advantage of allowing the users to make inquiries in their own, or in a more familiar language. Although international scientific interchange is becoming restricted to about four or five languages, users might have a prefered language.

An interesting example of such cooperation involves centres sponsored by national and international organizations : requests concerning nuclear cross-section data are answered by the Nuclear Data Group of the International Atomic Energy Agency in Vienna, a similar centre supported by the Organization for Economic Cooperation and Development in Paris, and national centres at Brookhaven National Laboratory in the United States and at Obninsk in the Soviet Union. While the input is shared, the service to enquirers is divided between the four centres on the basis of geography.

10. Evaluation of the Effectiveness of the Centres

High-quality scientific literature is usually subjected to the scrutiny of the peers in the scientific community before it is accepted as a new and valid contribution. This "peer judgment" is an important feature of the scientific value system; mere popular acceptance of the findings (for example, on the basis of articles in the newspapers or magazines) is no substitute for it.

Peer judgment devoid of political overtones makes itself felt at all levels of scientific activity; appointment and promotion in academic positions, acceptance of articles for publication in prestigious journals, awarding of research grants, etc. The information analysis centre must be part of the system. This can be done by establishing a formal review board representing the scientific community it intends to serve.

It is true that the referee system of scientific journals is currently under attack ; it has been accused of being too self-serving, too conformist and too suppressing of disagreement with prevailing concepts. Many changes have been proposed, mostly by frustrated authors whose contributions have been rejected; in particular, the critics attack the anonymity of the referees whose action can affect the career of a scientist.

The IAC must profit from the experience of the journal editors and publishers. The output of the centre must satisfy the scholarly standard of the scientific discipline. At the same time, it must survive in a competitive world--even if the centre is subsidized, it is in competition with other, often unrelated services. However, while important, the judgment of the marketplace by itself is not sufficient to evaluate the centre's contributions.

To assure quality, the services provided by the centre must be checked by competent experts not involved in the day-to-day operation of the centre, as indicated below.

a. Internal management audit

In order to examine the day-by-day activities of the IAC, it is suggested that the centre enlist the assistance of staff members of the

host organization. A supervisory committee should be created to study the total output of reports submitting their criticism and evaluation to the sponsors of the centre.

The potential membership of this committee could include : 1) the director of the division of the host organization who supervises the IAC in question; 2) a subject specialist who is not regularly assigned to work at the centre; and 3) a member of the top management of the host organization, preferably one with experience in financial or budget matters. Additional members with needed qualifications may be named. If the organization acts as a host for several centres, the same individual should serve as the executive secretary of the supervisory committee of all the centres, acting as the coordinator and assuring continuity as the members of the committees change.

The committee is expected to maintain close contact with the centre. This can be achieved by inviting the centre's director or staff members to its meeting, whenever their help is needed to amplify or clarify the written record. The committee's annual or semi-annual report should contain an evaluation of the operations of the centre, indicating not only outstanding achievements but also any shortcoming of the operations. The purpose of this report is to advise the management of the centre and of the host organization about the operational problems : therefore, it is not expected to circulate among members of the user community.

b. External review committee

In order to eliminate any bias that might arise because members of the above-mentioned committee belong to the same organization, it is recommended that a formal committee be created for evaluating, primarily the quality of the products distributed and the services rendered.

Members of this committee should be chosen from among the well-known experts of the field covered by the centre, staggering the period of service in order to have experienced individuals who know what is expected of them. As the members are able to examine the material alone, the various reports, journals, etc. should be mailed tothem a few weeks before the scheduled meeting of the committee, to reduce the number of meetings of busy and geographically-scattered people; the differences of opinion may be resolved during the yearly meeting.

The recommendations of these two committees should be carefully studied by the management of the centre and that of the supervisory or host agency. However, these committees should have no responsibility for operating the IAC; that responsibility belongs clearly to the director of the centre and his staff. Members of both committees are to be encouraged to keep in touch with the activities of the centre, however, without interfering with the actual operation or assuming a management function; their role should be strictly advisory.

11. Financial Aspects of Marketing

Because of their relatively short history, the variety of sponsoring and hosting agencies and the number of services, the financial aspects of the marketing operations of the information analysis centres are somewhat confused.

For a long time the centres were not sensitive to the problems related to marketing. Many centres were established ten to twenty years ago, when scientific undertakings, including information-related activities, found it relatively easy to obtain support. During the first period of their existence, the managers of the centres usually turned their attention toward input/output problems : defining the scope, organizing the storage/retrieval system and staffing the centre with competent people. In most centres, the input/output operations were financially supported by the sponsoring agency.

When, in many countries, budgetary problems slowed down support of research activities in general, and related information services in particular, attention was turned to the output services to determine what charges should be made to ensure the continued survival and, when possible, the expansion of the services. In this respect, the IAC faced the same problems as the other links in the information transfer chain, i.e., the primary journals, abstracting services, book publishers, etc.

Information activities are an integral part of the research process because the scientist's work is not completed until it is communicated to his colleagues, and thus enable them to examine, duplicate and finally to accept or criticize it. Therefore, it is logical that services that contribute to this goal should be more or less directly supported by research funds*.

The information analysis centre is trying to assume an important role in the information transfer chain; therefore, it too deserves to be supported by research fund. The IACs do truly creative work by selecting, reorganizing, evaluating, compressing and synthetizing material of interest to its clientele of peers.

However, although the principle of direct support is justified, the centres must face the fact that they will not be able to satisfy the demand, should their services become popular, because they cannot provide unlimited service without subsidy. For this reason, the expenditures for materials and personnel should be carefully divided between input and output activities.

The input portion : selection and indexing of the pertinent material, extraction of all useful knowledge and its storage in a convenient form, represents the basic contribution of the centre to the scientific or engineering community that it serves. The expenses related to the input, therefore, should be budgeted separately and supported without considering the cost of individual services. Partial or total recovery of the operating costs should be based on the expense of providing a service to an individual user; the cost of these services such as a personalized, computer-based alerting or searching service, or answers to specific questions, should be recovered.

There are cases when selling of the products to users may raise ethical problems. In many centres, the contributors become users of the material, some of which they themselves contributed. For this reason, it is desirable to create a special class for contributors, making the output of the centre available to them for a nominal sum or at no charge; otherwise,

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* An example of this support is the payment of "page charges" of journals by the author's institution.

the centre might find it difficult to obtain their material. These contributors may be considered as having already "paid their dues" and without a close collaboration with the active workers, the centre loses much of its effectiveness.

12. Termination of centres

a. General considerations

All information activities--specialized journals, abstracting services, and in particular, the information analysis centres--reflect the achievements and the problems of the timely aspects of science and technology that they serve. A vital, fast-moving field needs many special tools. The IAC usually has a more narrowly circumscribed field than the primary and secondary journals, and therefore, it is more sensitive to changes in interest in the technical community.

These changes may be due to a variety of factors. In pure science, the changes are seldom abrupt because the evolution of knowledge is usually a gradual phenomenon. On the other hand, the programmes which support applied areas are short-lived and are formally terminated. This usually means the end of specialized information services, including the IACs. The termination may be painful to some, but realistically it makes sense. For example, assuming that there was a centre devoted to research on poliomyelitis, the number of papers decreased substantially after the development of an effective vaccine. There is a time lag because of the period needed to carry out the studies and to prepare the papers, but after a certain period, it will become obvious that the specialized centre must cease its activity.

The most important requirement for the establishment and the continued existence of an IAC is a strong ongoing activity in a critical field. This does not necessarily imply new discoveries or newly emerging concepts. If a classical field, such as the study of cancer or energy generator, continues to be active, it has to be assisted by an information analysis centre. But the opposite is equally true : decrease of national interest in an area, such as the study of smallpox, will, sooner or later, result in the cessation of the IAC serving it.

A cursory examination of the history of centres which ceased to function reveals that a change of scientific interest is indeed the main reason for the demise of the centres. Information analysis centres behave like biological organisms and social institutions : they are born, grow up, mature - and when they outlive their usefulness or are the victims of political or economic circumstances - ultimately die.

In addition to such a more or less "natural" course, there are other inhibiting factors which interfere with the operation of the centre and even bring it to a standstill. These factors are outlined below :

b. Termination for financial reasons

If the original support of the centre has not been carefully arranged, the budgetary problems might become too serious and ultimately force the shutdown of the activities. As mentioned above, it is often easier to start a centre informally, without a formal budget, than to assure the continued operation of an established institution. A new

centre might be initiated by a single individual, working alone, devoting part of his working hours to this activity. An established centre, on the other hand, has staff members, clerical assistants who must be supported and incurs financial obligations for computer time, mail service, etc. that must be met. Because of its high visibility, the IAC is often the first item that is eliminated in times of budget restrictions. The management must therefore devote its attention to obtain continued support and to establish a reasonable charge schedule for its services in order to convince its present and prospective clients of the usefulness of the centre.

Neglect of such promotion of the good will of the sponsors and users may result in the demise of the centre because of the failure to ensure a continued solid financial base.

c. Human factors in the termination

Scientific and engineering work involves contact between peers, supported by information specialists. In view of the circumstance that many technical managers display an innate distrust of all work which is not an original theoretical study or "bench" work, it is important to emphasize that the activity in an IAC is similar to the technical work done by other members of the profession. If the centre's management does not succeed in convincing bona fide members of the profession to collaborate, the centre's survival will be in jeopardy.

Lack of understanding of the human factor and the resulting differences in the attitude toward operational problems can also interfere with the efficient operation of the centre. For example, a centre was shut down because the IAC management did not understand the real needs of the users who were engineers, accustomed to operating in at a brisk fashion. The centre was operated by university scholars who did not appreciate the importance of deadlines in project work. The resulting loss of support forced stoppage of the operation of an otherwise needed centre.

d. Disposal of the assets

The most valuable asset of the centre is its staff of experts. When a centre is shut down this asset is lost. However, its stock of specially indexed collection of articles--the raw material for evaluating and problem solving activities--remains. This collection must be retained when the centre is closed down. Should the stoppage be temporary--for example, for financial reasons that are expected to be solved--the availability of the old collection will greatly facilitate the restart of the operations. The physical assets--office equipment and furnishings--must be disposed of in an orderly fashion as provided at the time of the establishment of the centre. The intellectual fund of the centre should remain intact, as far as feasible.

CONCLUSIONS

Because of its dominance in recent times, the IAC is just beginning to have the established traditions and uniform practices of the other links in the information transfer chain. The information analysis centre represents a synthesis of a variety of tools used to help the practicing scientist to find his way in the maze of literature.

Information analysis centre may be encountered under a variety of environments; administratively, they may be attached to a special library, an engineering development programme, a research department or to an overall management organization. However, it is recommended that a new centre be attached to a research or development unit which is involved in active work in the IAC's area of interest.

Financial arrangements should be set before major commitments are made concerning the location and staffing of the centre. Selected services should be supported by charges to the users who request them; these charges should reflect the incremental costs--cost of printing, mailing, making a search--attributable to the enquiry. Input activities should be borne by the sponsoring institution or agency, as they may be considered as a contribution to the discipline or programme served by the centre. They represent a contribution to the field, making it conveniently available or assimilable by interested researchers.

Multiple sponsorship of a new centre by several agencies is often helpful in ensuring the survival of the centre; however, it alone is not a panacea. Widely-fragmented support could mean that the technical programme of the centre becomes the subject of controversy between the sponsors and thus frustrates and dilutes the centre in its efforts to achieve its objectives.

Although most technical information organizations are operating without a time limit, it is advisable to keep in mind that the survival of IACs is not always assured. Therefore, provisions should be made concerning disposal of the assets or the safekeeping of the critical data that have been developed during the operation of the centre and could be a valuable asset, especially if the operation of the centre is to be resumed in the same or in a related field.

It should be kept in mind that a centre might be operated under a different designation : activities similar to those of an IAC may be hidden in other organizations. Just as a knowledgeable translator might uncover a specialized glossary not given in the index within a book or article, the organizers of a new centre should carefully examine all types of information-handling agencies which might have already assembled the needed group of experts without even realizing it. Attempts should be made to discover the existence of a related "invisible college", i.e. the editorial board or the referees of a pertinent scientific journal, the chairmen or senior members of specialized divisions of a technical society, members of special investigating committees appointed by various government bodies, plant managers, and other ad-hoc groups which usually include many experts.

An IAC should examine modern tools of information science, such as computers and telecommunications, to ascertain how to serve its clientele effectively. However, it should be kept in mind that electro-mechanical techniques are not a substitute for the basic purpose of an information analysis centre : the use of human insight, ingenuity, and brainpower in order to reorganize a selected portion of science and technology and to make sure that previously-developed knowledge is not lost but is efficiently transferred.

APPENDIX

The Nuclear Safety Information Centre (NSIC) illustrates well the operations of and the services provided by a typical information analysis centre.

NSIC satisfies most of the prerequisites for an "ideal" centre as discussed previously. It has been established within a large, multi-disciplinary institution (the Oak Ridge National Laboratory) where it functions as part of a research division. Its director is a nuclear engineer who has supervised the Laboratory's nuclear safety experimental research programme and previously worked on several advanced reactor development projects; the assistant director, in charge of the day-to-day operations, is a chemical engineer with extensive experience in chemical processing problems and reactor operations. The full-time staff includes several subject experts, information specialists, editors and clerical assistants.

Technical expertise is provided by about 14 staff members from several research divisions of the Laboratory who are assigned to work at NSIC on a part-time basis; the time allotted to IAC activities ranges from half-time to one-half day per week (or 50% to 10%), depending on the importance of the subject to NSIC. As active researchers, the technical staff members maintain close contact with the current problems. They have their own desk at the centre, and are thus able to work on their NSIC assignments efficiently.

The information specialists and the clerical staff take care of the information-handling tasks, leaving the technical aspects of the problems to the subject experts. Problems related to computerized operations (inputting, formatting, storage, on-line and batch-type searching, SDI services, etc.) are handled by a programmer of the Laboratory's Computer Sciences Division who, with the backing of his division, selects the hardware and adapts available programmes to the requirements of NSIC and, when the need arises, develops new programmes. An information specialist trained in computerized techniques assists with the preparation of KWIC indexes.

The physical location of the centre also follows the criteria outlined above : it is housed next to a large document centre and library. Thanks to this arrangement, NSIC does not have to acquire many government documents that it might need occasionally because they are conveniently available in a neighboring room. Of course, the centre maintains its own collection of specialized documents which are not available anywhere else in such a complete form. Proximity to the library was found to save considerable time when the staff members needed the specialized library tools--abstract journals, dictionaries, etc. This cooperative effort obviates certain expenditures that an IAC placed in an isolated location would be forced to make.

NSIC was established in 1963 by a government agency, the U.S. Atomic Energy Commission, "to serve as a focal point for the collection, storage, evaluation and dissemination of nuclear safety information."

Safety considerations have always played an important role in the development of reactor-based power plants; during recent years, the volume of theoretical and experimental studies in the open literature and the output of the regulatory agencies increased very rapidly, making it difficult to keep up with the latest developments.

The centre's original task was to assist the headquarters' officials in formulating safety policy; very soon, researchers in Government laboratories, engineers of the utilities involved in the construction of nuclear power plants, and of design and construction firms took advantage of the services offered by the new IAC.

The original users thus were government officials and researchers of prime contractors*. Later on, they were joined by members of the general public whose growing concern with dangers to the environment aroused additional interest in the activities of NSIC in many circles.

The growing number of new nuclear power plants which reached the final design, construction or operating stage increased the number of scrutinized papers. The Nuclear Regulatory Commission which inherited responsibility for safety matters continued to support the centre whose services are now consulted by users from all countries of the world.

The over 120,000 items in the NSIC files are available in form of short abstracts and can be retrieved by a computerized system. They are used to answer inquiries and to prepare state-of-the-art reports and review articles for the bi-monthly journal : "Nuclear Safety", a journal containing original papers, review articles, tabulations, etc. on the analysis and control of hazards associated with reactors, operations involving fissionable materials, and the products of nuclear fission. Because of their specialized nature and length, many of these papers could not be published in the available engineering journals. The journal represents a convenient tool for keeping up with the latest developments in the field of reactor design, construction and operation, the safety aspects of nuclear fuel fabrication, spent-fuel processing, nuclear waste disposal and the handling of radioisotopes.

The full-time information specialists on the staff of NSIC scan the world-wide literature of nuclear technology in more than a thousand journals to locate papers pertinent to the scope of the centre. In addition, many government reports, internal communications--often of proprietary nature--and patents are also examined.

Of special importance are the many documents involved in the reactor licensing process, such as the preliminary and final safety analysis reports, environmental impact reports and also correspondence on unusual operating occurrences, inspection and compliance activities which are routinely forwarded to NSIC. In this manner, NSIC has built up a nearly complete collection of documents, papers, reports, patents, etc. on nuclear safety which can be conveniently consulted in one location.

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* Private companies and educational and research institutes which operate national laboratories and other facilities of the US federal government.

After acquisition, the documents are routed to the proper subject specialist, who prepares an abstract of the paper, assigns pertinent keywords to it from a thesaurus containing about 3000 coordinate indexing terms and indicates its category. The terms of primary importance are indicated by asterisks. The abstract or extract of about 100 words containing bibliographic information, including availability and cost, is then sent to the clerical assistants who carry out the input operations by means of remote consoles.

The information thus collected--accession number, author, title, corporate author, report number, bibliographic data, publication date, abstract or extract, availability, price and keywords--was originally recorded on large cards, filing duplicate cards under each keyword. While this system enabled the Centre to get into operation without waiting for the development of the computer programme, it was found that the stored items rapidly became too numerous.

A technical editor maintains quality control over the inputted abstracts and the keywords. The items are also assigned to one of the following categories :

1. General safety considerations
2. Siting of nuclear facilities
3. Transportation and handling of radioactive materials
4. Aerospace safety
5. Heat transfer and thermal transients
6. Reactor transients, Kinetics and Stability
7. Fission product release, transport and removal
8. Sources of energy release under accident conditions
9. Nuclear instrumentation, control and safety systems
10. Electrical power systems
11. Containment of nuclear facilities
12. Plant safety features-reactor
13. Plant safety features-non-reactor
14. Radionuclide release and movement in the environment
15. Environmental surveys, monitoring, and radiation dose measurements
16. Meteorological considerations
17. Operational safety and experience
18. Safety analysis and design reports
19. Radiation dose to man from radioactivity release to the environment
20. Effects of thermal modifications of ecological systems
21. Effects of radionuclides and ionizing radiation on ecological systems
22. Waste management for the nuclear fuel cycle
23. Nuclear safeguards.

The computerized storage system was developed to prepare for future growth. Originally, two basic products are generated by the computer : a bibliography with keywords and indexes, and an individualized set of cards for the selective dissemination of information (SDI); the latter programme is also used for retrospective bibliographic searches in answer to specific requests. Some major areas, such as "safety-related occurences" are covered systematically on an annual basis. A programme

has been developed for generating KWIC (keywords in context) indexes, to facilitate the searching, to index the publications of the centre and to create specialized bibliographies.

Other programmes are used to facilitate file checking and maintenance, to prepare indexed bibliographies and SDI programmes, and to interrogate the system through remote typewriter and cathode ray tube consoles, searching the master files by keywords, categories or authors, in the usual "and", "or" and "but not" mode.

The nuclear safety information centre offers the following services on subjects which fall within the limits of its scope :

1. Preparation of publication of state-of-the-art reports;
2. Assistance in the preparation of the bi-monthly technical progress review: "Nuclear safety";
3. Preparation of abstracts of the nuclear safety literature;
4. Publication of topical indexed bibliographies;
5. Selective dissemination of information;
6. Answering technical inquiries;
7. Preparation of special retrospective bibliographies;
8. Compilation of information on current research and development;
9. Technical consultation;
10. Collection of documents for review by qualified visitors.

The computer tapes are organized in a linear fashion, so that everything concerning one item on the tape appears together serially. The following information is given on the tapes :

1. Type (reports, journal articles, etc.)
2. Evaluation of contents (as to pertinency)
3. Category
4. Journal abbreviations
5. Date
6. Language
7. Country
8. Corporate author
9. Personal author (s)
10. Title
11. Description, such as : pages, figures, tables
12. Abstract
13. Keywords

For searching, the keywords are weighted, specifiying the acceptable total weight; negative weights are also permitted.

NSIC publicizes its activities through exhibits at technical and trade society meetings and through direct contact with government agencies, contractors and universities. The number of persons reached keeps increasing. An examination of the list of users revealed that most of them are employed by private industry (designers and operators of nuclear power plants), followed by staff members of government contractors, officials of the Nuclear Regulatory Commission and the Department of Energy, and of other federal, state and local government agencies. There are many users outside of the United States.

The coverage of the field has changed over the years as the general interest has shifted to other areas. The continued growth of the literature necessitated the temporary abandonment of certain categories. Another reduction of the coverage was caused by the assignment of environment questions to the Environmental Protection Agency.

The programme and project information file of NSIC makes it possible to maintain current awareness of the many nuclear safety research projects supported by various departments of the Nuclear Regulatory Commission. The information stored in the file includes :

1. The support group and contractor
2. Fund and manpower levels
3. Statement of scope and state-of-the-technology
4. Abstracts of the last three progress reports. (The oldest one is dropped each time a new one is added)
5. Projection of the expected progress for the next reporting period
6. Reports issued
7. Keyword indexing terms.

The resources of NSIC have been repeatedly used by technical and administrative groups to carry out special assignments.

Although originally NSIC's services were provided free, a schedule of charges has been instituted in accordance with the current government policy, which requires that the beneficiary should pay his share of the incremental costs associated with the "packaging" of information to suit his particular needs. However, the full costs of the information handling, related to the collection, evaluation and storage of the data base at the Centre are charged against budgeted funds. Assistance with problems, such as providing answers to questions, is still available free of charge, as long as it requires only a minimal use of the computer and not more than one hour of the staff's time; the cost of longer consultations must be reimbursed.

The importance of personal contact with users has been fully recognized. NSIC maintains a complete list of meetings of interest to the nuclear safety engineering community and sends staff members to cover these meetings. In addition, as mentioned above, technical exhibits are organized for presentation at major conferences to acquaint potential users with the services of the Centre. Folders containing flyleaves, forms and general information are made available to interested individuals. The efficiency of these personalized contacts may be seen from the fact that, during the first ten years of the Centre's existence, the number of requests for information increased tenfold.

The data base collected by NSIC during its 14 years of existence became an important tool to assist nuclear engineers and government officials who endeavor to develop the safest possible reactor-based power plants. Nuclear power plant design must take a wide variety of codes and regulations into consideration; the builders and operators have a considerable latitude in selecting features, operating systems and conditions in their effort to reconcile efficiency and the strict criteria established to protect the plant, its personnel and, in particular, the public at large from the consequences of errors, defects or malfunctions of the equipment. To do this, they must take the effects of unlikely natural catastrophes into consideration. This truly interdisciplinary effort is greatly assisted by the evaluated knowledge of the past, as exemplified by the activities of the Nuclear Safety Information Centre.

Information centers followed different paths of development in various countries, depending on the prevailing economical factors. In the Socialist countries, for example, their establishment was often initiated by a mission-oriented ministry or similar government agency. A good example is the "Soyuzsel'khostekhnika" which coordinates the scientific and technical information transfer in the field of agricultural, sylvicultural industry, forestry and food technology in the Socialist countries.

The GSSD (State Service for Standard Information Data) of the Soviet Union is involved in the exact determination of the standard reference data for the working scientist and engineer. Among the centers involved in this type of activity, the following may be mentioned: Scientific Information Center on Molecular spectroscopy; Data Center for the Thermophysical Properties of Engineering Materials at Moderate Temperatures.

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The Information Center of the Institute for Fine Mechanics in Warsaw

specializes in the study of protective coatings, metallography, heat treatment and welding as they refer to the scope of the Institute.

The Central Technical Library and Documentation Center (OMKDK) of Budapest exhibits a similar synoptic character: it represents a good example how to combine the functions of a technical library and of an information center to serve a technically complex but linguistically unified clientele. It is the most important technical information gathering and sitributing agency in Hungary; in addition to the conventional technical literature it examines marketing problems and novel technical approaches of potential interest for the national economy of the country.

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At the same time, OMKDK acts as the primary coordinating organ for international cooperation, checking the country's input into major international systems, such as AGRIS of the Food and Agricultural Organization, and INIS of the International Atomic Energy Agency. It is also the main agency in collaborating with the International Center for Scientific and Technical Information of the Council for Economic Mutual Assistance in Moscow.

This development of a special information center suits well the local conditions: the country is farther ahead of the emerging nations but lags behind the major the major technologically advanced countries in the East and West. The approach takes advantage of techniques developed elsewhere and concentrates on areas of potential economic interest for the whole country.

An interesting example of an information analysis center in a developing country is presented by the Rubber Research Institute of Malaysia. Rubber is a very important product of the country from the viewpoint of its economy. The importance of research has been recognized at an early age and the Institute has been established more than fifty years ago, in 1926. To-day, the Institute functions as the largest unit

of the Malaysian Rubber Research and Development Board, a government agency with jurisdiction of the research and development activities of the country's natural rubber industry.

The 18 divisions and sections of the RRIM cover every aspect of the industry's research and development activities. A continuous interaction and communication is maintained between the basic scientists, engineers, plantation officers, processors, remillers, manufacturers and traders.

The library and information services department acts in many respects as an information center. It is in close cooperation with the research community that it serves. This activity is especially important in a developing country where access to literature is more limited.

Of special importance is the organization of translation services. In addition to maintaining an indexed collection of translation of pertinent articles from a variety of languages, the department encourages the staff to learn relevant languages, to enable them to pursue graduate studies out-side of the English-speaking countries. The presence of linguistically-endowed specialists enables the staff members to learn about important developments published in Dutch, Chinese, Japanese, German, Russian or Italian and facilitates the study of these languages.

In view of the importance of the patent literature in this field, a patent alerting service has been initiated in 1974.

The library makes every effort to be aware of the field of activity of individual researchers and circulates the material to interested parties by developing their profile for a SDI (selective dissemination of information) system. This service is extended to management personnel.

Many requests are received and handled from interested parties outside of the Institute, even from overseas. The latest automated techniques are used for storing and retrieving the needed material. The Institute and its information service represents a valuable assets for researchers and users of natural rubber throughout the world.

The All-Union Institute for Scientific and Technical Information (VINITI) is probably the largest information-handling organization in the world. Like its French counterpart, the Bulletin Signaletique, its primary function is to bring the world-wide technical literature under bibliographic control, primarily by publishing abstracts journals covering most of the scientific disciplines; however, it performs many analytical functions, such as those discussed previously. It maintains a reference collection and even assumes responsibility for certain aspects of scientific and technical education. It supports local organizations which answer directly the queries from individual scientists and engineers.

The abstract journal, the well-known Referativnyi Zhurnal covers the literature in the fields of physical, mathematical, chemical, biological, geological, geographic and engineering sciences; it also surveys exhaustively the state of the art in many individual fields of science and technology. As noted in case of other agencies, VINITI recognizes the importance of the language barrier in scientific communication and provides translation of articles, when needed.

Only a few areas, such as clinical medicine, agriculture and architecture, are covered by other agencies; however, close collaboration is maintained to ensure uniformity of the output.

Subject specialists who are also linguists take care of the abstracts in the foreign-language literature. Every attempt is made to reduce the time lag between the appearance of the article and publication of the abstract; the goal is to reduce this lag below four months. In order to acquaint the potential users with the available services, a televised course on the handling of scientific information has been prepared.

These examples illustrate the variety of information centers already successfully operating in various parts of the world. The "Guidelines" represent an idealized state; in actual practice, local conditions, such as geographic location of the country, linguistic problems and of course, the availability of financial support affect the manner in which the new center will be organized.

NA-191-5

The Structured Abstract - An Innovative Tool for Information Transfer

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Abstract

The International Irrigation Information Center (IIIC) was established in 1975 by the International Development Research Centre of Canada in cooperation with the State of Israel, with the objective of promoting progress in irrigation, especially in developing countries. The Center produces a variety of publications, the main one being *Irricab, Current Annotated Bibliography of Irrigation.* Publications relevant to irrigationists are identified by searching seven major data bases, e.g. AGRICOLA and BIOSIS. All the original texts are then acquired and the information of interest to irrigationists is extracted and presented in a unique format, which may be described as a 'structured abstract'.

In contrast to the traditional abstract, the *Irricab* abstract has a systematic and pre-set format, with the following advantages for the user:

1) Information of fundamental interest to irrigationists, such as an irrigation system or soil type, is pin-pointed.

2) The contents and depth of a particular article can be more accurately assessed, by referring to lists of pre-selected terms. These lists indicate which aspects of irrigation are specifically dealt with; the type of research work carried out, etc. Furthermore, absence, as well as presence, of this basic information is consistently indicated.

3) The format is designed to be scanned quickly, reading time is minimized.

The technical advantages of the new system are:

1) The pre-set format allows for scientific personnel with little or no previous experience in abstracting to be trained relatively quickly.

2) As the pre-selected lists of terms incorporate most of the basic aspects of irrigation likely to be required for retrieval, our Center was able to start operating without a thesaurus or a list of standardized index terms.

3) The systematic method of analysis allows for more rapid extraction of information from the source publication, thus reducing abstracting costs.

4) By cutting out inessential words, language use is minimized, thus reducing costs of computer data storage and retrieval.

Although at present IIIC is not a data bank or an analysis center, the *Irricab* system lends itself ideally to the incorporation of numerical data. Thus a valuable potential exists for creating a data bank and ultimately a center for information analysis, within the framework of the present operation.

Introduction

The International Irrigation Information Center (IIIC) was established in June 1975 by the International Development Research Centre (IDRC) of Canada in cooperation with the State of Israel, the latter being represented by the Agricultural Research Organization of Israel and the National Council for Scientific and Technological Information.

IIIC is an autonomous and non-profit organization. Its objectives conform to those envisaged for AGRIS Level Two, i.e. the provision of in-depth information within a particular subject field.

The outputs of the Center include:

1. a) *Irrinews*, a quarterly international newsletter in English.

   b) *Irrinoticias* - Spanish edition of *Irrinews*.

2. Catalogs listing institutions concerned with irrigation and manufacturers of irrigation equipment; book lists, etc.

3. Reviews and technical communications.

4. A quarterly abstract journal, *Irricab, Current Annotated Bibliography of Irrigation*, concerned with on-farm water management.

Of these, only *Irricab* is of specific relevance to the present article.

Irricab: Vital Statistics

Over the 2-year period between 1975 and 1977, 5,300 references dealing with on-farm water management were identified from over 1,250 journals. Monographs, conference proceedings and other non-periodical literature increased the total number of relevant references to over 6,400. The original texts were in 25 languages from 78 countries.

In July, 1978, a special analysis of *Irricab* source journals revealed that the number of journals yielding relevant articles had risen to about 1,700.

To locate all this literature, IIIC searches seven major data bases: AGRICOLA, AGRIS, COMPENDEX, INSPEC, NTIS, ISI, BIOSIS.

The number of source journals yielding relevant material is unusually high, and reflects the multi-disciplinary nature of the subject. Agronomists, agricultural and civil engineers, water resource specialists, soil chemists and physicists, and members of various other professions are all engaged in irrigation.

Irricab users are offered a photocopying service, and also a special translation service from 22 languages into English.

Irricab Format

The unique *Irricab* format, which may be described as a structured abstract, is illustrated in Fig. 1.

0045 Barefoot, A.D. **Improvement of water application of self-propelled sprinkler irrigation system** (English). Technical report, 17 p., 1 figure, 2 photos, 7 tables, 10 ref.
The Office of Water Resources Research, Washington, DC, 1975 (Oklahoma State University, Oklahoma, USA)

IS center pivot sprinklers
SC sand; clay loam
GL USA (Oklahoma)
CP groundnut
CV soil water; evapotranspiration; plant yield
DT 1974
EV field plots

A self-propelled sprinkler irrigation system was evaluated regarding depth, rate and uniformity of application. Effect of wind speed on uniformity and on evaporation losses was determined. (R.K.)

KW nozzle size; nozzle spacing; sprinkler application uniformity; trafficability; wind speed

Figure 1: Sample item illustrating the format of a structured abstract.

Entries in *Irricab* are made up as follows:

Bibliographic details are listed at the beginning of each item. This is followed by the 'scope', which describes the four fundamental features of any literature dealing with irrigation, namely: the irrigation system (IS); the soil type (SC); location of the study (GL); and the crop involved (CP). 'Scope' is followed by 'coverage' (CV), indicating which aspects of irrigation are specifically dealt with. The following standard terms are used to indicate coverage:

water quality; water quantity; soil chemistry; soil water; soil physics; evapotranspiration; climatic effects; timing, calendar-based; timing, climate-indicated; timing by soil moisture; timing by plant factors; irrigation frequency; plant growth; plant composition; plant yield; instrumentation.

Next, the 'data period' (DT) indicates the years during which the experimental work was carried out or the data were collected. This is followed by the 'evaluation' (EV), which describes the publication from two points of view: 1) the type of research work carried out, and 2) the manner in which the information is presented in print. The following standard terms are used for evaluation:

field; field plots; field installation; laboratory; controlled environment; statistical analysis; mathematical model; theoretical; popular account; economic facts; review.

Following this is the 'annotation', a short indicative abstract describing the contents of the publication and the purpose of the work. Results and conclusions are not given, unless they are brief enough to be reproduced in full.

The 'keywords' (KW) following the annotation are extra terms considered useful for computer retrieval purposes.

So what is new?

The first question which comes to mind is: How does this new system differ from the traditional abstract?

The answer is that, in contrast to the traditional abstract, the *Irricab* structured abstract has a systematic and pre-set format. This allows standardization of contents, with the following advantages for the user:

1) Information of fundamental interest to irrigationists, such as an irrigation system or soil type, is pin-pointed.

2) The contents and depth of a particular article can be more accurately assessed, by referring to the 'coverage' and 'evaluation'. This is of considerable value in deciding whether a specific publication is worth buying, photocopying or translating.

3) Absence, as well as presence, of basic information is consistently indicated, providing the reader with a further aid to assessing the contents of a publication (Fig. 2).

0174 Kushnirenko, M.D.; Kurchatova, G.P.; Zhulavskaya, M.N. [Physiological response of apple varieties to irrigation] (Russian)
Sadovodstvo, Vinogradarstvo i Vinodelie Moldavii, December 1974, 12: 8-10, 2 figures, 3 tables (Institute of Plant Physiology and Biochemistry, Academy of Sciences, Moldavian SSR)

IS –
SC –
GL USSR (Moldavian SSR)
CP apple
CV water quantity; soil water; timing by plant factors; timing by soil moisture; irrigation frequency; plant yield; plant behavior
DT 1972-1973
EV laboratory; field plots

The water deficit of irrigated and unirrigated apple varieties (Banan Zimnyi, Wagner Price, Richard Delicious, Renet Simirenko and Jonathan) was determined by measuring the electrical resistivity of their leaf tissues. The irrigation schedule was the same for all varieties and was based on soil moisture deficit and on leaf water deficits at different growth stages. Plant response was correlated with electrical resistance of leaf tissue.

(R.K.)

KW water activity in leaves; electrical resistivity of leaf tissue

Figure 2: An annotation with dashes indicating that the irrigation system and soil type were not specified in the article.

If our system of indicating absence and presence of information succeeds in drawing the attention of irrigationists and editors to gaps in important information, then a possible side benefit of the *Irricab* system may be the eventual upgrading of the quality of primary literature.

4) The *Irricab* format is designed to be scanned quickly; reading time is minimized.

The technical benefits to IIIC of the new system are as follows:

1) The pre-set format allows for scientific personnel with little or no previous experience in abstracting to be trained relatively quickly.

2) As the 'scope', 'coverage' and 'evaluation' sections incorporate most of the basic aspects of irrigation likely to be required for retrieval, our Center was able to start operating without a thesaurus or a list of standardized index terms.

3) The systematic method of analysis allows for more rapid extraction of information from the source publication, thus reducing abstracting costs.

4) By cutting out inessential words, language use is minimized, thus reducing costs of computer data storage and retrieval.

Information Extraction *vs* Information Analysis

While engaged in locating and extracting information, IIIC makes no claim to being an information analysis center. This would involve critical evaluation, which at present is not a routine part of the Center's activities. Potentially, however, the *Irricab* system can be seen as the tip of an iceberg, with information analysis at the base (Fig. 3).

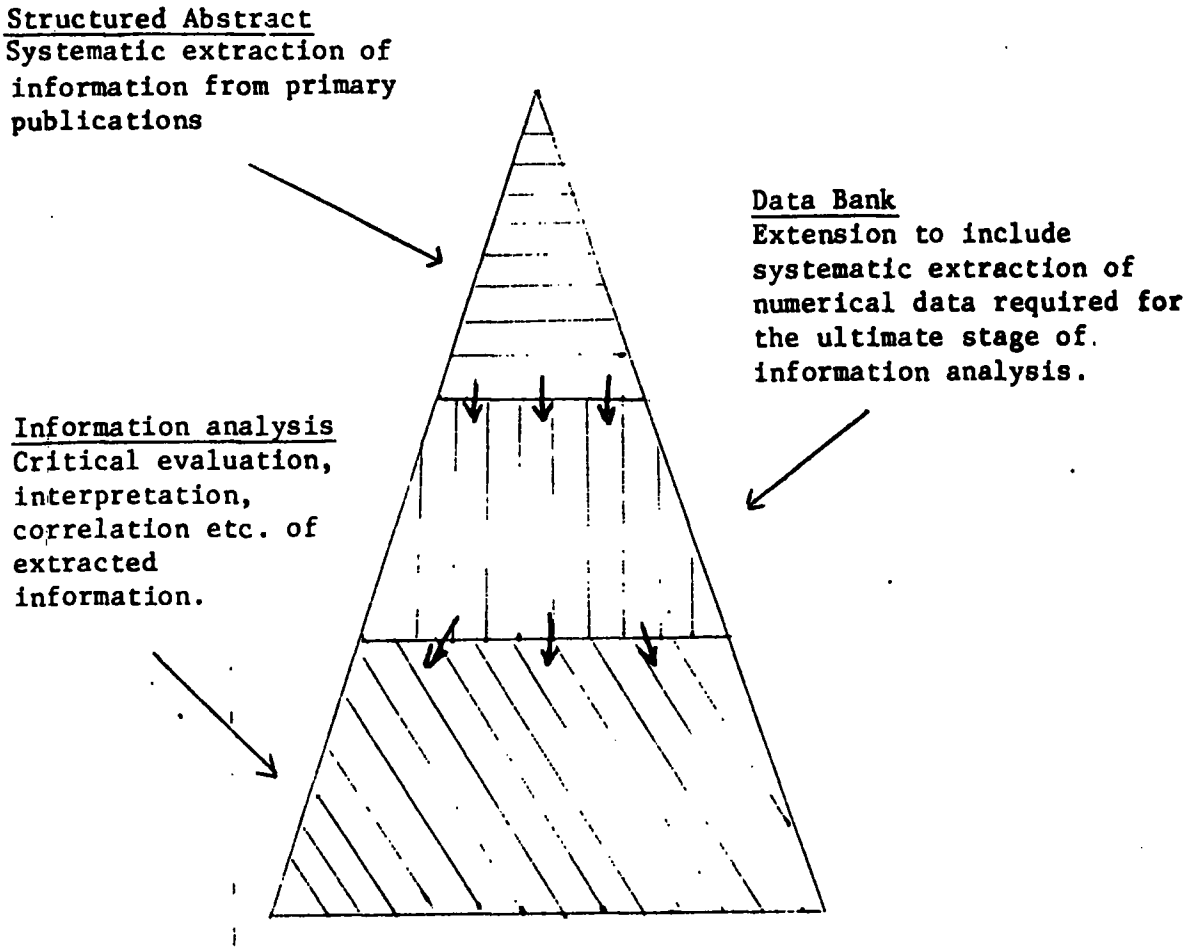

Fig. 3: Schematic representation showing possible development of IIIC into an Information Analysis Center.

Evolution

It is logical to maximize the benefits from an existing project. Instead of starting a data bank anew, and repeating the basic operating costs, a specialized abstracting service like IIIC can readily be extended to include systematically extracted numerical data.

Expansion of the existing service would, of course, require additional funding to cover increased processing, computer storage and retrieval, printing and other expenses. Financial support would also be

needed for devising an effective system of extracting and presenting numerical data, since high calibre specialists in irrigation and computerized information would have to be employed if the resulting data bank is to be of practical value.

Are these extra costs warranted? Who will benefit from the addition of a quantitative dimension? Regular users of *Irricab* would certainly benefit, through being able to identify and locate publications even more efficiently, especially those containing comparative data.

However, to make economic sense and for real benefits to accrue, the extracted numerical data and conceptual information needs to be systematically analyzed and evaluated by a subject specialist. In other words, to be cost-effective, a data bank needs to progress to the status of an information analysis center.

Conclusion

The structured abstract system has now been used by IIIC for 2 years. Its reception has been most favorable - unexpectedly so, in view of the conservative attitude of many scientists.

The unsophisticated format has proved acceptable not only to engineers and agriculturalists, but also to irrigationists concerned with legal, institutional and social aspects of the subject. Thus, there is every reason to believe that our system could readily be adapted and used by other specialist information centers.

There is also no doubt that the system has potential for further development, and IIIC is encouraged to consider the possibility of extending its activities to include numerical data and eventually information analysis.

International Irrigation Information Center

Irricab Vol. 1 No. 1

IRRIGATED CROPS

0084 Al-Nakshabandi, G.A.; Ismail, H.N. The transpiration of Mexipak wheat (Triticum aestivium L.) in Central Iraq (English)
Journal of Agricultural Science, Cambridge, 1975, 84(2), 231-237, 5 tables, 3 figures, 10 ref. (College of Agriculture, Abu-Ghraib, Iraq)

IS –
SC –
GL Iraq
CP wheat
CV water quantity; soil water; evapotranspiration; timing by soil moisture; plant growth; plant yield
DT 1969; 1971–1973
EV field installation; tabular evaluation

Evapotranspiration of *Mexipak* wheat was determined by means of lysimeters and soil moisture determinations. Values obtained by the different methods were closely related. Water use efficiency for grain production was calculated. (A.M.)

KW lysimeters; transpirometers; evaporation pans; net radiation; soil temperature; neutron probe; global radiation; potential evaporation

0085 Alfaro, J.F.; Griffin, R.E.; Keller, J.; Hanson, G.R.; Anderson, J.L.; Ashcroft, G.L.; Richardson, E.A. Preventive freeze protection by preseason sprinkling to delay bud development (English)
Transactions of the ASAE, 1974, 17(6), 1025-1028, 5 figures, 1 table, 8 ref. (Utah State University, Logan, Utah, USA)

IS portable sprinklers; climate control
SC –
GL USA (Utah)
CP apples; cherries
CV climate-indicated timing; plant growth
DT 1973
EV field plots; tabular evaluation

Evaporative cooling delayed development of apple and cherry bud growth by 17 and 15 days, respectively, thereby decreasing the probability of freeze damage. (A.M.)

KW frost protection; water application rate; evaporative cooling; air temperature; bud temperature

0086 Andreev, N.G.; Mikheev, V.A. [The effect of irrigation and mineral fertilizers on pasture crops] (Russian)
Doklady-Vsesoyuznaya Akademiya Sel'skokhozyaistvennykh Nauk, September 1974; 9: 9-10, 1 table

IS portable sprinklers
SC chernozem
GL USSR
CP feed cereals; clover; lucerne; pastures and feed crops
CV water quantity; soil chemistry; plant yield
DT 1970–1972
EV field; tabular evaluation; economic facts

Pastures and feed crops were grown using nine combinations of NPK and three amounts of water. 120 kg/ha N and 90 kg/ha K increased the yield 44%. Double amounts of N and K increased the yield 76%. The amount of P (30, 50 and 90 kg/ha) had little effect on yields. (R.L.)

KW fertilizers; nitrogen; phosphorus; potassium

0087 Anon. How much water? How much yield? (English)
Irrigation Age, 1975, 99(4), 34, 47

IS portable sprinklers; gravity; farm irrigation management
SC sand; sandy loam; silty loam
GL USA (Nebraska)
CP maize
CV water quantity; timing by soil moisture; plant yield
DT 1973
EV field; popular account

Based on field data, the relation between corn yield and total water applied (both irrigation and rainfall) was evaluated. Different irrigation systems and corn irrigation practices are discussed. (M.S.)

KW water requirement; supplementary irrigation; water economics; root zone; leaching.

0088 Anon. A closer look at trickle irrigation (English)
American Vegetable Grower, June 1975, 44,

Abbreviations: IS Irrigation system; SC Soil classification; GL Geographical location; CP Crop; CV Coverage; DT Data period; EV Evaluation; KW Keywords

Irricab

stands for
Current Annotated Bibliography
of Irrigation

Irricab
is a new journal appearing quarterly

Irricab
is intended to provide irrigationists
with quick answers to the following three questions:

- Which articles, books, etc.
are currently available in my particular sphere of interest?
- If a specific publication appears to be of interest,
is it worthwhile
to write and request the original material?
- If a particular publication is in a foreign language,
are the contents important enough to be translated?

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ACTION PLAN

A. INTRODUCTION

Background for the development of Information Analysis (IA)Activities

1. The first meeting of the UNISIST working group emphasized the need for better understanding of the nature and scope of IA activities.

2. The present meeting confirmed this priority need. All members emphasized that the functions of the IA, though initially important to development, is still today not clearly defined, even by those who perform it.

3. Where exceptionally, IA is identified, it is not thought as serving all sectors of socio-economic development. This is due to the fact that most IA services described in the literature are in the USA and serve the needs of researchers in advanced scientific fields.

4. The value of the COSATI 1967 definition is confirmed. Two precisions are added (see paras 5 and 6).

5. IA activities of major interest to development have to include and emphasize evaluation and compression activities (also called consolidated activities) that lead to the finish product with added value such as handbooks, manuals, state of the art reports, critical reviews etc.

6. Users of Information Consolidation (IC) are basically the repackagers and distribution services -

   - to the public
   - to the entrepreneurs
   - to the policy makers
   - to the scientists
   - to the educator and students

Example of such repackagers -distributors are the media for the public and the extension services for the entrepreneurs

Role of ICA development

(Why is it urgently needed)

7. With repackaging, another asset for the introduction of innovations is information consolidation. Research results and retrieval facilities are not limiting factors in most developing countries and certainly not in developed countries.

8. Information Consolidation saves more than 80% of the time which highly educated people spend searching for information. This is specially true today in the framework of Information explosion.

9. Information Consolidation replaces a large expensive collection of primary literature.

Situation of Information Consolidation in the world today

10. Most users need IC but often or not is not aware of the solution provided by the existing consolidated product which is today available.

11. Institutions in charge of IC have often the potential of providing the required consolidated products that -

- is either or not formalized
- either do not have the necessary financial support

What can be done to improve the situation

12. The overall objective is to organize IC in priority pilot sectors, both either regional or international level in order to ensure that national customers or global IC ... are well adjusted.

B. PLAN OF ACTION - 1979 - 1982

13. Surveys in collaboration with the best international focal points which are the priority needs in IC (particularly in the field of agriculture, industry and health) and which are the financial implications.

14. Survey in collaboration with the same national focal points existing in ICI activities.

15. ... decisions makers to the socio-economic development through ..... of a brochure based on results of the two surveys (see paras 13 and 14) and other means.

16. Promote the creation or the strengthening of regional or international IC services considered important for socio-economic development by launching a pilot project as a response to express priority needs (see para 13). The pilot project will involve a feasibility study to determine the locations of the IC services and their scope. It will also involve an operational phase and be subject to frequent evaluation.

17. Undertake a study in collaboration with relevant abstracts organizations to determine and easy-to-use way to identify the most advanced consolidated information products for definite categories of users.

Information centers followed different paths of development in various countries, depending on the prevailing economical factors. In the Socialist countries, for example, their establishment was often initiated by a mission-oriented ministry or similar government agency. A good example is the "Soyuzsel'khostekhnika" which coordinates the scientific and technical information transfer in the field of agricultural, sylvicultural industry, forestry and food technology in the Socialist countries.

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Of special importance is the organization of translation services. In addition to maintaining an indexed collection of translation of pertinent articles from a variety of languages, the department encourages the staff to learn relevant languages, to enable them to pursue graduate studies out-side of the English-speaking countries. The presence of linguistically-endowed specialists enables the staff members to learn about important developments published in Dutch, Chinese, Japanese, German, Russian or Italian and facilitates the study of these languages.

In view of the importance of the patent literature in this field, a patent alerting service has been initiated in 1974.

The library makes every effort to be aware of the field of activity of individual researchers and circulates the material to interested parties by developing their profile for a SDI (selective dissemination of information) system. This service is extended to management personnel.

Many requests are received and handled from interested parties outside of the Institute, even from overseas. The latest automated techniques are used for storing and retrieving the needed material. The Institute and its information service represents a valuable assets for researchers and users of natural rubber throughout the world.

The All-Union Institute for Scientific and Technical Information (VINITI) is probably the largest information-handling organization in the world. Like its French counterpart, the Bulletin Signaletique, its primary function is to bring the world-wide technical literature under bibliographic control, primarily by publishing abstracts journals covering most of the scientific disciplines; however, it performs many analytical functions, such as those discussed previously. It maintains a reference collection and even assumes responsibility for certain aspects of scientific and technical education. It supports local organizations which answer directly the queries from individual scientists and engineers.

The abstract journal, the well-known Referativnyi Zhurnal covers the literature in the fields of physical, mathematical, chemical, biological, geological, geographic and engineering sciences; it also surveys exhaustively the state of the art in many individual fields of science and technology. As noted in case of other agencies, VINITI recognizes the importance of the language barrier in scientific communication and provides translation of articles, when needed.

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Subject specialists who are also linguists take care of the abstracts in the foreign-language literature. Every attempt is made to reduce the time lag between the appearance of the article and publication of the abstract; the goal is to reduce this lag below four months. In order to acquaint the potential users with the available services, a televised course on the handling of scientific information has been prepared.

These examples illustrate the variety of information centers already successfully operating in various parts of the world. The "Guidelines" represent an idealized state; in actual practice, local conditions, such as geographic location of the country, linguistic problems and of course, the availability of financial support affect the manner in which the new center will be organized.

Information centers followed different paths of development in various countries, depending on the prevailing economical factors. In the Socialist countries, for example, their establishment was often initiated by a mission-oriented ministry or similar government agency. A good example is the "Soyuzsel'khostekhnika" which coordinates the scientific and technical information transfer in the field of agricultural, sylvicultural industry, forestry and food technology in the Socialist countries.

The GSSD (State Service for Standard Information Data) of the Soviet Union is involved in the exact determination of the standard reference data for the working scientist and engineer. Among the centers involved in this type of activity, the following may be mentioned: Scientific Information Center on Molecular spectroscopy; Data Center for the Thermophysical Properties of Engineering Materials at Moderate Temperatures.

Other centers of the Socialist countries include the Main Information Center of the Nuclear Program of Czechoslovakia and the Infcrmation Center on Heavy Industry in the same country. Both represent a mission-oriented approach that cuts across disciplinary lines: the first center serves the information needs of all institutions and organizations involved in nuclear technology while the second center specializes in problems relating to the cable-manufacturing and utilizing industry, covering also pertinent areas of electrical engineering, electrical machine construction metallurgy and chemistry.

The Information Center of the Institute for Fine Mechanics in Warsaw

specializes in the study of protective coatings, metallography, heat treatment and welding as they refer to the scope of the Institute.

The Central Technical Library and Documentation Center (OMKDK) of Budapest exhibits a similar synoptic character: it represents a good example how to combine the functions of a technical library and of an information center to serve a technically complex but linguistically unified clientele. It is the most important technical information gathering and sitributing agency in Hungary; in addition to the conventional technical literature it examines marketing problems and novel technical approaches of potential interest for the national economy of the country.

OMKDK created a coordinated network in cooperation with similar but much smaller agencies of various technical ministries to eliminate unnecessary duplication in the procurement of foreign journals and to assure the efficient monitoring of the literature. It subscribes to about 5000 journals and serves about 1200 registered users. Supplementing the conventional library circulation service, it issues critically evaluated reviews and state-of-the art reports; the purpose of this activity is to make sure that recent developments outside of the country will not escape the attention of leading engineers and managers at the industrial plants.

The work is carried out by about 400 full-time employees and by about 2500 external part-time experts who serve as reviewers, editors and translators. The central registry of translations, including also that of work in progress, helps to eliminate the costly duplication of translations.

OMKDK serves as the coordinator for the information centers maintained by the other ministries which supplement the purely technical material within its purview: the Ministry of Finance provides the financial information while the Central Statistical Office handles the statistical subsystem; the specialized libraries are supervised by the Ministry of Culture. The output from these organizations is of interest to engineers and managers and it is important that they be serviced in a coordinated manner.

At the same time, OMKDK acts as the primary coordinating organ for international cooperation, checking the country's input into major international systems, such as AGRIS of the Food and Agricultural Organization, and INIS of the International Atomic Energy Agency. It is also the main agency in collaborating with the International Center for Scientific and Technical Information of the Council for Economic Mutual Assistance in Moscow.

This development of a special information center suits well the local conditions: the country is farther ahead of the emerging nations but lags behind the major the major technologically advanced countries in the East and West. The approach takes advantage of techniques developed elsewhere and concentrates on areas of potential economic interest for the whole country.

An interesting example of an information analysis center in a developing country is presented by the Rubber Research Institute of Malaysia. Rubber is a very important product of the country from the viewpoint of its economy. The importance of research has been recognized at an early age and the Institute has been established more than fifty years ago, in 1926. To-day, the Institute functions as the largest unit

of the Malaysian Rubber Research and Development Board, a government agency with jurisdiction of the research and development activities of the country's natural rubber industry.

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Conclusions & Recommendations

1. The Group observed that there were in existence a number of so called Information Analysis Centers (IACs) which do not perform all the functions specified in the definition of such Centers contained in the UNISIST Feasibility Study and in the COSATI document. The evaluation and consolidation function was performed in varying degrees in some of these centers. Furthermore the word IAC implied the existence of an institution which was not necessarily the case as information analysis activities could well be performed even by individuals drawing upon information resources of the research institutions to which they were attached. The Group recommended that the term "Information Analysis Center" be replaced by "Information Consolidation Activities" which would define better the subject under discussion.

2. A distinction could be drawn between information analysis functions carried out to service research institutions and those performed for supporting economic social development such as extension services for agriculture, health and industry. Information Analysis Activities for research were well developed and new ones could be set up with no great difficulty as the need arose. The Group felt that priority should be given to the consideration of the need for establishing such activities in the areas most important to social and economic development.

3. The Group was of the opinion that a solid basis for the promotion of Information Analysis Activities in this category could be established through a series of actions detailed in the Action Plan contained in this Report. The Group suggests that UNESCO and other international organisations take the necessary steps and provide the financial resources for the implementation of this Action Plan for a 4 year period commencing from 1979.

4. Information Analysis services or units should be closely linked to the national focal points thus ensuring the coordination of its information activities with those carried out at national level.

5. At the same time, the Unit should, most often, be located within major research institutions and should respond to the identified needs of the country or region expressed through the scientific community.