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STRATEGIC PLANNING for TECHNICAL INFORMATION at OAK RIDGE NATIONAL LABORATORY

November 1, 1976

OAK RIDGE NATIONAL LABORATORY

OPERATED BY UNION CARBIDE CORPORATION FOR THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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STRATEGIC PLANNING FOR TECHNICAL INFORMATION AT OAK RIDGE NATIONAL LABORATORY

November 1, 1976

(Publication Date: March 1977)

A Staff Study By

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Program Planning and Analysis Office

[redacted]

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
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UNION CARBIDE CORPORATION
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ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

TABLE OF CONTENTS

TABLES AND FIGURES

PREFACE TO THE REPORT

PREFACE

The following report is the result of a staff study carried out by the Program Planning and Analysis Office (PP&AO) at the request of C. R. Richmond, Associate Director for Biomedical and Environmental Sciences, and approved by the Executive Committee on September 25, 1975. Background information for the report was gathered for analysis from numerous publications as well as interviews with over 50 individuals both of the ORNL staff and from the outside who were familiar with ORNL and ERDA information programs.

In addition to background research, a resource and advisory panel was appointed by C. R. Richmond to help identify the relevant issues, to provide a forum where different points of view on issues could be discussed, and to act as an expert review panel for the PP&A report. Members of the panel, who have all been significantly involved in ORNL's technical information programs, were:

S. I. Auerbach	Director, Environmental Sciences Division
A. A. Brooks	Manager, Computing Applications Department, Computer Sciences Division
W. B. Cottrell	Manager, Nuclear Safety Information Center
A. S. Loebl	Director, Regional and Urban Studies Information Center
B. F. Maskewitz	Director, Radiation Shielding Information Center
H. F. McDuffie	Director, Information Division
C. J. Oen	Technology Utilization Officer, ORNL
G. U. Ulrickson	Manager, Information Center Complex

A series of round table discussions was held with the panel to accomplish these tasks.

The conclusions in this report for the most part reflect the concensus of the resource and advisory panel. In areas where opinion was divided, PP&AO assumes the responsibility for the conclusion and recommendations made. The conclusions and recommendations of this report were presented at a Program Committee meeting on October 18, 1976. Some editorial changes were made to clarify specific points as a result of reviews and discussions before and after that meeting.

The resulting final report which follows is a staff analysis and as such does not represent any commitment by management to the conclusions drawn or recommendations made.

Program Planning and Analysis wishes to thank all of those individuals who cooperated in this study for their time and effort. The members of the resource panel deserve special credit for the hours they spent in discussing the issues, in answering specific questions and in reviewing the written material.

I SUMMARY AND MAJOR RECOMMENDATIONS

1. SUMMARY AND MAJOR RECOMMENDATIONS

Technical information activities are in fact a significant effort at ORNL. ORNL has a long history and tradition in technical information processing as well as a significant ongoing and growing program. Four and two-tenths percent of the FY 1976 operating budget and over 140 professional staff members are already involved in this effort. ORNL has established a position of prominence in the ERDA information effort with over half of all ERDA's identified programmatic information analysis centers.

Despite the significant success in the information program, there have been problems associated with its growth. This report presents for management some historic perspective on the information programs at ORNL and discusses the major issues that confront information managers at the Laboratory today. The report is divided into four main sections plus appendices.

Section 1, Summary and Recommendations, gives a broad perspective of the part technical information programs play in furthering the nation's and ERDA's goals in scientific research, development, and demonstration. Information policy is being looked at increasingly higher levels of government. In the recently passed Public Law 94-282, which establishes the White House Office of Science and Technology Policy, information dissemination is recognized as a significant area of contribution to the advancement and effective use of scientific findings. In ERDA, the recent reorganization of technical information into the new office of the Assistant Administrator for Institutional Relations suggests ERDA's increased interest in the contributions of its information program to its national goals. At ORNL the importance of a technical information program has been recognized in the statement of policy found in its 1976-1982 long-range plan to "encourage information activities that have a close association with our research and development programs."

Section II, Background, goes on to define a perspective for technical information work in terms of actual funding levels. In the Federal government, obligations for management, processing and transfer of scientific and technical information for 1973 were over $935 million. A breakdown by item and by function is given in Table 1. Over the period 1960 to 1976 federally funded scientific and technical information activities expanded over 6½ times. Within ERDA it was estimated that in FY 1976 somewhere between $32.5 and $37.5 million was spent for technical information among the Office of Public Affairs, overhead, and program accounts. Finally as was noted above, ORNL's information center and library programs alone amounted to over $7 million in FY 1976.

Section IV, Definitions and Scope of This Report, presents some definitions and perpective on the actual functions and activities carried out by various organizational units in the technical information programs at the Laboratory. The similarities and differences between information centers and libraries are discussed. Similarities are based on the main goals of furnishing needed information from materials collected and maintained within the organization. Differences include the attempt to maintain 99 percent comprehensive subject coverage for a very specialized center versus an attempt to cover 80 percent of an area for libraries; emphasis on facts and information for centers as opposed to the published unit record for libraries; and the subject specific orientation of users of centers as opposed to serving a site specific user group, i.e., the entire staff of a parent organization, for libraries. The characteristics of different types of information centers is also presented. The two major characteristics which make an analysis center different from other types of information centers are that the analysis center performs an evaluation function besides determining relevancy of information and it generates new knowledge by helping to fill in the gaps in knowledge as they are identified by the center staff as part of their function of evaluating the literature in a field. Other types of information centers that are defined include response centers, specialized bibliographic centers, data centers, special inventory collections and program support centers. These organizations focus either on a particular subject area or a user group. They can be either vertically oriented to supply depth of coverage or horizontally oriented to supply breadth across fields and then often suppy an interdisciplinary liaison function. In general, information centers contribute to the information transfer process by the currency of their information, the speed and ease of access to a highly specialized and comprehensively covered subject area, and tailored repackaging of answers to fit the needs of the users.

Sections III, Long-Range Goals, and V, Major Issues, of this report discuss the major issues now facing managers of information programs. Between 1963 and 1976 there were rapid changes and developments in information programs at the Laboratory. During this period and especially after 1970 there was a lack of top management policy and direction for technical information work. Because information work has been administratively decentralized at the Laboratoy there was a lack of Laboratory-wide strategic and goal planning. The following major issues are to a large extent the result of this lack of direction and need the attention of top management of the Laboratory.

1. Definition of the Laboratory *commitment to a long-range program* in information processing.

2. Identification of *line responsibility* for information work at the policy making level of Laboratory management.

3. Creation of a *coordination function* to improve cooperation and communication to solve common problems across various information organizations that are not administratively linked except at the highest management levels.

4. Creation of a climate where there is *actual and perceived equality in status* among professionals who make technical contributions regardless of the name of the organizational unit in which they work.

5. Commitment and availability of resources to the information program, especially *space and computing* capability.

More specifically, the following is a selected summary of the recommendations taken from Chapters III and V. The pages on which background information for each specific reommendation can be found is included in parentheses following the recommendation. It should be emphasized that the merits of each recommendation can be independently considered although some tend to complement the goals of others.

Goals and Philosophies

1. *Establishing a Laboratory Objective.* Management should consider the elements of the proposed strategic objective found on pages 26-27 and reach a consensus regarding ORNL's long-term goals for technical information activities. (26)

2. *Status and Recognition.* The basic issue of recognition and status resulting from the wage and salary classification system should be addressed and with some expediency. Those people in information centers who are doing technical work should be categorized at an equal level to those doing the same level of work in other organizational units. (59)

3. *Interaction with ERDA.* While the implications and directions suggested in this report should be discussed with appropriate ERDA managers, the Laboratory should continue to take the initiative to identify R&D needs in technical processing and develop its Technical Information Program. (71)

4. *New Opportunities.* The Laboratory should strengthen its programs and its information effort by reviewing the new opportunities presented and encouraging the marketing of those opportunities with the most potential. (81)

5. *Information Services to ORNL Programs.* Both research managers and staff should be encouraged to educate themselves regarding available information services that could offer cost-effective alternatives to present approaches to gathering technical information. Training courses in information tools and services should be offered through the in-hours education programs. (81, A56)

6. *Public Communication Activities.* Present public communications efforts and additional activities such as publication in science media and presentations at technical meetings which serve to educate the technical and information communities about ORNL's technical information activities should be encouraged. (80)

7. *Research on Effectiveness of Services.* Since the basic methodologies for evaluating effectiveness of information services do not exist Laboratory management should encourage research in this area. (74, A58)

Administrative and Organizational Changes

8. *Line Responsibility for Technical Information.* The specific responsibility for technical information work at the Laboratory should be delegated to one of the Laboratory Associate Directors and this delegation should be made apparent to the Laboratory and ERDA communities. (48)

9. *Technical Information Coordinator.* A Technical Information Coordinator for the Laboratory should be appointed to assist the Associate Laboratory Director for technical information to carry out his responsibilities. (48)

10. *Technical Information Program Advisory Committee.* Laboratory management should seek advice and review of ORNL's Technical Information Program from an outside advisory panel of experts. (50,77)

11. *Information Meetings.* A biannual technical information program information meeting should be held to serve as a control function for Laboratory management and also to help stimulate internal communication exchange. (50)

12. *Embedding and Centralization of Information Centers.* ORNL should continue to have some information centers embedded in research divisions and others administered through a centralized information division. General criteria are given for deciding the best arrangement. (52-53)

13. *Technical Information Division.* The Information Center Complex and the Libraries should be merged into a single technical information division separated from the publication, production and records management tasks which now exist together under the Information Division. (52)

Resource Allocation

14. *Office Space.* A management commitment to an information program requires that immediate consideration be given to short term solutions to the severe space problems that exist. (62)

15. *Information/Conference Center Concept.* The Information/Conference Center is a progressive idea which will uncover new potential while it solves some of the floor space needs and should continue to be aggressively pursued. (61)

16. *Generalized Computer Processing System.* The commitment of an ongoing support base for a generalized computer processing system should be developed and coordinated with a function which is funded to improve the interfaces between available systems and potential users. (65)

17. *Inventories of Information Resources.* Funds should be made available to develop inventories of processing systems, data bases and general information capabilities at the Laboratory. (56)

Studies and Analyses

18. *Cooperation With ERDA's Technical Information Center.* ORNL should investigate more aggressively the possibilities of coordination with the ERDA Technical Information Center in Oak Ridge so that ORNL management will have an established position in anticipation of the discussions which will almost certainly be forthcoming. (72)

19. *Goals and Organization of Individual Information Centers.* Discussions should be initiated to define the long term potential opportunities and goals of presently existing information centers on an individual basis. Depending on the long-range goals that are defined a decision should be reached defining whether the center should be embedded in a research division or administered through the Information Division. (53-54)

20. *Cost Recovery.* The issue of cost recovery should be further investigated and if it is found to be in the Laboratory's best interest, a position should be developed to encourage ERDA to review this policy which now seems to be implemented almost wholly by exception. (69)

21. *Computing Resources.* A supplementary study to ORNL's ADP Ad Hoc Committee's report should be undertaken to explore the specific problems and needs for computing resources of information processing. (65)

22. *Standardization of Data Formats.* A study should be undertaken to investigate the possibilities for standardization and compatibility in bibliographic and numeric formats at the Laboratory. (65)

23. *Library Resources.* The functions of the libraries should be carefully studied as part of an effort to define how to most effectively mobilize the Information Division resources. (54)

Finally, Appendices to the report give details in support of the material presented in the main body. Of specific interest is Appendix 1. It presents histories of the three main areas of the Laboratory's information programs, i.e., information centers, the libraries and computerized processing systems. There were three main historical thrusts that have taken place in information center development in the Laboratory. The first was the result of the President's Science Advisory Committee's report issued in 1963 entitled *Science, Government, and Information* (more popularly known as the Weinberg Report after the committee chairman) which advocated the creation of specialized information centers as a "major key to the rationalization of our information system." Weinberg, then director of the Laboratory, became a forceful advocate of such centers and during the period of 1962 to 1970 over 15 centers were established at ORNL. The second major thrust came in the summer of 1970 as a result of the National Science Foundation Study grant on "The Environmental and Technological Assessment." One of the tasks set up was the development of a major environmental data system and the computerized tools to make large amounts of environmental information accessible to researchers. As a result of this effort the Environmental Information System Office (EISO) was established in 1971. EISO has since grown and been incorporated into the Information Division as a major $3 million program called the Information Center Complex. The final thrust for information centers came in 1973 when the Laboratory's technical information activities began to coalesce into a indentifiable program with stature in its own right. This was manifested by the establishment of the Information Center Complex and during the same year by the creation of the Information Analysis Center Forum, a voluntary association of information professionals with the goal of encouraging cooperation on issues of common interest to information centers.

Also of special note is Appendix 3 which lists new opportunities for information work at ORNL. This includes suggestions for subject areas for new information centers, opportunities for special projects like directories of experts and expertise, ways to promote better service to aid in-house research and areas of applied research in information processing which would benefit the Laboratory's programs.

II BACKGROUND

II.1. INTRODUCTION: INFORMATION AS A MAJOR THRUST

At a meeting on "Information in National Policy Formulation and Governmental Management,"[1] Quincy Rogers of the Domestic Council Staff, Executive Office of the President, suggested that information policy is being looked at in increasingly higher levels of government. In current legislation on the White House Office of Science and Technology Policy there is added emphasis on scientific and technical information handling. Indeed, information dissemination is recognized as one of the areas from which members of the President's Advisory Committee is to be drawn (Sec. 302 (b) of Public Law 94-282). The Committee has also been assigned the responsibility to conduct a comprehensive survey of scientific and technical information handling on a government-wide basis.

Previously at the federal level the importance of information processing has been given considerable attention. The report *Science, Government, and Information*[2] (The Weinberg Report) issued by the President's Science Advisory Committee, January 10, 1963 begins:

> "the transfer of information is an inseparable part of research and development. All those concerned with research and development - individual scientists and engineers, industrial and academic research establishments, technical societies, Government agencies - must accept responsibility for the transfer of information in the same degree and spirit that they accept responsibility for research and development itself..
>
> The technical community generally must devote a larger share ... of its time and resources to the discriminating management of the ever increasing technical record. Doing less will lead to fragments and ineffective science and technology."

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[1]ASIS Bicentennial Conference entitled *America in the Information Age*, sponsored by the Library of Congress, Washington, D.C., April 12-14, 1976.

[2]U.S. President's Science Advisory Committee, *Science, Government, and Information: The Responsibilities of the Technical Community and the Government in the Transfer of Information*, (Washington, D.C.) January 10, 1963.)

The National Academy of Sciences, Committee on Scientific and Technical Communication, issued a report in 1969 entitled *Scientific and Technical Communication: A Pressing National Problem and Recommendations for Its Solution*[3] which stated:

> "New science and technology rests firmly on the base of information generated in the past; thus the effectiveness of future work in universities, government laboratories and industry depends on the efficiency of present information transfer."

Within ERDA long-term goals and responsibilities for technical information programs are not yet clear. However, the recent creation of the Assistant Administrator (AA) for Institutional Relations and reorganization of technical information work into an Office of Technical Information under the new AA are hopeful signs that technical information will get higher priority attention than in the past. In many areas the need for better transfer of technical findings and other opportunities where information can play a key role have already been identified. A few of these are discussed under Appendix 3, New Opportunities for Technical Information Work at ORNL.

Within the Laboratory, according to the ORNL *Long-Range Program Plan, 1976-1982*, a significant aspect of the Laboratory objective is "to generate, analyze, and systematize new scientific knowledge ... for implementation." This is consistent with the acceptance that the dissemination of new scientific findings beyond the point of discovery is an integral part of the research and development processes. Further, one of the internal policies as set forth in the Plan states that the Laboratory will "encourage information activities that have a close association with our research and development programs." The potential for growth in the Laboratory's technical information program as discussed below is considerable. It is the purpose of this report to help management define what the long-range objective should be and then to discuss some specific actions that could be taken to ensure progress toward meeting the defined goals.

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[3]Committee on Scientific and Technical Communication, *Scientific and Technical Communication, A Pressing National Problem and Recommendations for Its Solution*, National Academy of Sciences (Washington, D.C.: National Academy of Sciences) 1969.

11.2 THE SIZE OF THE BUSINESS

Federal Funding of Information Activities

In order to gain some perspective of the size of the business that is information processing, it may be useful to present a financial context. In theory, according to a special report issued by the Library of Congress, Congressional Research Service (CRS) entitled *Federal Management of Scientific and Technical Information (STINFO) Activities: The Role of the National Science Foundation* (STINFO Report),[4] budget levels for scientific and technical information services have been tied to overall R&D expenditures. Various commentators have offered figures ranging from 3 to 10% of the actual R&D budget as a "proper balance" for information expenditures.[5]

In a recent analysis NSF found a continuing historic trend over the past 15 years to support strongly scientific and technical information activities through Federal obligated funds.[6] The cost of Federal STINFO for 1975 is estimated as $485.0 million or approximately 2½% of the

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[4]Committee on Labor and Public Welfare, *Federal Management of Scientific and Technical Information (STINFO) Activities: The Role of the National Science Foundation* (Washington, D.C., U.S. Government Printing Office) 1975.

[5]It actually is very difficult to establish just how much goes into STINFO activities since definitions of what is included in various summaries differ. In much of the following analysis data is used from the NSF report entitled *Federal Funds for Research, Development, and Other Scientific Activities,* NSF 75-334, Volume XXIV, 1976. This is despite the fact that their definition for inclusion is not exactly the most useful for th Laboratory perspective, since it includes pure production and distribution functions which are not included in this report's analysis of technical information processing. In addition, the NSF study does not include STINFO costs under R&D contracts and grants but only direct obligations of Federal agencies.

[6]"Federal Funds for Research, Development, and Other Scientific Activities," *Surveys of Science Resources Series, National Science Foundation,* Volume XXIII (Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office) 1974.

overall obligations for research and development. A 1973 survey conducted by the U.S. Office of Science and Technology found that outlays for FY 1972 were more like $914.3 million rather than $419.4 million as reported by the NSF for that year. They attributed this largely to differences in categorization and inclusion of STINFO costs among government contractor projects. The Congressional Research Service stated that both estimates are probably conservative and total obligations for STINFO activities are probably two to three times the amounts reported. Finally, the NSF has just issued a new report[7] which quotes a Federal Council for Science and Technology's estimate for federal obligations to scientific information transfer over a 1969 to 1973 period. Table 1 is taken from that NSF sponsored document.

Although precise totals differ, there have been some definite trends in STINFO work at the federal level:

- Between 1960 and 1976 federally funded STINFO activities have expanded almost 6½ times.
- In 1976 STINFO obligations are expected to be equal to 2½% of all Federal R&D obligations, compared with 1% percent in 1960.
- The greatest increase in absolute terms has been for documentation, reference, and information services.
- Research and development in information sciences has grown from 4% of the STINFO total in 1960 to 17% in 1967. This category has shown the greatest relative increase.[8]

ERDA's Budget in Information Processing

There is no good analysis of the amount spent on technical information activities within ERDA. Previously the Office of Public Affairs' budget for their technical information activities was estimated at $6,965,000 for FY 1976.[9] However, this does not include any of the work sponsored by ERDA's

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[7]King, D. W. *et al.*, *Statistical Indicators of Scientific and Technical Communication (1960-1980), Volume II: A Research Report*, prepared for the National Science Foundation under Contract NSF-C878, May 1976. (PB-254060)

[8]It should be noted that the Laboratory has almost no work in this area.

[9]From package entitled *U.S. Energy Research and Development Administration, FY 1977 Budget Submission to Congress, Estimates for Laboratories...* put out by the Field Operations and Analyses Branch and dated January 30, 1976.

TABLE 1: FEDERAL OBLIGATIONS FOR MANAGEMENT, PROCESSING AND TRANSFER OF SCIENTIFIC AND TECHNICAL INFORMATION, DATA AND TECHNOLOGY*: 1969-1973

Item	1969		1970		1971		1972		1973		1969-73 Percent Change
	$	%	$	%	$	%	$	%	$	%	
Documentation.	130.3	19.2	147.1	19.8	170.6	20.1	178.8	19.6	185.5	19.8	42
Research and Technical Work Information	28.6	4.2	31.2	4.2	35.0	4.1	38.7	4.2	31.5	3.4	10
Information Analysis Centers.	52.9	7.8	57.3	7.7	71.7	8.4	82.2	9.0	83.3	8.9	57
Scientific and Technical Library.	71.8	10.6	73.5	9.9	83.9	9.9	90.1	9.9	92.9	9.9	29
Technical Data	202.7	29.9	213.1	28.8	228.4	26.9	230.3	25.2	232.0	24.8	14
Information Service Center .	63.4	9.4	71.1	9.6	94.4	11.1	107.2	11.7	115.3	12.3	82
Foreign Exchange	5.1	0.8	5.9	0.8	8.6	1.0	10.3	1.1	11.0	1.2	116
Technology Transfer.	21.9	3.2	32.7	4.4	33.3	3.9	36.5	4.0	42.7	4.6	95
Other.	101.2	14.9	109.2	14.7	123.4	14.5	140.1	15.3	140.9	15.1	39
TOTAL.	677.9	100.0	740.9	100.0	849.3	100.0	914.3	100.0	935.1	100.0	38
Management and Administration	149.5	22.1	167.7	22.6	179.2	21.1	196.2	21.5	205.4	22.0	37
Input.	213.2	31.4	231.1	31.2	282.7	33.3	310.2	33.9	319.8	34.2	50
Output	163.5	24.1	179.5	24.2	205.4	24.2	212.9	23.3	220.7	23.6	35
Support.	77.6	11.4	84.4	11.4	103.4	12.2	112.2	12.3	112.5	12.0	45
Conferences and Symposia . .	16.0	2.4	17.2	2.3	19.5	2.3	20.3	2.2	19.5	2.1	22
Research and Development in STI	55.4	8.2	59.8	8.1	57.3	6.7	60.5	6.6	56.4	6.0	2

* Includes Intramural.

SOURCE: Federal Council for Science and Technology, Committee on Scientific and Technical Information, Report of the AD Hoc Group: Federal Agency Obligations for Management, Processing and Transfer of Scientific and Technical Information, Data and Technology (FY 1969-1973).

programmatic divisions which funds almost all of ORNL's ERDA-sponsored programmatic work. However, in a summary of the first Technical Information Panel meeting as distributed by C. M. Gottschalk on 4/9/76, E. E. Stokely (ERDA Office of Technical Information) was quoted, "the FY 76 budget for technical information is $7.5 million with an estimated $25-$30 million additional spent by ERDA on technical information and covered by overhead or program accounts. OPA (Office of Public Affairs. The technical information component of OPA now reports through Institutional Relations) will ask for an increase in FY 78."

Because there are no figures readily available on the distribution of funds for technical information work funded by each Assistant Administrator's office, one cannot compare the Laboratory's position relative to ERDA's other organizational units based on size of budget. However, there has been published over the past few years a list entitled *Directory of USAEC (ERDA) Information Analysis Centers*. A comparison over the last four years shows ORNL consistently having over half of all of the ERDA information centers listed in this document. This is a strong indication of ORNL's lead in ERDA's programmatically supported technical information work.

Size and Distribution of the ORNL Program in Technical Information

Table 2 summarizes the funding for various technical information activities for the Laboratory in FY 1976. The total operating budget of the Laboratory was $168.2 million. Therefore, the percent devoted to information work is 4.2% or somewhat higher than the estimated national level of funding for STINFO activities relative to the R&D budget but less than the 10% figure that has been suggested.

In addition to this dollar commitment, the Laboratory already has a significant investment in personnel in information work. At present there are 18 professionals working in the library system, well over 100 professionals in the technical information centers and other related projects, and 25 in the Computing Applications Department of the Computer Sciences Division (CSD) directly working on technical information processing applications of which a major part is done in cooperation with ORNL. ERDA's national computer network for technical information retrieval, RECON,

Table 2

SIZE OF INFORMATION PROGRAMS AT ORNL

Programs		FY 76 Funding (In $K)[1]
Research Division Information Center Programs		2,986
Energy		609
Environmental Sciences		252
Health Physics		197
Neutron Physics		509
Physics		705
Reactor		589
Solid State		125
Information Center Complex		2,780
Library Services		1,322
Computer Sciences[2]		770
	TOTAL	7,858
Total less Computer Sciences		7,088

[1]Except for Library services which are funded by Laboratory overhead, these totals represent direct programmatic funding from ERDA for information activities. In-house divisional transfer of funds are not included.

[2]Although the Computer Sciences Division is administered by the Union Carbide Nuclear Division, the work is closely connected to ORNL information processing activities and can be viewed as part of a family effort.

is also operated physically within the Laboratory in close cooperation with ongoing Laboratory information activities by the Computer Sciences Division. Both RECON and CSD's in-house on-line retrieval system ORLOOK, are integrated into a larger processing system called ORCHIS (see Appendix A1 for details). When combined these systems provide an outstanding national resource that link our activities with the outside in a very real way.

Finally, if we look at the Oak Ridge area it has been estimated that there are over 400 people involved in technical information activities including ORNL, the Technical Information Center, and the Computer Sciences Division. This national resource in scientific and technical communication can make a valuable contribution to ERDA and national goals in research, development, demonstration and technology transfer and should be recognized.

III LONG-RANGE GOALS

III.1. HISTORIC NEED FOR STRATEGIC PLANNING

The field of information processing is broad and complex. It begins in the scientist's laboratory when he or she records experimental or theoretical conclusions and ends when that information is provided to a user who then builds on it to form new conclusions or uses the results for practical applications. This transfer process includes the publication, collection and organization of materials, retrieval of materials and information, analysis and/or synthesis of many pieces of information and finally the transfer of original, repackaged or new knowledge to a user who is often a producer as well.

Until the 1950's publishers, secondary sources such as abstracting and indexing services, libraries, and invisible colleges (working groups of specialists) formed the basic organizational links which carried out these transfer functions. The rapid proliferation of funding for science after World War II and the growth of scientific information severely taxed these traditional methods of organization and control and created great pressure in the system of scientific and technical communication. New ways were sought to control the new knowledge that was generated and to rationalize the technical information transfer system. In 1961 the President of the United States appointed a panel to look at the situation at the national level and make recommendations. The report of the panel, known as the *Weinberg Report*[10] after the committee chairman, defined the concept of the specialized information center which is "...primarily a technical institute rather than a technical library. It must be led by professional working scientists and engineers who maintain the closet contact with their technical professions.." as a "major key to the rationalization of our information system." Weinberg, who was also Director of ORNL at the time, became a vocal and visible advocate of the concept. As a result, there was a rapid proliferation of specialized information centers at ORNL. Through the 1960's concurrent with this active promotion of specialized centers, came rapid developments in computer technology. The advances in technology and economics

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[10] See U.S. President's Science Advisory Committee, *Op. Cit.*

of computerized information processing began to allow larger and more rapid access to major storehouses of information. Massive data bases could be created, manipulated and repackaged. New information tools like computerized selective dissemination of information and computerized retrospective bibliographic searches became available and are now part of the scientific information transfer system. There was a trend toward making financial support available for specialized customized information services among sponsoring agencies. ORNL's information user and sponsor groups proliferated from the internal ORNL community and AEC (now ERDA) to other federal agencies, other AEC facilities and the world scientific community. At the same time there was a trend within the Laboratory toward cutbacks in overhead service which included the traditional information activities like the libraries. Enterprising and enthusiastic people who were not constrained within the existing information organizational structure moved in to fill the vacuums that were formed in the areas where money was available. There was a proliferation of new varieties of organizational units called by a variety of names including information centers, response centers, *et al.* The functions and goals of these were philosophically different from the older Weinberg centers but were not always clearly defined.[11] The Information Division which once served as a coordinator and clearing-house for technical information and information services no longer fulfilled this function organizationally. Relationships between older institutions and the new had to be established and in some cases interface frictions developed. In addition, the new institutions had their own share of gestation difficulties including lack of experience and overzealousness. Internally some friction developed among organizations. Externally, some over-commitments were made. During this period of growth clear top management direction was not given and this resulted in a lapse in Laboratory-wide strategic and goal planning. Some actions that were taken may have seemed and indeed may have been opportunistic because of this lack of clear Laboratory policy.

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[11]Additional discussion of this can be found in section V and in Appendix 1, Historic Trends in Information Center Development at ORNL.

These were some of the historic forces that created the difficulties which prompted the request for this study of information processing at ORNL in 1976. It should also be stated, however, that these same forces had many positive results. Indeed, it was these forces which have culminated in the present outstanding effort at the Laboratory and has put ORNL in a strong position as a leading force in ERDA information work.

III.2 DEFINING THE LABORATORY'S LONG-RANGE OBJECTIVE

Because technical information activities are important to the progress of scientific research and development and because they are in fact, a significant and growing effort at ORNL, a well defined long-range strategic objective for the Laboratory's multipurpose, multifaceted information program is needed. This will provide ORNL information managers a basis on which they can make appropriate decisions, commitments and operational plans. Secondly, a well defined objective would provide a clear statement of our position to ERDA which they can use in making their strategic plans for field operations. Thirdly, a defined objective will provide the needed guidance to Laboratory staff and potential employees regarding their own career development. Finally, a basic concept in management is that a sound strategic plan is a prerequisite for an effective capital appropriations program.[12] Capital budgeting is a continual dilemma for all Laboratory programs. Perhaps with more precisely defined long-term goals, our cases can be presented more effectively.

The following is a proposed strategic objective which contains the elements that are needed in a Laboratory commitment to a technical information program at ORNL. Management should consider each of these elements and come to a consensus regarding ORNL's long-term goals for technical information activities based on those elements that are accepted.

Proposed Objective

To develop the long-term Laboratory objective in technical information by emphasizing: 1) support to ongoing research activities at ORNL and 2) an independent program effort where our special subject expertise combined with our expertise in handling and processing information will contribute to ERDA's mission. To accomplish this major two-pronged objective the Laboratory is prepared to:

1. Increase the visibility of ORNL information work as an important part of the national R&D effort.

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[12]*Corporate Planning: Selected Concepts* by Basil W. Denning, McGraw-Hill, London, 1971.

2. Actively seek funding for information projects which address national or international information needs of ERDA. Other federal agency (OFA) and other insitutional support will be encouraged if it will enhance ERDA programs or develop capabilities that ERDA is likely to need in the future.

3. Actively promote new concepts relating to technology understanding and transfer and development through our expertise in information work including such things as information support for conferences, workshops and public energy debates, support of the Information/Conference Center concept, and support for the development of ERDA's high priority regional center idea for our region.

4. Encourage organized information support for all substantial Laboratory programs and for each professional staff member.

5. Build a climate where professional staff can maintain equal status for technical contributions whether they are made within an organization called an information center or whether they are in any other type of organizational unit. This includes the upgrading of professional recognition of high level technical work in information centers.

6. Actively seek an ERDA commitment to the capital resources, especially space and computing capacity, necessary to support the ORNL strategic goals for technical information work.

7. Establish and maintain an administrative structure to facilitate these other objectives and allow flexibility for this rapidly growing and changing area to develop and evolve.

8. Undertake research projects to help solve problems in information science which will have direct benefit to the Laboratory's program.

Finally, to fulfill these objectives the Laboratory should focus its special capabilities on four user communities:

1. To assist ERDA and other sponsors in meeting national energy objectives with our information capabilities and expertise. This will become increasingly significant as processed, systematized and analyzed information gains recognition as a necessary ingredient in a successful national energy program.

2. To better serve our own research scientists and research projects in carrying out more effective and efficient work. Indeed, professional staff from the information field are becoming integral parts of the research term in some areas. Information analysts are one of the functional experts that should be included in matrix concept of program management.

3. To provide the larger scientific community the necessary information to forward scientific knowledge. ORNL has some special capabilities and potential to be a national technology resource, a major component of which must be the analysis and synthesis of knowledge produced from experimental and theoretical R&D.

4. To help the information science community advance the state-of-its-art in problem areas which will also have direct benefits to the Laboratory's own programs. ORNL resources and activities provide an ideal experimental laboratory for some of the work that needs to be done and is being sponsored by the federal government through the National Science Foundation in the area of scientific and technical information. Indeed, some of our unique potential has already been recognized and is being taken advantage of as in the case of Metrics, Inc.'s consulting with members of the ICC in their study of the cost/benefit picture of information center work.

IV DEFINITIONS AND SCOPE OF THIS REPORT

IV. DEFINITIONS AND SCOPE OF THIS REPORT

For the purpose of this report, it is important to define some of the activities and functions of various information processing organizations.[13] There are many titles given to organizational units. In some cases there are true distinguishing philosophical differences between them in their types of activities and goals. However, there are also common characteristics and functions. Since the Laboratory is a technical institution placing the highest value on technical work, amount of technical subject knowledge is a criterion which has been used to attempt to differentiate philosophically among the various information activities. As long as it is recognized that expertise in areas of information processing such as organization of materials and computer systems development also requires high levels of skill and ability, it is appropriate to deal with this distinction. Figure 1 shows the products and activities of technical information organizations with a qualitative indication of the level of technical expertise required to effectively perform it. The organizational units which carry out these activities are shown on Figure 2 as a continuum in terms of technical subject knowledge which is generally required of professional staff. Many of the functions listed in Figure 1 are carried out by more than one of these organizations and indeed the precise definition of where one ends and another begins on the Figure 2 continuum is not always clear. In addition there are two other activities not listed on Figure 2 but are integral to ORNL's technical information efforts. They are the computing applications work done through the CSD and the special project work that is funded as specific tasks rather than as part of ongoing organizational units. The scope of this report focuses on ongoing organizational links in the technical information transfer process excluding purely production oriented activities and emphasizes special libraries, information or data centers, of which there

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[13]A more detailed analysis of why this differentiation has become so controversial is found under the section V.4. Classification of Personnel and Differentiation Among Organizations.

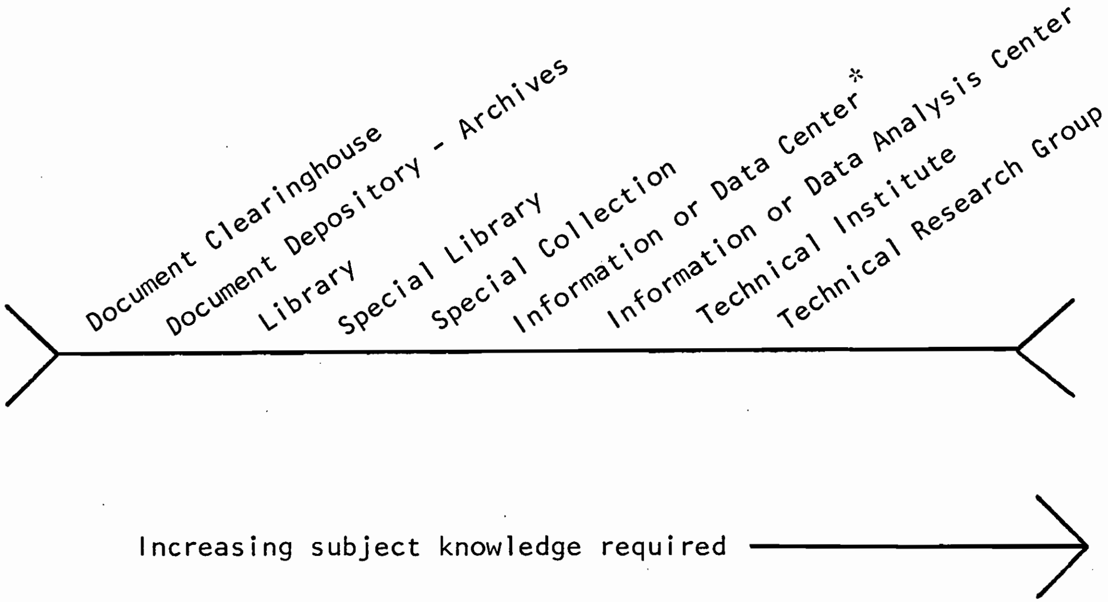
Figure 1

PRODUCTS AND ACTIVITIES OF INFORMATION ORGANIZATIONS
AND LEVEL OF SUBJECT EXPERTISE REQUIRED*

Publications and Products	Level of Subject Expertise
Selected Bibliographies	Moderate
Annotated Bibliographies	Moderate
Abstract Journals	Moderate
Literature Reviews	Moderate
State-of-the-Art Reports	High
Systematized Data Tables	Moderate
Evaluated Numeric Data	High
Newsletters	Moderate → Low
Computer Code Data Packages	
Collection	Moderate
Evaluation and Packaging	High
Directories (e.g., People, Research, or Facilities and Equipment)	Low
Topical Technical Reports	High
Topical Analysis Reports	High
Technical Journal	High → Moderate
Services	
Selective Dissemination of Information	Low → Moderate
Verification and Location of Documents	Low
Query Response Service	
Minimal	Moderate
Active Service Function	Moderate → High
Loans Hard Copy Documents	Low
Purchases Documents for Users	Low
Consulting Services	High → Moderate
In Subject Area	
In Information Processing	
Other Activities	
Builds and Maintains Data Base(s) - Bibliographic or Numeric	
Collects	Low
Systematized (e.g., Keywording, Classification)	Moderate
Analyzes and Evaluates	High
Clearinghouse for Evaluated Computing Technology and Data Libraries	Moderate
Maintains Hard Copy Document Collection	Low
Collects	Low
Systematized (e.g., Cataloging)	Low
Sponsors Technical Workshops, Seminars	Moderate → Low
National Standards Development	High
In Subject Area	
In Information Processing	
Research Projects in Subject Specialty	High
Computerized Information Systems	
Operates	Low
Maintains	Moderate
Designs and Develops	Moderate → High

*Categorized very broadly into High/Moderate/Low based on surveying selected information and research professionals.

Figure 2   TYPES OF INFORMATION PROCESSING ORGANIZATIONS



*Includes a variety of types of centers such as response centers, specialized bibliographic centers, program support centers, special inventory centers, *et. al.*

are a variety, and analysis centers. It deals with other organizations and activities as they have a bearing on these. Although the Computing Applications Department in the Computer Sciences Division (CSD) is not administratively a Laboratory organization, it is integrally involved in the activities of all of the other organizations and therefore it has been considered throughout this report.

In dealing with the three main types of organizations it is first important to point out similarities between them. Figure 3 lists three basic similarities among centers and libraries. In addition, many of the products and activities listed in Figure 1 are common to all three organizations. Figure 4 is a listing of these same products with an indication of which organizations are presently involved with those activities at ORNL. The overlap of functions is quite apparent.

In looking at distinguishing characteristics among the three types of organizations, one can first differentiate between libraries and centers and then further consider the characteristics that make a center uniquely an *analysis* center. Figures 5 and 6 do this respectively.

In addition to these distinctions it is perhaps necessary to portray some of the philosophical flavor that distinguishes the various groups: *Analysis Centers*. In the concept of the information or data center as originally envisioned by the *Weinberg Report*, the information analysis center is supposed to function as a technical focal point for the results of research done in a specialized field. As a focal point for technical information, the center collects, analyzes and repackages the results, with an emphasis on analysis. The two major technical contributions of all developing analysis centers are:

1. The creation of a new science, of new results, based on amassing and systematizing already existing data in the tradition of such great scientists as Darwin and Mendeleev. As Weinberg points out in his paper *Second Thoughts on Scientific Information*[14] the technical theorist using the inductive method in science brings together seemingly disparate facts and the identification of regularity out of the sea of diversity. However, in order to reach this goal Weinberg states that the information center

[14]Weinberg, Alvin M., *Second Thoughts on Scientific Information in the Information Analysis Center: Seven Background Papers* reprinted by Panel #6 of Committee on Science and Technology Information, October, 1969 (COSATI 69-6).

Figure 3

SIMILARITIES*

Information Centers and Libraries

1. Both collect, organize, index, and maintain files of information.

2. Both are located ideally as close as possible to a research organization.

3. Both furnish information based on materials in their files.

*Source: Paper entitled *Seminar #3* presented by R. R. Dickison, at the Atoms in Action Demonstration Center, Panama City, Panama, 1967.

Figure 4

INFORMATION PRODUCTS AND ACTIVITIES AND ORGANIZATIONS WHICH PROVIDE THEM

Publications and Products	Analysis Center	Information Center	Technical Library
Selected Bibliographies	X	X	X
Annotated Bibliographies	X	X	
Abstract Journals	X	X	
Literature Reviews	X	X	
State-of-the-Art Reports	X		
Topical Technical Reports	X		
Topical Analysis Reports	X		
Technical Journal	X		
Systematized Data Tables	X	X	
Evaluated Numeric Data	X		
Newsletters	X	X	X
Computer Code Data Packages	X		
Collection	X		
Evaluation and Packaging	X		
Directories (e.g., People, Research, or Facilities and Equipment)	X	X	
Services			
Selective Dissemination of Information	X	X	X
Verification and Location of Documents			X
Query Response Service			
Minimal	X	X	
Active Service Function	X	X	X
Loans Hard Copy Documents		X	X
Purchases Documents for Users			X
Consulting Services			
In Subject Area	X	X	
In Information Processing	X	X	X
Other Activities			
Builds and Maintains Data Base(s) Bibliographic or Numeric			
Collects	X	X	X
Systematizes (e.g., Keywording, Classification)	X	X	X
Analyzes and Evaluates	X		
Clearinghouse for Evaluated Computing Technology and Data Libraries	X		
Maintains Hard Copy Document Collection	X	X	X
Collects	X	X	X
Systematizes (e.g., Cataloging)			X
Sponsors Technical Workshops, Seminars	X	X	
National Standards Development			
In Subject Area	X		
In Information Processing	X	X	
Research Projects in Subject Specialty	X		

Figure 5

DIFFERENCES*

Information Centers	Libraries
1. Concerned with information retrieval	1. Concerned with published unit record, document retrieval
2. Staffed largely by qualified scientists	2. Staffed largely by qualified librarians
3. Subject scope focuses on narrow, specialized fields	3. Subject scope is usually broad and general
4. Results of activities are published	4. Rarely publishes results
5. Comprehensive coverage 99% inclusive	5. Have attempted more selected coverage of broader areas (80%) of a field is reasonably expected
6. Must get unpublished literature to be at the state-of-the-art	6. Emphasizes published literature
7. Serve entire scientific community	7. Serve parent organization in which it's located
8. The center staff can respond to technical questions based on their knowledge as well as published documentation	8. Technical questions answered by identifying published documentation or by referral to subject experts, perhaps an IC
9. Usually funded by program monies	9. Funded by organizational overhead

*Some of these comparisons were taken from a paper entitled *Seminar #3* presented by R. R. Dickison, *Op. Cit.*

Figure 6

WHAT IS UNIQUE TO AN *ANALYSIS* CENTER?*

1. Analysis centers perform an evaluation function in addition to determination of relevancy of information, a function which other types of information centers perform.

2. Analysis centers generate new knowledge by filling in gaps in the knowledge as they are identified. This is done by encouraging related researchers to undertake work in an area or on occasion by undertaking the research as a project of the center.

3. Rapid changes in technology do not significantly change the evaluation function or major product of analysis centers since the work is human intensive.

*Based on the results of a study conducted by Metrics, Inc. under an NSF grant entitled, *Development of Cost Benefit Methodology for Scientific and Technical Information Communication and Application to Information Analysis Centers*, these were the three factors that were established as unique to analysis centers. These are preliminary results of their analyses. This information was obtained through private communication with Dr. Robert Mason, President of Metrics. A published report of their findings is in process.

plays a key role in the systematization of the process of induction. In order to be successful it must collect *all* of the relevant data. Further it must select and interpret and therefore must be manned by scientists who can glean the scientific gems and make sense of them. In the process of examining the data they find new correlations and this create new science.

2. To uncover gaps in needed knowledge so as to provide a rational basis for recommending experimental programs. As a focal point for the collection of research results and thus as a disseminating point for answers to querries based on them the information center can play a valuable role in pinpointing areas where gaps exist. In some cases the center staff will undertake research to fill the identified gap; in other cases a research group will work on the problems identified by the center.

Information and Data Centers. Included in this category are various types of centers each focusing on a particular subject area or user group. They can be vertically oriented toward supplying depth of coverage or horizontally oriented to supply breadth and perhaps an interdisciplinary liaison function. In general, the special contribution and goals that centers can play in the transfer process revolve around:

° Currency of information available

° Speed and ease of access to highly specialized subsets of information

° Comprehensiveness of the information delivered

° Repackaging for ease of use thus reducing cost in research staff time in literature searching

To meet the specific needs of the sponsor or user community the following types of centers have evolved. Some existing organizations may not fit neatly into any one category but may have elements of more than one.

Response Center. These can be oriented either as internal support for ongoing Laboratory programs or toward a national program effort. Their *raison d'etre* is currency and accurracy of information, speed of access, and ease of use. The rate of scientific discovery and technology transfer and the concomitant body of knowledge has accelerated and grown so rapidly that traditional means of information seeking by individual researchers have not been able to adequately cope. The need for fast turnaround times in retrieving relevant information has been accelerated considerably by new advances in information processing technology. This type of center specialized in the development of ways to provide this immediate response to inquiries.

Specialized Bibliographic Centers. These centers attempt to serve as comprehensive resources for information in a special subject area. Their service is oriented toward collecting, systematizing, and repackaging bibliographic information as well as responding to requests. In the case of multidisciplinary or mission oriented centers, the technical generalist function that is provided becomes very important. Information centers form the resource pool for a significant amount of this generalist activity and fill the need for putting fragmented findings into a coherent overall perspective.

Data Centers. These are similar to bibliographic centers except the unit of collection is numeric rather than bibliographic data.

Special Inventory Centers. These are oriented toward comprehensively gathering data on special resources other than the bibliographic or published unit record such as an inventory of ongoing research or of information sources. They are often useful in the management of research and development.

Program Support Centers. These are centers set up as an adjunct to a research group or program to facilitate the most efficient information seeking channels. The centers' breadth and depth of interest are determined by the defined user group. The goal is to be most cost effective by using the expertise of information specialists as part of the project team.

Technical Libraries. The traditional focus of libraries are in-house support and service to ongoing programs of the parent organization. With the exception of the reference or user services departments the library organization is oriented toward the published document. The reference section, however, more closely resembles program support types of information centers with the exception that their user community is the entire Laboratory staff and management. Thus they tend to remain more generalist oriented.

Finally, in addition to these technical contributions of various types of information organizations, other benefits result from information activities. These are useful to note in the context of the services and goals that are provided:

1. Information activities act as front windows and publicity mechanisms for ongoing research work. In some cases, an information center in an ongoing research program will act as a public communication arm of the technical program. A center's regular interaction with a broad international user clientele through newsletter, correspondence, and other means acts as an information transfer and communication link beyond just the transfer of published results.

2. Not only do information organizations deal directly with the technical community, but they also have contact with other information specialists at other scientific institutions. Often these information professionals act as a gatekeeper for their research staff in selectively disseminating information within their organizations.

3. In light of ERDA's present priorities, there seems to be increased emphasis on interdisciplinary problems. Control of relevant information in such areas is considerably more difficult and yet considerably more important to advances in the program. Rapid, up-to-date and reliable access to revelant information as well as important tasks in information review, analysis and synthesis could make invaluable contributions in such areas.

V MAJOR ISSUES

V.1. ADMINISTRATIVE ARRANGEMENTS

Introduction

Beginning about 1972 when the Environmental Information System Office emerged as an important concept different from already existing ideas about independent, embedded Information Analysis Centers (IAC's) (See Appendix la, Historic Trends in Information Center Development at ORNL) there was considerable debate on the issue of organizational arrangements for information centers at the Laboratory. The main debate centered on whether all information centers should be centralized into one division or whether true analysis centers must remain embedded in research divisions to maximize interaction with ongoing research. A further issue that was periodically raised was the relationship of the centers to the library system.

In 1974 the biomedical and environmental information centers were centralized into the Information Center Complex in the Information Division in order to improve the effectiveness of the Laboratory's information activities in this area through better coordination among centers and library resources and to provide a long-term organizational home for this growing program. The physical science and engineering oriented centers remained administratively embedded in their research divisions. At about the time that the environmental and biomedical centers were centralized, another new organization called the Information Analysis Center Forum was created to foster better communications and coordination between independently administered centers by cooperating on problems that centers have in common such as software and hardware development, public relations, and utilization and development of personnel.

It seems that while the technical information program was still relatively small and weak within the Laboratory structure, the attraction to try to gain strength through organizational rearrangement was very great. Although there remain some administrative irregularities that should be straightened out, the course of time has led to a *de facto* structure which has begun to work fairly effectively. Thus, today, the following facts seem relevant to the recommendations which are made regarding administrative and organizational arrangements for technical information work within the Laboratory:

1. The Laboratory has a wide variety of information processing activities ranging from clerical distribution and control functions like Laboratory Records to highly technical activities. Although the technical level and goals of these functions differ, they do have many functions in common such as inputting, software development, *et al.*

2. The location of these various activities are scattered across the entire Laboratory structure, across Associate Directors and even across the Nuclear Division Structure (e.g., CSD applications projects).

3. The Assistant Administrator for Biomedical and Environmental Sciences and the Information Division Director have present line reponsibility for the single largest part of ORNL's technical information program. Therefore it seems that this line functions as a coordination point for information issues when they come into the Laboratory from ERDA.

4. Those information activities which are funded through program money have a wide variety of sponsors. More than half of the work is Work for Others (WFO). Sponsors within ERDA include biomedical and environmental research, physical research, information services, and fusion power research and development, *et al.* WFO sponsors include the Nuclear Regulatory Commission, the National Library of Medicine, The National Science Foundation, the Environmental Protection Agency, and the National Institute for Environmental Health Sciences. In addition, there is a significant amount of technical information work for internal use which is supported by overhead, e.g., libraries ($1.3M).

5. There are at present two administrative alternatives for information work which has a high technical component (especially intense debate has occurred regarding IAC's in this regard) and requires significant interaction with active research staff: 1) embed the activity in the research division, 2) centralize it into an information analysis division. The Laboratory now has activities functioning in both modes quite successfully.

6. The Information Analysis Center Forum, formed in 1974, is a voluntary association of information centers and information center personnel who are beginning to work together and communicate to improve operations of information activities at the Laboratory and solve common problems in cooperation.

As a voluntary organization it has obvious limitations in terms of amount of authority that can be exercised to require conformance. Participation is based on already overtaxed resources in personnel time and money to support projects.

7. ERDA's own internal technical information activities are not yet well organized. Activities and funding have existed in the Office of Public Affairs, Technical Information Branch which has recently been reorganized under the Assistant Administrator for Institutional Relations.

8. As an interface in the information transfer process between the research work and the broader technical and information communities it is imperative that any successful technical information project be closely involved with technical subject expertise as well as the information community. Any administrative arrangement must provide for optimizing the interactions among these groups and any structure that is ultimately implemented should allow enough flexibility so that new initiatives and new ways to improve interactions are stimulated.

Based on these facts and careful analysis of their implications, it seems that two ingredients are necessary for the most effective organization of information work at ORNL. One is administrative centralization; the other is cooperation and coordination of independently administered organizations.[15] The necessity for these two ingredients is accepted by those information professionals with whom this issue was discussed. The disagreements and discussion now involve who and at what level these two functions should be performed. The following represents a staff judgement on the most effective resolution of the issue. Reasonable differing views of information center managers are indicated as they have been advocated.

The Line Management Function

A visible top management commitment of support to technical information work at the Laboratory is needed. To provide this there must be a focus and delineation of responsibility at the policy making level of the Laboratory, i.e., the Associate Director (AD) level or

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[15]See Appendix 2 for a Union Carbide Management System definition of these position functions.

above, so that there is a point of identified responsibility for meeting Laboratory goals in this area. It would seem that the present situation where the line responsibilities meet at the Laboratory Director's level is not the most effective. Therefore, it is strongly recommended that the specific authority for technical information work at the Laboratory be clearly delegated to one of the Laboratory Associate Directors and that this delegation be made apparent to the Laboratory and ERDA communities. It is hoped that the acceptance of this responsibility will result not only in a paper commitment but will also be personified in a personal commitment and position of leadership by the Associate Director selected.

The Coordination Function

Because it is recommended that the administrative line responsibility be kept at the AD level there remains a need to coordinate information activities which are dispersed throughout the programmatic divisions with each other as well as with those within the Information Division. Due to the size of the program, the large number of sponsoring organizations, the variety of types of activities, the wide distribution of activities and the large potential for growth, for at least the near-term, organizing the coordination function will probably require a significant amount of attention. Therefore, it is recommended that the Associate Director who is given responsibility for technical information appoint a Technical Information Coordinator for the Laboratory to assist him in carrying out his responsibilities. At least for the near-term it is recommended that this Coordinator be appointed to the staff of the AD's office for whatever time is necessary to help carry out the accepted recommendations of this report and to develop and improve the strategic planning elements of this document based on the results of that experience. This should be completed within an agreed upon time frame, probably one or two years.

The other major options for the placement of this coordination functions are to:

1. Appoint a coordinator who would assume this function as part-time responsibility to her/his ongoing job within one of the information activities. This situation would be similar to the Geothermal Coordinator presently at the Laboratory.

2. Delegate the responsibility to the Information Division Director whose main job is line management of a significant proportion of the Laboratory's information work and who spends time dealing with these issues in that capacity. Such a combined function of line manager and program coordinator exists in the ORNL safety program.

For the present neither of these options seems workable because of the quantity of effort that probably would be required. However, both should be seriously reconsidered for the long-term.

Finally, in discussing the functions that such a coordinator might play it was agreed that the coordinator should not get involved in the day to day operations of any of the information organizations unless a specific problem arises. It was also recommended that the functions of the coordinator be clearly defined by the Associate Director. The following is a list of functions that are in need of attention and could be made the responsibility of the appointed coordinator:

- Reviews new opportunities including those identified in Appendix 3 and takes action to stimulate our taking advantage of those which seem appropriate.

- Assists Finance and Materials in coordinating financial responsibilities relating to information processing activities and in addressing the recommendations included in the section on financial arrangements for information work.

- Briefs visitors, especially high level sponsors on ORNL information programs when a general overview that cuts across any single organizational unit is desired.

- Mediates among embedded centers, the various Information Division organizations and services, and the Computer Sciences Division as needed.

- Facilitates cooperation with the ERDA Technical Information Center and other area resources.

- Reviews and when appropriate coordinates proposals for technical information work.

- Provides input to the Laboratory's long-range planning efforts regarding technical information activities.
- Encourages efficiency in common services like CSD hardware, software and concept development and library services.
- Provides a highly visible image to demonstrate ORNL leadership in the field of information processing. Participation on national and international committees is an example of ways in which this leadership can be demonstrated.
- Contributes to Laboratory-wide standardization and compatibility of information at a time when national needs clearly point to the requirement of compatibility between systems at the Federal level.
- Identifies and stimulates opportunities for internal professional development such as arranging seminars, workshops, etc.
- Undertakes research projects to help solve problems in information science which will have direct benefit to the Laboratory's program.
- Encourages public communications and marketing opportunities to improve the Laboratory's information program.

Advisory Committee Function

Because the field of information processing is large, complex and rapidly growing, it is difficult to keep aware of all the advances that are being made. As discussed above, internally at the Laboratory, we have our own diversity and lack of tight centralization. This creates a problem of control which is further compounded by the lack of information expertise within top managerial levels. Thus, it would be very reasonable for Laboratory management to seek advice and review from an outside advisory panel of experts. This is quite consistent with the philosophy behind ORNL's advisory committee structure. Actually the information centers which are integrated into the research divisions are discussed by the division advisory committees as part of the research effort. But, they are also a part of ORNL's technical information effort and should be viewed as an integral link in this program.
An annual or biannual technical information program information meeting would serve as a useful control function for Laboratory management and would also stimulate internal communication and exchange. The

Technical Information Coordinator in conjunction with the Associate Director for technical information policy should be given responsibility to coordinate such meetings.

The type of issues which should be addressed by the advisory committee and the areas of expertise which they could lend include:

- Are we at the state-of-the-art in our technology in information processing, especially in computer and communications technology?

- Do our interests in subject knowledge or processing knowledge coincide with outside activities of which we might be unaware?

- Are there areas of potential Laboratory involvement which we are not pursuing and where we could make a significant positive impact?

- What is the quality of our information products and services?

- Are we staying attuned to national and especially Federal trends in standardization and compatibility among systems?

V.2. ORGANIZATIONAL CHANGES

In support of the goals of the administrative changes that are discussed above, certain organizational changes for information activities have been suggested. The most significant one which was offered by the division director involved was the proposal that the Information Center Complex and the Libraries be split off into a technical information division, separated from the publication, production and records management tasks which now exist together under the Information Division. The different administrative requirements of these two types of activities have already been recognized in the present arrangement where the ICC reports through a different Associate Director from the other Information Division activities. The goal in this split would be to bind technical information support activities more closely to the research and development activities, to upgrade the present in-house support and to allow the division director of a new technical information division to focus attention on technical information transfer in a concerted way.

The present Information Division has 285 members divided almost evenly between these two types of activities. Since the division is reasonable large enough to split, such a reorganization would have significant advantages and is recommended. The new technical information division should report to the AD responsible for technical information. The publication and records management functions could continue to report to the AD for administration. Some thought should be given to combining the management of the Laboratory's Central Files and other office support functions with these records management functions.

Whether or not this reorganization takes place, there are some recommendations that should be considered to strengthen our information efforts. These would be facilitated by the change described above. A discussion of these follows.

Information and Data Centers

A good information center seems to be where you find it. Based on past experience the center can be effectively operated either embedded in a research division or administered through a centralized information division. However, it is also true that for an analysis or a highly specialized service function, the work must be performed by or in very close cooperation with technical experts. If the Laboratory has a technical program in a given area then the expertise will be most readily available within the programmatic division. Thus, in the long-term if the following criteria are met the center should generally be integrated into a research division:

1. The activity is an integral part of an ongoing research program.

2. The center is very interactive with the ongoing research and technical staff of a research division.

3. The director of the center is a qualified research staff member of the discipline.

4. The center's staff does work or has continuing professional interest in the experimental, theoretical or analytical work in the discipline.

On the other hand, if a center has a mission that cuts across programs or supplies an ERDA-wide function more strongly than one specific to a Laboratory program, then it could be in a centralized information organization specializing in supporting ERDA's information programs and goals.

Since the missions and goals of organizations do change, and especially in the case of information organizations there has been significant evolution, there should always be sufficient flexibility so that adjustments can be made. The above criteria are suggested as broad, longterm guidelines. Movement into or out of the information or research divisions should remain a realistic option as the missions and goals of the centers evolve.

To specifically address the situation of presently functioning centers, it is recommended that discussions be initiated to define the long-term potential, opportunities and goals of each of ORNL's information centers. These discussions should involve programmatic division directors in the technical areas of the center, the Information Division Director, the appropriate center director and the Technical

Information Coordinator. Depending on the long-range goals that are defined, a plan should be formulated to integrate that center into the division which can contribute most to its proper development.

Library and Specialized Information Services

At present the main functions of the Libraries of ORNL are:

1. To provide general information support activities, especially query answering service to staff members who do not use a more specialized intermediary like an information center or a dedicated information specialist.

2. To provide the purchasing and acquisitions functions for all published materials.

3. To maintain a general but carefully selected, accessible collection of published materials which supports the major research efforts at the Laboratory.

4. To provide some specialized information services that are needed Laboratory-wide including a selective dissemination of information program covering the major abstracting and indexing services in science and technology, a major computerized retrospective bibliographic search capability, again covering the major abstracting and indexing services, and a technical translation service.

If the reorganization of the Information Division takes place, these functions of the libraries should be studied as part of the effort to define and most effectively mobilize the Information Division resources. Some specific recommendations which should be investigated further are described below. They are grouped under four main categories: availability of published materials, user services, materials processing services, and the cost of services.

Availability of Published Materials

In about 1950 a decision was made to centralize the Laboratory's collections of published materials.[16] Recently, the staff of some geographically dispersed divisions have indicated a desire to begin

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[16]See Appendix A1, History of ORNL Libraries, for additional details.

their own library collections similar to those already available to the Biology and Thermonuclear Divisions. An alternative to setting up a branch library that has been used, quite successfully in the coal program for example, is the use of a librarian who serves the function of identifying and obtaining hard copy of relevant materials although no formal library collection is maintained. A visible consulting service should be available to the divisions and programs to provide the expertise to help them with their library needs. Such service should be paid for by the division with some equitable provision made for the fact that geographical distance prohibts equal use of central overhead facilities.

Finally, a hard copy reproduction service in the library should be reconsidered. Such a service did exist but was discontinued when funds were cut and services had to be curtailed. Special requests like xeroxing long lists of articles should be answered by a centralized service for the sake of cost efficiency. This is especially valuable for those researchers who do not have access to clerical help for such purposes. Charges should be established for users to pay for such services.

User Services

The user services function should continue to contain special services such as translation, SDI and retrospective bibliographic machine searches on the bulk data bases as well as interface with the new computerized systems like the New York Times Data Bank, DIALOG, ORBIT, and RECON. These should be available as a service to individuals, researchers, divisions, centers or any other group as they are now through the Library.

Another main area of user services which has considerable unused potential for aiding ongoing research is the reference function. One use for a specialist from this type of service was noted under availability of published materials. Some of the individual librarians or information specialists may be assigned to centers, divisions, or programs; some will serve as reference staff and will be available to do general reference work on a quick turnaround basis. Some of these specialists could specialize in administrative, legal, policy, biographical and general areas of knowledge to provide such services as the Management Information Directory now operated within the Program Planning and Analysis Office.

Specifically, consideration should be given to enlarging and upgrading the general reference service now provided by the Central Research Library to include an active and aggressive consulting and referral service. This service would make available the expertise to improve the efficiency of information seeking activities of all Laboratory programs and staff members. The task group approach to major publications which is discussed under new opportunities would also be facilitated by such an arrangement.

Finally, in order to be most effective with present Laboratory resources there is a need for inventories of processing systems, data bases and general information capabilities. The user services function as a switching and referral point would be a logical place to handle such projects. If this is to be done, appropriate funding would have to be arranged.

Materials Processing Services

Processing services include such activities as acquisition of materials, organization of materials and systems development activities. The acquisitions function is now carried out for the entire Laboratory by the present Library Acquisitions Department and should continue to do so. By requiring that acquisitions are channeled through a single office, a central record can be kept of all materials available around the Laboratory. In the area of organization of materials, the Cataloging Department does the classification and subject indexing of the materials which are received for the Libraries, there are some indexing and thesaurus building projects carried on in various information centers and each center produces keyword lists for their own data bases. It appears that some consideration should be given here, especially if the Information Division is reorganized as proposed above, to developing a central group of experts who could put their skills together to solve the problems of vocabulary control and organization of materials and information. A center of expertise in this area could provide a valuable service for Laboratory programs which require assistance in organizing files and information. The need for such expertise is also discussed under section V.10. Quality Control.

In systems development, input and data base processing there presently exists the services of the Computer Sciences Division, the Library Systems Office, the Information Center Complex Data Base Management Section, and each individual center has some processing facilities. Some advantage is gained by these individual groups working closely and independently with their particular application. However, if the Information Division is reorganized consideration should be given to pooling some of these resources so they can provide a greater and more generally available service and expertise.

The Cost of Services

In general, an additional benefit of functional groups as described above would be to identify a central cost center arrangement and encourage costing out of internal services by use. Wherever possible, consideration should be given to providing a resource pool where services can be charged out above some base funding level. This base level should continue to come from Laboratory overhead to develop the large central collections and necessary systems that are not attributable to any single program effort. A certain amount of discretionary development time should be built into the system so that there are resources available to assist in developing new programs and improving services not directly attributable to any specific program.

V.3. CLASSIFICATION OF PERSONNEL AND DIFFERENTIATION AMONG ORGANIZATIONS

Although recommendations regarding how to classify information center personnel is out of the scope of this study, the issue of personnel classification must be noted as a major priority issue. The lack of clearly defined status has already had a negative impact on the morale of the professional staff in ORNL information programs and as the field grows it may become a real obstacle to professional career development as well as the Laboratory's ability to attract high quality new professional staff.

For at least four years, Wage and Salary has given the issue sporadic and inconclusive attention, and frustrations have grown. In dealing with this issue a significant amount of attention has been focused on the question of what information work should be viewed as technical work and what organizations are to be viewed as technical organizations in a laboratory which puts highest value on "technical" activities.[17] Therefore, the differentiation among types of information organizations has become very sensitive.

It seems that there has been an excessive amount of attention in trying to differentiate information analysis centers and personnel from other information organizations. There has been an emphasis on being an *analysis center* or a *technical institute* rather than a *library* type center. Semantics have been pushed as a practical solution to open opportunities for better status. A very real and instructive example of this problem as perceived by information people is that writing state-of-the-art reviews is a common activity engaged in by research scientists and is highly valued in the research community. Top level people are asked and gain prestige from doing such -- as long as they do it as a researcher. If the same work is done within

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[17]Although the ultimate determination of value is based on the Hay Plan principles of know-how, problem solving ability, and accountability, technical content of the job is a significant weighing factor in the practical results of job evaluations.

an information center it is regarded as an information activity and the salary of a person doing the work classified in an information category would be lower and have less status. This is not to say that all work and positions in an information center are of a highly technical level. But it is to say that those people who do make technical contributions should simply be categorized at an equal level as those doing the same work regardless of the title of the organization in which they work.

Centers have flourished despite the absence of agreed upon terminology, and it appears that definition and differentiation are not really the underlying cause of the problem. However, the exercise of doing so may be useful for other reasons and should be addressed by the Technical Information Coordinator. The basic issue of recognition and status resulting from the wage and salary classification system needs to be addressed and with some expediency. Once this is accomplished the issue of definition will be defused.

V.4. SPACE NEEDS

In studying the problem of space needs for information processing, there are two dimensions that must be taken into account. First, there is the simple amount of floor space that is required. Second, there is the geographical arrangement of the space. The daily transfer process among internal users, information personnel, the library or other resource materials, and computer systems requires that proximity and physical accessibility be major considerations. Developments in telecommunication and computer technology, especially terminal access to data bases through computerized retrieval systems have helped bridge some of the problems of distance. But these systems need to be kept accessible. Increasing dependence creates additional burdens and demands on such systems. Although there will always remain active shuttling about, wasted time and energy could be reduced with improvement in location of work space. This would improve efficiency and effectiveness in the transfer process.

Specifically, the present space situation has created the following limitations on information processing work at the Laboratory:

> *Inefficiencies in Work Effort.* Much information work is done on the telephone or in meetings with clients, users and specialists. Office sharing and overcrowded space create significant disruptions for the non-involved party. It also limits the ability of the information specialist to meet privately with a client without having the office mate leave or lose work concentration. Productivity per person has suffered due to such overcrowding. Management efficiency has also suffered due to added burdens of managing physically dispersed units which require high volume interaction.
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> *Refusal of Special Resources.* One center felt it necessary to refuse an offer of the U.S. Census Bureau's city, county, and town map collection due to lack of storage. Similarly, hard copy for manual reference of raw data on vital statistics, energy and land use planning was also refused due to lack of space for storage and reasonable access.
>
> *Impairment of Work Quality.* In the case of one large project, lack of sufficient work space was the overriding obstacle to getting the work done at all, no less with a high quality level. Specifically, lack of space caused moving the staff and materials several times which resulted in loss of materials, recurring disorientation of staff, duplication of effort and significant wastes in time. A staff member finally was transferred because

> of the impossible work conditions. All of these problems caused schedule slippage and prevented best quality effort. This ultimately resulted in the expenditure of $17,000 to set up a HUD trailer so the work commitment could be fulfilled. This experience caused significant problems in staff morale and motivation.

In reviewing the space situation for information processing, it is heartening to note that not only is the problem recognized, but also some steps have been taken to help alleviate it. The proposed Information/Conference Facility is a very exciting concept which goes beyond merely providing more of the same type of space. It is a progressive idea which will uncover new potential while it solves some of the floor space needs and should continue to be aggressively pursued. However, it must be cautioned and was indeed considered by the various line organizations that geographic isolation of a center from researchers, both as users and resources is a potential problem that should not be overlooked. The Central Library indicated its present central location was ideal; moving to a remote perimeter location would necessitate physical redistribution of materials. Similarly, information specialists and centers which have frequent interaction with technical people need to be near their contacts. Some centers will request to remain geographically within their respective research divisions and this option should be left open. In cases where compromise will be made, then the negative effects of geographic distance should be ameliorated by facilities such as sufficient telephone lines, adequate capital equipment such as terminals and other computer peripherals, and adequate motor vehicle access. Administrative integration is also a counter force to encourage interaction among geographically separated organizational units.

Looking more specifically at the preliminary report on the proposed Information/Conference Facility there are many positive ideas. However, some caution must be exercised in evaluating the suggested rationale for the center. In the enthusiasm of presenting the idea and the interrelationships among components, and thus maximizing its selling potential, we may be putting ourselves in an all-or-nothing proposition. This comes at a time when the specific needs for information work are real, immediate and pressing. There is a significant risk involved in gambling on getting funding for the costly concepts envisioned in the combined facility when the more basic needs remain unfilled.

Finally, given that the facility is funded and built, the absolutely earliest occupancy date projected would be 1983.[18] So, the problems of space for at least the next seven years remains. Since the space problem is acute Laboratory-wide, there has been some discussion of refusing new work due to the lack of space. The potential for growth in information work is considerable. Therefore, a management commitment to an information program and acceptance of information work as a growth area, requires consideration of alternative, shorter term solutions to the already existent space problems.

Finally, the interaction of space needs and computer needs is a significant one because geographic dispersion makes the requirements for remote access to systems even more significant. The problems of limited on-line computing capability should be kept in consideration when making decisions on space needs for information processing.

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[18] This assumes the earliest possible authorization in FY 1979 plus four years for construction.

V.5. COMPUTING NEEDS

Since computing technology forms the backbone of many of the information activities at the Laboratory, present limitations on computing facilities creates a special problem. In March of 1976 the ORNL Ad Hoc Committee for Long-Range ADP Planning produced a plan[19] which addressed the hardware problems at the Laboratory and included some of those of information organizations. For the Laboratory's purpose this report has proven quite useful, but because of its broad scope it does not adequately address the specific needs of information processing. There still remains a need for more detailed and supplementary analysis of the specific needs in not only hardware, but for software and systems as well. Justifications for needs should include a deeper analysis of such aspects as past and projected growth trends in information work, potential new activities and accomplishments. For example, not having better computer facilities has caused the following types of limitations in the kind and quality of work at the Laboratory:

1. Limitations in interactive capability means there is a limitation on terminal activity in the field. People cannot get access to the computer to do the kinds of searching and production activities that need to be done in the most effective manner.

2. Long response time on the on-line systems causes considerable wastage of time.

3. Because of limitations in the hardware, creating on-line file maintenance systems has been difficult. Such systems are the next step in improving our entire information processing system. A cost/benefit anlysis of such a step needs to be undertaken.

4. Our lack of computer facilities severely limits the amount of information that can be stored on-line.

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[19] *Computing Facilities Long-Range Plan: Oak Ridge National Laboratory, 1976-1982*, dated March, 1976.

5. The RECON system has been limited in the size of the data bases and in the number of bases that it can support because of insufficient storage space. RECON already has been limited in usage because the computer capacity is essentially saturated. This has meant that the publicity has been played down to prevent demand which could not now be met.

6. The cost of building data bases at the Laboratory could probably be reduced with better hardware facilities.

7. High quality publication production is limited due to the overload on the AM748 photocomposition equipment.[20]

In the area of hardware, it is also important to note the special needs of information processing. Small number crunching in many divisions can ride on the coattails of the big number crunching programs. Information processing on the other hand needs different configurations in the central processor and it needs different kinds of peripherials for textual and information handling. Specifically, some of the needs include:

1. More effective and reliable off-line storage such as tapes and tape drives.

2. Much more on-line storage.

3. A machine that is better designed for communication handling.

4. More fast central processsor memory for operating large interactive systems.

5. A high level of reliability. Down time is intolerable because people cannot get on with their work. Some kind of redundancy in the system may be necessary.

6. A mass storage device for the 4.5 million records that ORNL has available in bulk data bases. Batch mode selective dissemination of informattion system is now available and this should be maintained on some kind of mass storage device to help in reliability as well as to increase computer storage space which is now at a premium.

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[20]H. F. McDuffie notes that John Seybold, a nationally recognized expert in word processing and text editing, has been commissioned to do a study which will include recommendations on upgrading publication capabilities. The report is expected by late September, 1976.

In the area of software there is a need for a new approach which requires a quantum jump rather than simply a transition in funds for the next step in software development. This includes creating an on-line capability which would make available the state-of-the-art capability in computer processing of information. In addition to the need for the next step, there is a need to more effectively utilize the resources which are presently available. Due to the historical lack of coordination and thus the inability to mobilize funds for common needs there has been a lack of software development sharing. Some of the centers use software which might be useful to other centers yet there is no common mechansim for exchange. The exception to this is the generalized ORCHIS system which has been developed despite the lack of coherent support. However, even this major resource is now in need of ongoing maintenance as well as development funding. A commitment of an ongoing support base for a generalized system should be developed and coordinated with a function which is funded to improve the interfaces between available systems and potential users.

Related to this is a need to investigate the possibility of standardization and compatibility in software systems and also for input formats for these systems. Standardization in bibliographic format has been suggested before but not much progress has been made in-house. The Technical Information Coordinator should further investigate the possibilities. There is also work being done on national and international standards by ORNL staff members. Such work should be recognized and publicized in conjunction with internal efforts in standardization.

Finally, it is recommended that some supplementary study to the Ad Hoc Committee's ADP report be undertaken to identify the problems, the needs and the justifications for the special computing facilities for information processing.

V.6. FINANCIAL ARRANGEMENTS AND COST RECOVERY

Due to the considerable diversity in sponsorship as well as products and services of information activities and due to the decentralization of the internal structure with regard to information centers, there has not been effective oversight in financial arrangements for information activities. In general, financial matters are attended to by the divisional finance officer where the activity is administered. However, there are some special financial considerations and expertise that are needed and are common across various information activities, especially across information centers. Until about a year ago these matters were not dealt with in a well coordinated and efficient manner. At that time the financial manager for service divisions was asked to take the responsibility of interfacing between Laboratory units and ERDA, ORO, and UCC-ND on financial issues and in ensuring the implementation of ERDA directives. However, now attention can only be given on a fire fighting basis and requires a good deal of running around and coordinating input when an issue like cost recovery is raised by ERDA. ORNL inevitably finds itself in a defensive position. It is felt by the financial people involved that the clarification of line responsibility in information work will help solve this problem.

Cost Recovery

The issue of cost recovery policy for information centers was thoroughly investigated by AEC (ERDA) between 1972 and 1975. An AEC Task Force on Information Center Pricing under the chairmanship of W. R. Mitchell undertook an investigation to recommend policy to AEC. In their report[21] the pros and cons of charging users were summarized.

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[21]Report entitled *Review of Information Analysis Centers (Specialized Information and Data Centers)* dated May 27, 1974 submitted to John A. Erlewine, AEC General Manager by William R. Mitchell, Chairman of Task Force on Information Center Pricing.

The position finally taken by the Mitchell group was that non-AEC users should be charged for services and products. They pointed out that there was, at that time, an apparent Government-wide trend as indicated and justified in the President's Budget of FY 1973, "In many cases of Government activity, where identifiable benefits accrue to specific individuals or groups, charges are imposed on the users or specific beneficiaries to provide a more equitable and efficient sharing of these Government services." Information Centers, they concluded fall within the policy covered in Appendix 1701 of the ERDA (AEC) Manual. Because the government does recover the cost of responding to requests related to the regulatory process, they concluded that an *a priori* blanket waiver for information centers was inappropriate. However, in the interpretation of this position exemptions were recognized which allowed some centers the flexibility they needed in dealing with their users.

Since most of the ORNL centers disagreed with the accepted philosophy of cost recovery, immediately after the directive was issued there was a great deal of correspondence and concern about its implementation and effects on ORNL's centers. First, there was the requirement to establish which ORNL units fell under the definition of information center for cost recovery purposes. Then there were justifications for blanket waivers for centers. Finally, there was a requirement to list and justify specific waivers for users when the center was not exempt from the pricing policy.

During 1974 and 1975 these demands were disruptive to centers. However, at present each center seems to have justified itself in one of the approved categories and has made its own accomodation with its circumstance. Indeed 13 out of 17 centers listed got exemptions from full cost recovery. The specific justification for each center's position and the specific waiver lists for the four subject centers are outlined in a memo from R. Hibbs to R. J. Hart dated June 30, 1975 and entitled *Charging for Information Center Products and Services*. Of those that did not, an important question now remains regarding who receives the money collected. This was identified as a major issue by one center director who estimates that the center loses about $20,000 annually because of this policy. The present ERDA policy is that all information center products and services are to be sold and marketed through the NTIS (the National Technical Information Service). Those ORNL centers who have had experience with a NTIS arrangement indicate that this is an efficient method of billing. However, the income collected by NTIS is not returned to the centers. Rather it is deposited in ERDA's general revenue fund or if the center is sponsored by other agencies, it is deposited with that agency in direct ratio to the percentage of support provided. This procedure is unfavorable to the centers and indeed creates a paradox. The more information disseminated to users, the "poorer" the center will become since the more time spent on outside requests the more resources are diminished and are unavailable to service the funded activities. Thus, unless ERDA provides earmarked funding to cover the cost of serving outside users, a center will either have to curtail level of service or sacrifice ERDA funded work.[22] This situation is, in general, not as financially problematic as it might seem except in a few cases for three reasons:

1. Most centers are exempt from the cost recovery requirement.

2. Of those that are not, in some cases other arrangements have been made to relieve much of the burden. The Toxicology Information Response Center for example, does have an interagency agreement which allows them to recover NTIS collected revenue. This amounts to some $60-80K annually.

3. The amount of revenue we are dealing with after reasons one and two above is quite small.

However, for some centers the justification paper work is time consuming. In addition the real problem that remains is the accomodations that have been made all circumvent the intent of the actual policy. This is done with understanding and approval of our ERDA sponsors. However, if a center cannot justify a way around the policy

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[22]Argument based on that outlined in a memo dated May 16, 1975, from H. R. Beatty to H. M. Beckler and G. A. Riser.

it becomes a significant disadvantage. Therefore, it would be valuable for this to be further investigated and if it is found to be in the Laboratory's best interest, a position should be developed to encourage ERDA to change this policy which now seems to be implemented almost wholly by exception. There has already been some indication that ERDA is questioning the validity of this policy and it may mean that some initiative from the field will stimulate their reevaluation.

V.7. ORNL INTERFACE WITH ERDA

ERDA's plans for technical information are not yet clear enough to give the Laboratory much direction in terms of the way our information activities should develop. ERDA has just undergone a major reorganization in July of this year which has transferred the Office of Technical Information out of the Office of Public Affairs and into the new Assistant Administrator for Institutional Relations. The new director of that office has not yet been appointed and thus the future emphasis of the office can not be anticipated. There are however, two possible exceptions to this lack of direction. First, there is the Office of the Assistant Administrator for Environment and Safety (AES) who has had a major continuing commitment to information processing and has appointed a director for AES information systems who has already been in close contact with ORNL information programs. Second, in the area of nuclear data, perhaps due in some part to Brookhaven's personal initiative, the Division of Physical Research has taken an active role in data center planning. They have begun to implement some long-range decisions in Nuclear Structure and Charged Particle Reaction Data based on two reports they commissioned.[23]

The probable reason for some of the problems within ERDA is inherent in the way they have structured their information activities. The independent assistant administrators each have technical information programs in their own areas. Those programs are overlaid by the Office of Technical Information which has some general responsibility for information programs. This has created an ill-defined matrix structure without any real authority from top levels of management. This situation in some ways parallels the problems that have existed here at ORNL and

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[23]*Study on the Compilation and Evaluation of Nuclear Structure and Charged Particle Reaction Data* by the BNL Study Group, October 15, 1975, BNL-NCS-20573 and "Recommendations on the NNSCS-BNL Study by the Ad Hoc Panel on Basic Nuclear Data Compilations," National Academy of Sciences, Committee on Nuclear Science, March 19, 1976.

which are addressed in the section on administrative arrangements.

However, there has been recognition of this problem and there are some indications that some positive steps are being taken. Obviously this new reorganization is an attempt to better define needs and implement programs. In addition, the reconstitution of the Technical Information Panel and its subcommittees that have formed over the past year may be a start in the right direction. We should do our utmost to have our professional information expertise used by and input into these committees so we can help ERDA formulate their plans.

However, at this point it is not advisable to wait for ERDA to move. While the implications and directions suggested in this report should be discussed with appropriate ERDA managers, the Laboratory should take its own initiatives. In doing so it will probably provide ERDA with some model aspects which could be reflected in ERDA's own system. We should be aggressive and make a decision to build areas of our own choosing as the opportunities are opened. Some of these opportunities are presented in Appendix 3.

<u>Interfaces With TIC (ERDA Technical Information Center)</u>

Exactly how TIC will fit into ERDA's plans for technical information also remains unclear. However, there has been discussion over the past few years regarding ERDA's intentions for information work for the Oak Ridge Complex including ORNL, TIC and CSD. Although this has not been written and is certainly subject to the attitudes of the new ERDA Director of the Office of Technical Information when he or she is appointed, the main thrust has always been to somehow combine the input and processing capability of TIC with the in-depth subject expertise available at the Laboratory using CSD to provide the most efficient systems for processing, retrieval and manipulation.[24]

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[24]For a more detailed summary of this concept see the ORNL internal document *PROSPECTUS: Centralization of ORNL Information Centers*, by H. F. McDuffie, revised April 25, 1974.

The goal of more effective integration and thereby utilization of all the resources is a very reasonable one and ORNL should build on the lead already taken by the ICC and proceed to investigate the possibilities so that management will have a position developed in anticipation of the discussions which will almost certainly be forthcoming.

V.8. EFFECTIVENESS OF INFORMATION CENTERS

There are two levels at which the question of effectiveness of information centers can be addressed. First, there is the question of the effectiveness of the concept of an information center in a philosophical sense. Second there is the practical aspect of the effectiveness or efficiency of any given center in an operational context and in the context of its user community, i.e., relative to its specifically funded goals.

On the philosophical level there have been numerous attempts to evaluate the concept of information centers.

If one accepts the philosophical premise as stated in the Weinberg report that the dissemination and integration of the results of research and development is an integral part of the R&D process, then from the information center perspective the question becomes, is an information center an effective mechanism through which to carry out these functions.

As the concept was implemented it was quickly discovered that the initial cost of collecting and organizing already existing knowledge in any comprehensive way and then keeping abreast of current publishing, not to mention nonpublished information, is an expensive proposition. The cost per unit output is extremely high in absolute dollars yet perhaps not out of proportion relative to the total investment in research and development.

If a center is an analysis center with emphasis on analysis and evaluation, and therefore is viewed predominantly as a research activity, then it must be justified on the same grounds as any research project. The tools of collection, organization and manipulation of citations and information can be viewed as operating costs analogous to the equipment, chemicals, and machines used by experimentalists in their work or to materials used by assessment groups in their work. However, it is probably true that the question of effectiveness is more appropriate for other types of organizations which are not research units, where the work concentrates on such services as collection, selection and organization of information to be passed on to others outside the organization for analysis and technical evaluation. Unfortunately there are no generally acceptable means for evaluating effectiveness of the products or services of these types of organizations. Much study has been done but significantly more is needed. For example, in a recent study carried out under a National Science Foundation grant the characteristics that information center users consider most important are cost, accuracy, currency, response time, ease of access, ease of use, technical quality, coverage of topics, understandability, format, media recall and relevance. However, the conclusion of the study was clearly that there is not enough information currently available to evaluate exactly how these affect any cost/benefit picture.[25] Similarly numerous studies have been done on such things as library reference services, again without having determined any acceptable algorithms for determining effectiveness.

Turning to the second aspect of information center effectiveness, i.e., does any given organization fulfill its potential, is it run as an effective operation, and does it satisfy its users and sponsors, one again finds specific quantitative criteria with any acceptance are nonexistent.

Some centers, and at times the Library, have kept statistical counts on users, number of requests and type of requests for the purpose of fund justification. TIRC sends out an evaluation form with each transaction. However, means to measure the satisfaction and the value of the answers is not usually available. Therefore, the benefit side of a cost/benefit equation is not definable.

Since the basic methodologies for evaluating effectiveness do not exist and ORNL has an interest in the answer to the question, it seems reasonable for the Laboratory to encourage research in this area. Cooperation with ongoing studies in information science like that done by Metrics, Inc. noted previously should be encouraged. The Laboratory might even go a step further in actively promoting such research using ORNL centers as experimental subjects.

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[25]Draft report from Metrics, Inc. prepared under NSF grant SIS75-12741. The paper was prepared by Ethelyn Bishop and Audrey Clayton and is entitled *User Values of Information Service Characteristics*, working paper 703-76-7.

Despite the absence of formal criteria, however, centers do continue to be funded and there have been various sets of criteria, albeit perhaps subjective or informal, that sponsors must use in making decisions on funding. At present, individual ORNL centers are evaluated by their respective sponsoring organizations on the basis of site reviews and periodic status reports which the centers issue. More generally, ERDA assigns oversight responsibility for the macro information program of which centers are a part. According to ERDA Manual Chapter 3201, entitled "Reporting and Disseminating Technical Information," the Director of the Office of Information Services (now Office of Technical Information) has responsibility to review the technical information programs and systems of contractors to evaluate their effectiveness. The local operations office is responsible for carrying out at least once very three years in collaboration with the ERDA Technical Information Center an onsite appraisal of the technical information activities of each cost-reimbursable organization having a program over $1 million. The last evaluation of ORNL's program was carried out about August of last year. Although no formal report has yet been issued the responsible individual at Oak Ridge Operations indicated that he was totally satisfied with the Laboratory's information efforts. Finally, information centers which are integrated into the research divisions are considered by the Divisional Advisory Committees. As reflected in the discussion on the size of the business above, in sheer numbers, ORNL presents a role of leadership. In general, the continued growth in information programs and dollars reflects at least a tacit satisfaction on the part of our sponsors.

V.9. QUALITY CONTROL

In addressing quality control of information products and especially those products of information centers, there are two categories of materials that must be considered. The first is the formally published products which undergo at a minimum the same types of quality control that all published reports go through at the Laboratory, dependent upon the division from which it is issued. The second aspect, however, is more difficult to deal with. It covers the whole range of other services and products that occur on a rapid turn around basis or less formally and includes such things as computer generated bibliographies, query responses, and selective dissemination of information.

First, regarding quality control of published products, there seem to be two aspects of the product which should be evaluated:

1. The technical content as is common to all ORNL publications.

2. The information component which includes evaluation in the area of organization of information and control.[26]

There are adequate mechanisms set up in most cases for peer review of the technical component of research reports. There are strong traditions of such review in combination with technical expertise which is usually available in-house. However, in the cases where the report is more heavily weighed toward an information oriented tool like a bibliography or index, the basis and expertise for evaluation are somewhat less available and the peer review tradition has not been as strong. The Laboratory has not emphasized technical expertise in the areas of information processing, especially in such areas as vocabulary control and organization of materials. Expertise has not been abundantly available nor have outside contacts to seek it been routinely used. However, as we have taken on projects, thesaurus building for example, we have begun to develop expertise based on

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[26] In the case of technical research publications produced by analysis centers or as special research projects, this second aspect is not relevant.

on-the-job development. The proposed strengthening of the materials processing services area of the Information Division will help build this expertise.

The second type of information product, the specialized or personalized product does not seem to have any quality control mechanism applied. At present quality control remains up to the Director of the center or project and the only external control mechanism that was noted was reliance on feedback from the user community. One might be satisfied that the customer is right or one might take the position that he/she is not an expert and therefore is not in the best position to judge. In addition, the price of the work (or lack of it) does not necessarily cover the full cost of the service. Therefore, the user may be getting a bargain in any case.

The above description of the present situation with regard to quality control of information products at the Laboratory does not mean to imply that the products are not well done, well executed and at the state-of-the-art. Rather it simply points to a lack of routine basis of evaluation. Part of the solution to this problem would be gaining a broader expertise base for more effective peer review. The current trends of growth in the Laboratory's technical information program has already helped to improve this situation.

Finally, because this is a fairly new area of work, there is the lack of top management understanding of the business. This adds to the problem of quality control which is common to all new areas in which the Laboratory becomes involved. There generally remains some discomfort on the part of management until they either gain knowledge with time or they find some other reassurance that our work is on target and well regarded. Seeking outside expertise to help in evaluation is another obvious mechanism that should be used. The advisory panel recommended previously would be useful as ORNL's work in information continues to grow. In general, a formal periodic internal evaluation and outside confirmation of strengths, weaknesses and plans for developments would prove valuable.

V.10 PUBLIC COMMUNICATION

Another aspect related to effectiveness of information centers and information work is the area of public communication. Since the business of most information processing activities involves the transfer of information, there is an inherent need to be a known, visible, and credible resource in order to be effective. This also has a direct impact on marketing of new information programs and products and these opportunities will be discussed in the next section.

The researcher is a creature of strong habit in his/her information seeking activities. Whether or not the tools that are potentially available will be used by a researcher has not been necessarily a matter of the most efficient or effective route as studies in the management of R&D[27] have concluded. Rather they take the easiest and most familiar access route even though the rate of satisfaction or success is not high.

Conclusions from the 1976 Metrics, Inc. study of *User Values of Information Service Characteristics*[28] of the Department of Defense (DOD) funded information centers indicate that both usage and awareness of information centers are low within the possible user universe. Actually less than a third of all DOD scientists and engineers are aware of the existence of such centers. One Denver Research Institute[29] study showed that design and production engineers in commerical enterprises of moderate technological sophistication get their technical information primarily from commerical product sales literature and sales representatives. Government publications ranked near the bottom of the list in significance as an information source.

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[27]See for example Thomas J. Allen, *Performance of Information Channels in the Transfer of Technology, Industrial Management Review,* Volume 8, pages 87-98, 1966.

[28]*Op. Cit.* Discussions with Robert Mason.

[29]*Commercial Application of Missile Space Technology* by John G. Wells, L. G. Marts, *et al.*; Denver Research Institute Report No. N-64-24335; 1963, 262 pages.

This same issue was presented by Louis Branscomb in 1972 in a keynote paper in his analysis of how to evaluate information centers.[30] In examining alternative ways to evaluate centers, he eliminates the marketplace mechanism for evaluating them due to the following influences:

- ° Inadequate economies of scale resulting from reaching too small a fraction of the potential market;
- ° Traditional attitudes of the technical community toward information transfer mechanisms of new kinds, combined with;
- ° A tenacious and well justified desire of scientists to reserve their dependence on information sources to those sources whose continuous availability and quality are reasonably well assured;
- ° Less than full confidence in the reliability of the information products offered, so that the user does not risk defraying a substantial cost for information with an even greater cost avoidance achieved by relying on it;
- ° Less than fully effective marketing of information analysis center products, combined with the fact that information is more efficiently and effectively wholesaled than retailed. Thus economic return depends on intermediate institutions such as libraries, which are not in a position to recover or even measure economic benefits from good information.

Further he notes that this problem is aggrevated by the total lack of education in information research tools in the university science curriculums to prepare students for contemporary innovations in the evaluation and handling of knowledge, an issue which NSF has recognized and determined to try to correct.[31]

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[30]From a keynote address by Lewis M. Branscomb at the Forum sponsored by COSATI Panel on Information Analysis Centers entitled *The Management of Information Analysis Centers*, COSATI No. 72-1.

[31]*Toward National Coordination of Scientific and Technical Information Through Research and Development*, paper presented by Dr. Lee G. Burchinal, Head of the Office of Science Information Service, National Science Foundation at the 37th annual meeting of the American Society for Information Science, Atlanta, Georgia, October 15, 1974.

Francois Kertesz further analyzed the issue of marketing and its relationship to effectiveness in his discussion of areas of common concern to analysis centers:[32]

> A potentially fruitful area of collaboration between centers is that of the preparation of publicity material. The whole *problem of publicity,* - or more generally of *public relations,* - is of great importance for the continued existence of the centers. They are ready to help their colleagues but a large portion of their potential customers do not take advantage of the available services, either because of ignorance or because of lack of interest.
>
> Of course, publicity can be made in many other forms; it should include articles written for journals read by all scientists in a given field such as *Physics Today, Chemical Engineering News,* etc. Special lectures at local meetings of technical societies should be considered and it is important not to forget the undergraduates at universities. The sooner in his career a technical man learns about the available information tools, the more probable he will actually make use of them.

There are already efforts underway at the Laboratory as well as in the professional information community in Oak Ridge to better educate researchers on the resources available to them. The public relations committee of the Information Analysis Center Forum produced an exhibit on Laboratory information centers which was originally intended to inform an internal audience by placing it in the 4500N central lobby. Since then the exhibit has been set up at various public and professionally oriented locations. In May the East Tennessee Chapter of the American Society for Information Science sponsored a conference discussing environmental and energy information sources in Oak Ridge designed to acquaint information professionals from across the nation with the technical information work being done here. These kinds of public communications efforts as well as additional activities such as publication in science media and presentations at technical meetings which serve to educate the technical and information communities should be encouraged.

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[32]Kertesz, Francois, *Talks Presented at Recent Meetings on Information Problems,* (Oak Ridge, Tennessee, Oak Ridge National Laboratory) August 12, 1965, ORNL-TM-1230.

V.11. MARKETING AND NEW OPPORTUNITIES

As has been indicated throughout this report, the Laboratory's information program is in a leading and growing position within the ERDA and technical communities. If Laboratory management makes the commitment to ORNL's information program there are many potential opportunities for growth that could be pursued. Some of them have been pointed out by research staff who have used information resources in one area and recommended that similar techniques be applied to other areas. In other cases new concepts in information activities to aid in the transfer of technical information have developed within ORNL's information centers. The information conference center concept and aid to conferences and meetings in general are ideas with enormous potential. Finally, more active assistance to our in-house research efforts could be stimulated to increase our research efficiency. Research managers should be encouraged to educate themselves regarding the services that could offer a cost-effective alternative to present non-organized techniques.

A discussion of specific new opportunities for technical information work is presented in Appendix 3. The Laboratory should strengthen its programs and its information effort by reviewing these and encouraging the marketing of those opportunities with the most potential.

VI APPENDICES

HISTORIC TRENDS IN INFORMATION CENTERS' DEVELOPMENT AT ORNL

APPENDIX VI.1.a.

HISTORIC TRENDS IN INFORMATION CENTERS' DEVELOPMENT AT ORNL

The historic trend in information centers and information processing at ORNL has basically been one of success and growth. There have been some centers which were born, flourished and have since died as well as some that were really stillborn. As a general trend, the causes of failure can be as much attributed to the newness and struggles of an evolving concept during the 60's and early 70's and to the evolution of the related technical programs at ORNL as to problems inherent in the Laboratory's capability or desirability to handle this type of activity.

The growth of information centers and information processing at the Laboratory can be viewed in terms of three main historic thrusts. The first was the result of the President's Science Advisory Committee, Panel on Science Information's report entitled *Science, Government and Information*[1] (and more popularly referred to as the Weinberg Report, after Weinberg the chairman of the Panel and then Director of ORNL) published in 1963. In this report the concept of the *information analysis center* was formally developed and advocated. Actually organizations under other names, carrying on the activities which were thereafter to be called information or data analysis centers, already existed.

The Nuclear Data Project which had been in existence for almost 15 years, first at the National Bureau of Standards and then at the National Academy of Sciences under the direction of Katharine Way, was brought over to the Laboratory in 1964 with the encouragement of Weinberg. While at the Academy the group operated as an independent and somewhat isolated center. Dr. Way in collaboration with Weinberg decided that the group would gain strength from closer contact with active ongoing research in nuclear physics, and that the interaction at the working level would bring finer discrimination and judgement to their analyses consistent with the concept espoused in *Science, Government and Information.*

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[1]U.S. President's Science Advisory Committee, *Science, Government, and Information: The Responsibilities of the Technical Community and the Government in the Transfer of Information,* (Washington, D.C.), January 10, 1963.

There were other center type activities already functioning in 1963 at the time of publication of the Weinberg Report. The Criticality Group at ORNL under the direction of Dixon Callihan recognized the need to collect data nationwide and consolidate it into a formal coherent central repository which would make it available nationwide in the late 1950's and early 1960's. The standard publication *Criticality Dimensions of Systems Containing* U^{235}, Pu^{239}, *and* U^{233} was already underway and the production effort formed the base of what was only formally in 1965 to become the Criticality Data Center. In the Health Physics Division under the guidance of Walter S. Snyder the basis of what was to become the Information Center for Internal Exposure existed long before its formal funding began in 1965. As early as the 1940's, work was begun on evaluating data for inclusion in the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP) handbooks. By 1960 Dr. Synder and his staff had amassed great amounts of data which he felt should not be personal files but available to the wider scientific community.

Work began on the Charged Particle Information Center at Los Alamos in 1955 and was formally tranferred to the Laboratory in 1962. The predecessor of the Controlled Fusion Atomic Data Center, and the Atomic and Molecular Process Information Center, traces its history back to 1958 when a group of scientists began formally compiling atomic cross section values needed in CTR work. Finally, the Accelerator Information Center began in the mid-50's to help keep ORNL researchers informed on the new fast-breaking area of accelerator building and operation. Again, this project was not formally named as a center until 1965.

The concept of the specialized information center emphasized that it should be primarily a technical institute rather than a technical library. "It must be led by professional working scientists and engineers who maintain the closest contact with their technical professions and who, by being near the data, can make new syntheses that are denied those who do not have all the data at their fingertips. Information Centers ought to be set up where science and technology flourish."[2]

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[2] *Ibid.*

From this philosophical position Weinberg became a forceful advocate of the creation of such specialized centers at ORNL. During the period from 1965 to 1970 over 15 different centers were formally established at the Laboratory under the stewardship of Weinberg and his appointed assistant for information center work, Francois Kertesz. These included:

Center	Date Established
Accelerator Information Center	1963
Actinide Research Information Center	1966
Atomic & Molecular Process Information Center	1963
Biogeochemical Ecology Information Center	1969
Charged Particle Cross Section Data Center	1962
Criticality Data Center	1965
Environmental Mutagen Information Center	1969
Information Center for Internal Exposure	1965
Isotopes Information Center	1966
Nuclear Data Project	1964
Nculear Desalination Information Center	1966
Nuclear Fuel Technology Information Center	1965
Nuclear Safety Information Center	1963
Radiation Shielding Information Center	1962
Research Material Information Center	1964

As evidenced by statements in both interviews and publications, all of these centers were significantly influenced by the views expressed in the Weinberg Report and by the activities of Kertesz, supported by Weinberg.

The individual histories of these and other ORNL centers are summarized in Table 1.

During the late 1960's and culminating in the summer of 1970 the second major thrust in information center development was initiated. In the summer of 1970 under an Interdisciplinary Research Relevant to Problems in Our Society (IRRPOS) study grant from NSF on "The Environment and Technological Assessment," the concept of an environmental information system was developed as part of a broader Laboratory effort in diversification into the environmental area.[3] The philosophical basis

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[3]For fascinating and cogent summary of the effort and developments Laboratory-wide, the following study is recommended reading: *Redeploying Big Science: A Study of Diversification at Oak Ridge National Laboratory*, by Albert H. Teich and W. Henry Lambright, Albany, N.Y., Institute for Public Policy Alternatives, State University of New York, 1975.

Table 1

INFORMATION CENTERS AT ORNL - PAST AND PRESENT

Name	Years Established (Unofficially Begun)	Brief Comments on Administration
Accelerator Information Center	1963 (1955) - 1975	No longer a funded center. Ceased operation with the retirement of F. T. Howard.
Actinide Research Information Center	1966 - 1976	Does not exist. Was very short lived and never really developed into a significant center.
Atomic & Molecular Process Information Center (Changed name and sponsor)	1963 (1958) - 1970	Changed name and sponsor in 1970 to Controlled Fusion Atomic Data Center.
Biomedical Computing Technology Information Center	1975 - *	Just starting up as a sister center to RSIC in Neutron Physics Division.
Biomedical Studies Group	1974 - *	Part of the ICC. Works with EPA in writing state-of-the-art monographs.
Biogeochemical Ecology Information Center	1969 (1967) - 1971	Forerunner of ESIC and IBP centers in old Ecology Section.
Charged Particle Cross Section Data Center	1962 (1955 at LASL) - 1976	Functions were transferred to BNL as a result of ERDA study on nuclear data.
Coal Technology Information Center	1974 - *	To support Coal Program. Less than 1 MY effort. Part of ICC.
Controlled Atomic Fusion Data Center	1970 - *	Formerly Atomic and Molecular Processes Information Center (1963-70). Now at level of ½ man year.
Criticality Data Center	1965 (1955) - 1975	Center was closed when program was transferred to Y-12.

*Centers functioning in FY 76.

Table 1 (cont'd)

Name	Years Established (Unofficially Begun)	Brief Comments on Administration
Data Extraction and Analysis Group	1974 - *	Part of ICC. Is part of the National Library of Medicine's Toxicology Information Program.
Ecological Science Information Center	1971 - *	Part of the ICC. Supports and works in close cooperation with programs in the Environmental Sciences Division.
Energy Information Center	1972 - *	Evolved out of energy data base from summer 1970 study. Part of ICC.
Energy Research, Development and Demonstration Inventory	1974 (1971) - *	Evolved out of Congressional request. Became ongoing center in ICC.
Environmental Mutagen Information Information Center	1969 - *	Part of the ICC. Works in close cooperation with scientists in the Biology Division and at the National Institutes of Health.
Environmental Response Center	1976 - *	Part of ICC. Established to provide services to a diverse user group on short-term contracts to avoid resource conflicts with ongoing long-term projects of Ecological and Environmental Sciences section of ICC.
Environmental Teratology Information Center	1976 - *	Part of the ICC. A sister center to EMIC and works in close cooperation with scientists from the National Institutes of Health.
Health Physics Information Center	1974 (1972) - *	Still in the developmental stage. Will be composed of various data bases to support researchers in sections of Health Physics Division.

Table 1 (cont'd)

Name	Years Established (Unofficially Begun)	Brief Comments on Administration
Eastern Deciduous Forest Biome Information Center (International Biological Program)	1971 - *	Is directed by Julie Watts (CSD) under the Environmental Sciences Division.
Information Center for Energy Safety	1976 - *	Just organizing as a sister center to NSIC in Engineering Technology Division.
Information Center for Internal Exposure	1965 (1959) - 1973	Has not been funded or actively kept up since 1973. Files are still available and used internally. Back to personal file of Sam Bernard.
Isotopes Information Center	1966 (1962) - 1972	Operated within the Isotopes Division. Funding was abruptly cut off and center closed without formal documentation.
Molten Salt Reactor Information System	1971 - 1976 (?)	Mainly a computer based file of abstracts. Fate varied with MSR Program.
Nuclear Data Project	1964 (1948) - *	A major national data analysis center in the Physics Division.
Nuclear Desalination Information Center	1966 - 1972	Was mainly a program support function for the ongoing work at the Laboratory.
Nuclear Fuel Technology Information Center	1965 - 1968 (?)	Set up in the Metals and Ceramics Division using funds from studies and evaluation program. When program folded no money was available for continuing the center.
Nuclear Safety Information Center	1963 - *	A major embedded information center in Reactor Division.

Table 1 (cont'd)

Name	Years Established (Unofficially Begun)	Brief Comments on Administration
Oak Ridge Regional Modeling Information Center	1974 (1971) - *	Is presently an experimental data and software system tied intimately with ongoing regional modeling research in the Energy Division.
Radiation Shielding Information Center	1962 - *	A major embedded center in the Neutron Physics Division.
Regional and Urban Studies Information Center	1974 - *	A demographic and socioeconomic center with large data files. Originally set up to work with local and state governments.
Research Materials Information Center	1964 - *	A small embedded center in the Solid State Division.
Toxic Materials Information Center	1972 - *	Part of the ICC. Originally part of Environmental and Trace Contaminants Program. When program folded TMIC continued to be funded.
Toxicology Information Response Center	1971 - *	Part of the ICC. Functions as a major center in the National Library of Medicine's Toxicology Information Program.

of this system emphasized the development of environmental data systems for researchers who required large amounts of accessible environmental data and the computerized tools to manipulate them rather than in analyzing and evaluating the technical content of the literature in the image of Weinberg's technical institute. The concept of service to a broad user community including local and regional decision makers like "the Mayor of Wartburg" by providing response center outreach services was also a motivating force.[4] This emphasis was philosophically different from that of the very specialized technical institute functioning within the highly specialized technical community and embedded in the ongoing research organization.

In addition, part of the reason for this difference in underlying philosophy between the earlier and the new centers could also be attributed to the nature of the scientific disciplines that were being served. The earlier centers were mainly in highly structured and specialized areas in physical and engineering sciences (perhaps with the exception of the Nuclear Safety Information Center). The newly emerging centers covered much broader and certainly less theoretically simple interdisciplinary sciences. The problem at hand was just being formulated and needed information services at a much broader level of service. The amount of material needing to be covered, the span of disciplines combined with large gaps in the knowledge available confined some of these centers to bibliographic rather than data compilation and compaction tasks longer than was the case with the earlier centers. Analysis tasks have only become part of these centers' work in the last few years.

Also different was the planning process. With earlier centers the working group and professional-technical society sections formalized the data collection and analysis efforts already underway informally but growing too fast to be kept up with on that basis. With the Environmental centers the information organizations at the Laboratory were formulated in parallel with the working research groups.

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[4]Personal communication with C. J. Oen who was involved in some of those deliberations.

So, by the end of the summer of 1970, the IRRPOS information work was emerging as a strong independent effort. As a result of the summer activities and then perhaps further stimulated by the personal interest of the then Laboratory Associate Director for Biology and Medicine, James L. Liverman and the active leadership of Gerald U. Ulrikson, the Environmental Information Systems Office (EISO) was formally established in June 1971 as a separate entity organizationally reporting directly to Dr. Liverman. From its early development EISO tried to establish an organization with five basic components:

1. Centers
2. Data Bases
3. Special Projects
4. Central Services
5. Library Resources

In the early stages many of the programs entailed data base building and it was these data bases that eventually formed the basis of the new environmental and energy information centers that were established between 1970 and 1974.

For example, in the first EISO newsletter dated February 1972 the following data bases were described:

Toxic Material in the Environment
Social Sciences
Regional Modeling
Energy Data Base
Materials Resources and Recycling
HUD Solid Waste

Of these, Toxic Material formed the backbone of the Toxic Materials Information Center (TMIC) which was formally established later that year; the social sciences data bases later developed resources for the Regional and Urban Studies Information Center (RUSTIC) which was formally established in 1974 and the Energy Data Base formed what became the Energy Information Center later in 1972.

Because of the emphasis on coordination and systems development coupled with aggressive leadership and effective marketing, EISO developed special capabilities which attracted special information projects to the Laboratory. Included among the early tasks were the Environmental Terminology Index, the in-house availability of the

University of Georgia Selective Dissemination of Information (SDI) program at ORNL, Survey of Energy Resources for the 1974 World Energy Conference, computerized Directory of Environmental Life Scientists for the Institute of Ecology and the Energy R&D Inventory. This earlier contract type of special projects were precursors to later special projects, to internal reorganizations which have culminated in the Information Center Complex (ICC) special sections, to larger projects such as the work in the Data Extraction and Analysis Group and the Biomedical Studies Section, and in the case of the Energy R&D Inventory to a full information center.

Besides the EISO administered centers which were established between 1970 and 1974 the three life sciences divisions were also involved with establishing centers philosophically somewhere between the earlier Weinberg centers in the physical sciences and the newer systems oriented work from the summer study of 1970. In the newly formed Environmental Sciences Division, the Biogeochemical Ecology Information Center recognized by 1969 under the sponsorship of AEC's Division of Biology and Medicine in cooperation with the NSF's International Biological Program (IBP) grew into the Ecological Sciences Information Center (ESIC) as well as helped seed the IBP/Eastern Deciduous Forest Biomedical Information Center, both of which were formally established in 1971. Today ESIC is part of the Information Center Complex.

In the Health Physics Division the Information Center for Internal Exposure (ICIE) was an already established center. In about 1967, J. A. Auxier and K. Becker proposed the establishment of an Information Center for Dosimetry based on experience in the Health Physics Division with ICIE. Due to lack of funds, work on this project was postponed. Finally in 1972 the Health Physics Division was reorganized and Auxier became Division Director. He set up a special Education and Information Section. Reactivating the earlier ideas of new analysis and consultation centers like that for dosimetry, preliminary work was begun on the Health Physics Information System (HPIS). It was formally funded by AEC/Division of Biology and Medicine (DBER) in 1974.

Finally in the Health Physics Division, the Civil Defense program grew and the social science collections which developed out of the summer of 1970 evolved administratively with the project work into

Health Physics. These data base collections eventually formed the backbone of RUSTIC (officially funded in 1974) which followed the Urban Research Section of Civil Defense into the Energy Division and is now administratively under the Regional and Urban Studies Section.

By 1969, the Biology Division under the guidance of then Division Director Alexander Hoellander already had set up the Environmental Mutagen Information Center in the same philosophic vein as the Weinberg centers of the earlier 1960's. A working group of mutagensis biologists saw the need to focus information collection in the rapidly growing area. Heinrich Malling who already had an extensive personal collection volunteered to take on the responsibility of forming a center which was formally established but funded in 1969 by internal divisional funds for the first two years until formal funding came from the National Institute of Environmental and Health Sciences. Also set up in the Biology Division in 1971 was the Toxicology Information Response Center as a part of the National Library of Medicine's (NLM) Toxicology Information Program. The center was the direct result of the 1966 President's Science Advisory Committee's report on the handling of toxicological information. Henry Kissman of the National Library of Medicine was active in bringing this program to ORNL. The final decision to locate TIRC at the Laboratory was based on the availability of facilities that already existed here, presence of considerable relevant technical competence and accessibility to necessary computing facilities.[5] The purpose of the center was to cope with the information explosion in the fast-breaking field by centralizing the collection, organization, and dissemination of toxicological information on a nationwide basis.

All of these divisionally administered life science developments were funded separately from EISO but there were significant attempts made at coordination and better integration. Sometimes cooperation was difficult because of the differences in the philosophy of developing a center and due to some internal politics in the development of information activities among these various organizations. But significant pressure was put on the Laboratory to centralize our life sciences and environmental centers by DBER. Finally in 1974 the environmental

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[5]From Program Committee Minutes dated 12/12/75, on the Information Center Complex (ICC).

and life science centers that were operating with the exception of the HPIS and IBP centers, were organizationally integrated into the Information Division.

Meanwhile, during this period of growth for environmental centers, there was a tightening of budgets and a changing of research projects in other Laboratory areas. This led to a closing of some of the centers established in the 1960's. These included:[6]

Criticality	1975
Information Center for Internal Exposure[7]	1973
Isotopes	1972
Nuclear Desalination Information Center	1972

The final thrust in information centers brings us into the present status of information center and information processing work at ORNL. It began about 1974 and can be viewed as the beginning of a period of maturity for technical information centers at ORNL. It was marked by two events that happened in 1974: 1) the administrative centralization of the biomedical and environmental centers under the Information Division (ID) and 2) the formation of the Information Analysis Center Forum as a voluntary association of IAC's to deal with problems and issues of common interest. The maturity that these two events implied has distinct overtones for the next decade of information processing. Over 15 years of information center and information processing development at the Laboratory paralled by similar evolutions in the external information community has resulted in an information science expertise which has stature in its own right. The value of information work as an integral part of the R&D process and the institutionalization of specialized information products and services in the research environment has been well established in the scientific community and its

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[6]Other of the older centers had already folded for reasons given in Table 3 and still others that have been mentioned in the literature began as divisional projects and never really got formal sponsorship and folded. These included:

Actinide Information Center	1967
Nuclear Fuels Technology Information Center	1968

[7]It was noted by the former center director that the ICIE was in part a casualty of the dictate to centralize life science information center administration because in 1972-73 funding was disrupted but no centralization materialized.

main funding source as evidenced by the fact that in 1976 there was an estimated $492 million dollars in federally obligated funds for scientific and technical information.[8]

At ORNL the centralization of centers under the Information Division gave added stature to the Division and a disciplinary home as well as opportunity for recognition and career development for information professionals. Some of the internationally recognized centers like EMIC and ESIC proved that they can function effectively through affiliation with an information division as long as they are able to maintain strong programmatic ties with the technical research, the Environmental Sciences Division in the case of ESIC and the Biology Division and the National Institute of Environmental Health Sciences in the case of EMIC. On the other hand, many embedded centers have remained in their technical divisions and organized the IAC Forum to share their information processing expertise. In both cases these events indicate that there is room for considerable diversity in addition to a common ground and expertise in information processing at ORNL. The present stage of development portends the increasing recognition of this information expertise and the opportunities for program growth based on it. The creation of three new centers in 1975-76, Biomedical Computing Technology Information Center, Information Center for Energy Safety, and Environmental Teratology Information Center supports this trend. The sponsors of each of these made the decision to locate their information work at ORNL as much, if not more, based on the consideration of our experience in information processing and the capabilities of individuals as the to the particular subject expertise available.

Paralleling and interrelated with the philosophical and organizational thrust described above were the actual ways in which the centers were initiated and funded. In the case of the centers which evolved in the 1960's the working groups of scientists either informally

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[8]National Science Foundation, *Detailed Statistical Tables, Federal Funds for Research, Development, and Other Scientific Activities, Fiscal Years 1974, 1975, 1976,* Volume XXIV (NSF 75-323).

or through society sections or groups acknowledged the need to get in better control of the literature and knowledge available in their areas. In some cases actual funding was immediately forthcoming. In a majority, however, the work was absorbed into the divisional overhead in the beginning until formal funding sources were identified. The following description given by a center staff member is typical of the history of such centers.

> As the field developed, the need for data increased; there was not time or money to duplicate effort. Working groups continued to exchange data until it became too massive a problem. The people in the field saw the need and desirability to collect information in a coherent fashion, to make it available collectively. Small groups came together under the American Nuclear Society and the need to assign responsibility resulted in the establishment of a center.[9]

Or a similar pattern noted:

> The center was established by a group of scientists who compiled atomic cross sections needed in controlled thermonuclear research.[10]

In all cases the eminent researchers working in the area took the responsibility of making a focal point for information in the field and these leaders remained intimately involved in the IAC development. Most of them were very directly influenced by the thinking espoused in the Weinberg Report. Another thread common to the establishment of some centers and complimentary to the above was the growth of centers out of a single, major publication. Often the publication was the result of the synthesis of the information gathered by the working group. As the literature grew, a bigger operational base was needed to continue the publication activity. These became formalized and expanded into IAC's. Table 2 shows the documents, dates, and centers that built on an ongoing publication. Often a combination of the above two forces merged into the formalization of the center.

With the second major thrust into the life science and environmental centers, the sponsorship evolution was quite different as noted above.

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[9]Discussion with E. B. Johnson formerly associated with Criticality Data Center.

[10]Discussion with Francis McGowan formerly director of the Charged Particle Cross Section Data Center.

Table 2

CENTERS ESTABLISHED IN CONJUNCTION WITH SPECIAL PUBLICATIONS

Publication	Date Publication Began	Center	Date Established
*Nuclear Safety	1959	*Nuclear Safety Information Center	1963
Isotopes and Radiation Technology	1963/64	Isotopes Information Center	1966
Critical Dimensions of Systems Containing U^{235}, PU^{239}, and U^{233} (TID-7028)	1964	Criticality Data Center	1965
International Commission on Radiological Protection Handbooks (Recommendations)	1958	Information Center for Internal Exposure	1965
National Committee on Radiological Protection Handbooks (National Science Foundation issued)	1940's		
Permissible Dose for Internal Radiation	1958		
*World-wide Directory of Cyclotron and Other Types of Resonance Accelerators	1955	*Accelerator Information Center	1965
*Nuclear Data Sheets *Nuclear Data Tables	1959 1959	*Nuclear Data Project	1964
*Atomic and Molecular Collision Cross Sections of Interest in Controlled Thermonuclear Research (ORNL-3113)	1961	*Atomic and Molecular Process Information Center	1963
*An Invertory of Energy Research	1972	*Energy Research and Development Inventory	1974
*Atomic and Nuclear Data Tables	1961	*Charged Particle Cross Section Data Center	1962

*Still active at Oak Ridge National Laboratory in 1976.

Rather than by state-of-the-art publications like *Nuclear Safety* or by working scientific group personal collections these new centers evolved out of computerized data bases and special information projects. The directors were not the eminent leaders in the field. Indeed the fields themselves were new to ORNL. Rather they often came from related fields or other disciplines and became involved in the information component in parallel with other staff members who began working in the new research programs in these same areas.

Causes of Center's Closing

In surveying general historic trends in information the final issue to be addressed is whether there are any generalizable causes for the failure of centers. If we consider some characteristics of centers which have failed like single program sponsorhips, lack of director with charisma, reputation or klout, size of staff, size of budget, types and variety of products, *et al.* we can point to other centers with the same characteristics that have proven successful, at least on the basis of one's ability to judge without significant analysis of subjective input. As discussed in the section on effectiveness, it would be very difficult to form a judgement on a relationship between effectiveness and success of a center since generally accepted tools to evaluate effectiveness of information centers do not exist. In discussions of center failure with people who were involved with them, in only one case was there some expression that the work was discontinued because of lack of usefulness of the concept of a center in a cost/benefit sense in relation to the work being carried out. In a second case, one center director felt that the level of effort for the data compilation being carried out was difficult to justify because users were basic researchers and there was no real applications market. Some aspects of the work of this center was transferred to a larger data center. In actually analyzing the reasons stated for the closing of various centers as presented in Table 3, we find that many are actually similar to reasons for closing out the technical program with which they were affiliated at the Laboratory, rather than to reasons inherent in the concept of a center. Since these early centers were tied to the Weinberg philosophy of the center being part of the ongoing research, their closing at the termination of the ongoing research work could be considered a logical conclusion.

Table 3

REASONS FOR CENTERS CLOSING

Center	Date Closed	Reason Given
Actinide Information Center	1967	Never got external funding because Washington tightened budgets.
Charged Particle Cross Section Data Center	1976	Since there was no applied use (it was used by researchers) it was difficult to justify the level of effort needed. The recommendation to move the functions to BNL from their study report was accepted based on the consideration of making the entire nuclear data effort more consolidated and efficient.
Criticality Data Center	1975	When AEC closed the facility at Y-12, the data center as part of the program no longer existed. No further explantion was ever given.
Information Center for Internal Exposure	1973	When the decision to consolidate environmental centers was made in 1972-73, it disrupted funding but no centralization was forthcoming. The work just stagnated.
Isotopes Information Center	1972	No real explantion was ever given. The Director was told that the cost/benefit picture was not good. The thinking among center staff was that it was a small AEC Division so it could not swallow a big center budget.
Molten Salt Information System	1976	Termination of the technical program.
Nuclear Desalination Information Center	1972	Termination of the technical program.
Nuclear Fuel Technology Information Center	1968	When the assessment program lost its funding, there was no basis left so it closed.

HISTORY OF ORNL LIBRARIES

APPENDIX VI.1.b.

HISTORY OF ORNL LIBRARIES*

During World War II, because of the secrecy required in the Manhattan District activities at Oak Ridge, the earliest library-type services were strictly compartmentalized. A physicist or chemist worked his own section with no knowledge of what other sections were doing. As a result, in the laboratories at ORNL a number of individual collections of library materials were accumulated.

The scientists who transferred to this new Laboratory from the University of Chicago were accustomed to having a library and expected library service. It soon became apparent to many of them that the scattered and unorganized material was not satisfactory. They began asking that something be done toward obtaining a library. Three physicists were asked to serve as a library committee for the physics collection to recommend books and journals needed in their field. A similar committee was set up for the chemistry collection.

In August 1946, A. M. Weinberg, at that time a member of the Physics Division, writing at the request of the Research Director E. P. Wigner, strongly recommended that the Library obtain a complete list and a complete file of the reports issued by the Metallurgical Laboratory Project at the University of Chicago. This request initiated a vigorous effort to build up and organize the report collection in the Library.

About this time at the request of Dr. Charles A. Thomas, President of the Monsanto Chemical Company in St. Louis, the librarian of the Monsanto Library in Dayton visited the Oak Ridge Monsanto plant and wrote a report which recommended a proposed organization plan for a library having an abstracting and searching staff, a central file of reports under the jurisdiction of the Library, and an eventual hundred thousand volume library.

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*Sources include: 1) *Tennessee Librarian Volume* 10(2) 1958
2) E. B. Howard's Thesis
3) Conversations with Ray Dickison and Ann Klein

During the first years following the war, the individual collections were grouped together, creating about seven departmental collections. These were not yet organized or administered as libraries, although several people were appointed to look after them.

There is no one definite date that a library came into existence. The growth of material and the needs expressed in 1945-1946 in combination with other events including the transfer of the Laboratory from the Manhattan Engineering District to AEC on January 1, 1947 brought many reorganizations at ORNL, including the beginning of a formal library organization. This culminated in the appointment February 1, 1947 of Dr. Edward Shapiro, a chemist at the Laboratory, as the Technical Librarian. As of this date all requests for books and journals were to go through the Librarian's office for approval, instead of being sent directly to the Purchasing Department and for the first time a formal library organization existed.

When Dr. Shapiro was transferred to the Brookhaven National Laboratory a year later, there were thirteen additional staff members and approximately 15,000 volumes in the library. There was a Chemistry Library, Physics Library, Training School Library, Biology Library, and Medical, Mathematics, Metallurgy and Health Physics Collections. The collections were not staffed by professional library personnel.

In January 1948 Jack C. Morris, a trained librarian, was appointed Chief Librarian. During the post war years as the research program increased, it became apparent that the war-built facilities originally intended to last for only two years were inadequate. In 1949 a twenty million dollar program of permanent construction and improvement was undertaken.[1] Space for a library was included in this building program, and planning for a Central Library was one of the first tasks Mr. Morris faced.

The completion of a Central Research Building made possible the move and consolidation of the Chemistry, Physics, and Training School Libraries and the Mathematics Collection, into one Central Research

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[1]U.S. Atomic Energy Commission, *Oak Ridge National Laboratory*, (Oak Ridge, Tennessee: Atomic Energy Commission, 1951), p. 66.

Library in September 1952. All ordering and cataloging of books was then centralized. The Library was set up with four functional sections:

1) Reference and Circulation
2) Acquisitions
3) Cataloging
4) Technical Reports

There remained then outside this central collection, the combined Health Physics-Metallurgy Library, the Biology Library, and the Technical Library of the Y-12 Electromagnetic Plant. The Y-12 Library was transferred to the Oak Ridge National Laboratory in 1954 and became a branch library serving the personnel of both plants located within that area. The Medical Collection remained in the Medical Department but still was not staffed by library personnel.

J. C. Morris died in 1954 and was succeeded by R. R. Dickison who is the Director of Libraries today.

In May of 1957 the libraries become a department of the Laboratory's Technical Information Division. Previously it had been a part of Weinberg's staff under E. J. Murphy, a special staff assistant.

In 1958 the central libraries performed all of the usual functions of procurement, organization of materials, and reference and loan services. A full-time translator maintained an extensive collection of translations, while a semi-monthly acquisitions list was issued which indicated additions to the library's books, journals, and translations holdings.

A number of bibliographic and indexing projects were undertaken in connection with report collections. A photocopying service was also maintained and tables of contents of current journals were reproduced and distributed. The library ordered reprints, standards, specifications, etc., for all divisions of the Laboratory.

In 1962, the Health Physics, Metallurgy, and Ecology collections were merged during the year with the Central Research Library collection leaving only the Engineering collection and the K-25 Library not part of the centralized library system.

Also, in the years 1961-1962 a major change was seeded in the area of Library operations. This was the introduction of the computer into the Library processing routines. A more detailed description of the development of library systems can be found in Appendix 1.c., Historic Trends in Processing Systems Used in ORNL Technical Information Work. The first application of the computer was in KWIC (key-word-in-context) title indexing of technical reports. As a result of the success of this operation, a separate Library Systems Development Office was established under Ann Klein.

Also in the early sixties, the library began making extensive use of microfilm. This was due to the ever present need for space. Today about 30,000 volumes of back runs of journals have been replaced with cartridge microfilm and about 75% of the 600,00 research and development reports in the collections are in microfiche format. The library's collections of telephone directories and college catalogs are also being replaced with microfiche.

While these changes were taking place in the Library System in the early and mid-1960's another type of information processing activity was gaining interest at the Laboratory. This was the information analysis center concept forwarded by Weinberg, Laboratory Director at the time, and presented in the report of the President's Science Advisory Committee in 1963 of which Weinberg was the chairman. As discussed in the section on history of information centers some 15 new centers were established at the Laboratory during this period. The needs of these centers in gathering hard copy of relevant documents put a significant new burden on the library staff. Since the philosophical position was that these new centers aimed at 99% coverage of the literature in a field whereas in general a library aimed at about 80%*, the difference required significant verification of materials and interlibrary loan borrowing. It forced the Library into a new role from retailer of

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**Second Thoughts on Scientific Information,* A. M. Weinberg in the Information Analysis Center: Seven Background Papers, reprinted by Panel #6 of COSATI, dated October 1969.

information to one of wholesaler in document delivery. To help handle the new volume of work and to help alleviate some of the pressure, the Library appointed a Library Liaison for ORNL Information Centers whose responsibility it was to act as a funnel for all requests from the centers. (This function was terminated in 1972.)

In 1971 the libraries became a part of the newly-formed Information Division where it remains today.

In 1972 two major changes took place. In the administrative area, the reports sections was integrated into the reference and circulation section in order to better serve the Library user who did not really make the distinction between a technical report and other types of published material. By combining the services the user could come to one place with a request and the Library staff could effectively guide him/her to the proper place to find the needed material. Also that year the library acquired its first terminal for on-line searching of computerized bibliographic files. This was for use with RECON. It was the first introduction of computerized *retrieval* in the Library environment at the Laboratory, but it established a trend that has continued. The Library now makes extensive use of large commercially available systems to access the major abstracting and indexing services in science and technology. The systems currently in use are ERDA's RECON, Lockheed's DIALOG (acquired in 1974), Systems Development Corporation's ORBIT (acquired in 1975) and finally the New York Times Information Bank (acquired in 1976).

In 1973 the Library's services were broadened to include the Office of Language Services previously a separate section in the Division under Francois Kertesz, and the computerized information retrieval services under Herbert Pomerance which had also been functioning as a separate office. This second operation first came to the Information Division in 1972 and is discussed in the section on processing systems.

The latest administrative reorganization, which took place in the Library last year, was the splitting up of the reference and circulation functions. This was done to upgrade the professional reference function and to allow the professional reference librarians the opportunity to more effectively use their skills and knowledge in assisting the research staff as well as to increase the efficiency of circulation activities. It also will allow additional career development opportunities for professional librarians.

In the processing end of library operations the Library's Systems Development Office is now in the process of converting the files for use with either COM (computer output microfilm) or on-line retrieval from a display terminal. This latest development which was initiated this year was a result of the massive amount of book and journal information which the Library had in machine readable form, in combination with current Nuclear Division efforts to reduce the volume of paper produced.

Present Situation and Future Needs

Today, some thirty years after its beginning, the library system has grown to contain about 200,000 bound volumes, 600,000 research and development report, 3,500 periodical subscriptions, and an extensive microfilm collection. There is a staff of 49 persons, including 18 professionals, who provide a wide variety of information services and utilize and develop new methods in librarianship to better serve the researchers at the Laboratory.

This staff of 49 represents a ratio of about 1:100 to total Laboratory staff. This ratio has remained relatively constant through the years and seems to be a reasonable level for the current scope of services offered. Funds for materials also have stayed at a reasonable level.

However, there are two very significant problems which the Library faces. The biggest and overriding problem is that of space, both storage for materials and work space for staff. The main answer to continuing need for storage space has been microforms. This is not fully acceptable to many staff members. And it is further compounded by the inadequate and outdated microform reader-printers which will be discussed below. In terms of limitations on work space, the recent separation of reference and circulation in an effort to improve services is hampered considerably by the lack of space. The reference staff has no place to work with clients in a quiet, relaxed atmosphere. They do not have any private work areas in which to retire to work on difficult problems without being constantly distracted by traffic flow through the Library and questions asked by passer-bys.

The other significant problem for the Library is the fact that it is in competition with the research divisions for capital equipment money. Because of priorities, the Library has difficulty in obtaining such needed equipment as microform readers, computer terminals and even typewriters. Much of this equipment is necessary for effective Library operations. Unfortunately the equipment the library now has is badly out-of-date. Particularly in the case of the microform printers, this lack of ability to upgrade equipment has caused complaints and has further compounded the dissatisfaction of the researchers with the use of microforms.

HISTORIC TRENDS IN PROCESSING SYSTEMS USED IN ORNL TECHNICAL INFORMATION WORK

APPENDIX VI.1.c.

HISTORIC TRENDS IN PROCESSING SYSTEMS USED IN ORNL TECHNICAL INFORMATION WORK

Processing Systems for Information Centers

The historic trends in information processing systems for information center work at the Laboratory were similar to those that occurred in the development of information centers. As there has been a trend toward increased administrative consolidation and closer policy coordination for various decentralized centers there has also been a trend toward a more unified approach to an integrated Laboratory information processing system.

From the first computerized systems in the early 1960's until about 1970 processing systems designs were decentralized. Just as the early information centers were embedded in the research activities and evolved to reflect the nature of the subject field served, the early processing systems were embedded in the individual centers and were developed to meet the specialized needs and specifications of the particular center. Indeed, many of the early centers chose not to computerize their processing systems in the early 60's because of various reasons, the state and cost of the technology being some considerations. The following excerpt from ORNL-TM-996[1] published in 1964 is very instructive with regard to the philosophical approach to processing systems during the early formative years.

> As a result of this variety in supervision, the actual operational methods of the centers are quite dissimilar. A slight loss of efficiency is considered a small price to pay for the gain in the originalty and competence of the centers. Chemists, physicists, and engineers have different educational backgrounds and varying temperaments; what is suitable for the other might be completely unacceptable at least on individual grounds for the other. The divisional management is relied upon to make sure that this permissive method will yield generally acceptable results. In addition, a coordinator has been appointed who is responsible for the review of the activities and about new developments in the field of information handling. In view of the variety of the background of the centers, the storage and retrieval tools used also cover the whole gamut of possibilities; no attempt is made to force uniformity. The equipment and the personnel depend on the field. Where the number of papers published per year is relatively small, a single individual usually is assigned

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[1] *Information Centers at the Oak Ridge National Laboratory*, Francois Kertesz, ORNL-TM-996, 1964.

as a part-time duty to read the "extract" or "abstract" on ordinary file cards; the simplicity and adaptability of this system which is very widely employed at Battelle Memorial Institute's information centers, was found very useful even by one of the largest ORNL centers - the Nuclear Safety Information Center. On the other hand, the managers of the Isotopes Information Center, the interest of which is centered on reorganization of the published literature, attempting to systematize the data according to specific isotopes and their use in a given industry, found the Termatrex "Peekaboo" system of great help for this work. The Radiation Shielding Information Center personnel, being neutron physicists, are accustomed to carry out computer calculations and therefore it was natural for them to make considerable use of the computer for organizing their material. Computers are also used to a great extent by the Charged-Particle Cross-Section Data Center. The Research Materials Information Center takes advantage of a recently developed microfilm retrieval system, designated as Miracode, of the Recordak Company.

The Nuclear Data Group which until recently was a separate, National Academy of Sciences supported, entity in Washington, D. C. organized its own library-type holdings because it did not have a convenient access to the needed material; later, at ORNL it was found useful to continue this practice. The group subscribes to about 40 journals which cover a large percent of the data of interest to the nuclear data field. The Engineering Data Collection, which handles a large blueprint collection, makes use of aperture cards.

At present, groups and individuals who intend to submit a proposal for starting a new center are studying various storage, retrieval and general organizational methods before selecting the best suited for their purpose. For this reason, visits have been made to leading information centers throughout the country and representatives of other centers were invited to visit the Laboratory and to present talks.

With the developments in technology and corresponding decreases in the cost of computing in information processing applications, the use of computers has become an increasingly cost effective and integral means of production for centers. Although some centers have retained manual non-computerized systems the future trend toward computer usuage will continue. Therefore, the following discussion will focus on computerized systems. Table 1 is a summary of selected software systems which present an overall perspective of the chronology of processing systems at the Laboratory.

TABLE 1

SELECTED SYSTEMS AND PROGRAMS IN COMPUTERIZED TECHNICAL INFORMATION PROCESSING FOR ORNL

Operational Date (Initiated)	System	Computer/ Developer	Organization	Comments
1961	KWIC	7090/Bell Labs	Library	First use of computer for information processing at Laboratory. Used to index technical reports by title.
1962	RSIC	7090/RSIC	RSIC	First computer-based information system used by an Oak Ridge IAC.
1962-63	Responsa-TIC system	CTC	TIC	CTC programmers set up their system to search NSA subject indexes.
1963	IBM 7090 System In-House (Edits)	In-house Programming	RSIC	Tape based system for information retrieval.
1964 (1962)	Library Circulation	CDC 1604/ Math Division	Library	Began automating library housekeeping functions.
1965	NSIC System	CTC/7090	NSIC	Implemented batch computer processing system.
1965	NSIC/SDI	CTC	NSIC	First computerized SDI.
1965	Serials Automation	7090/In-house Programming	Library	Computerized ordering, check-in, claiming, union listing, journal routing.
1966	NSA Indexes	7090/CTC	TIC	Automation of NSA indexes and cummulative data base.
1966	Data System	In-house	Controlled Fusion	Developed own system for specialized application.
1967	SADS/DSEP	CTC	Biology Division	Data base management and querry analysis for alphanumeirc and digital data in hierarchical structured, statistical analysis of data.
1967	CHORD-S	CTC	Reactor Division	Engineering data in retrieval files for information from power reactor PSAR's (Preliminary Safety Analysis Reports). Never became fully operational due to cost and difficulty of obtaining input.
1968	NSIC	CTC	NSIC	Added on-line file maintenance and search system. First remote access to an IC's file.
1968	Book Catalog	Math Programming	Library	These were computer generated but printed on microfiche for space reasons.
1968	IIC System	CTC	IIC	System developed to retrieve bibliographic information.
1968	PPIF	CTC	NSIC	For computerized storage and retrieval of technical administrative safety R&D projects.
1968	ADSEP	CTC		Automated manipulation of structures was programmed.
1969	NDP/ Bibliographic	360	NDP	Computerized bibliographic files and indexes.
1969	Responsa	TIC(DTIE)	Library	Capability to search NSA 1962-1966 index.
1969	SARIS	360/CTC	RSIC	With coming of 360, re-programmed system to take advantage of additional fast memory and disks.
1970	ADSEP/TEXT	Math Division	EIS Math Division	Free form text input added to ADSEP to to begin the generatized system concept. PUBLISH, ORLOOK, KWIC capabilities added.
1970	BIRS	360 Michigan State University	EIS	Began document acquisition and control system for ordering. Used on Energy and Regional Modeling data bases. Intended as a stop gap measure to get program moving.
1970	CRBE	360		First 360 terminal system.
1970	RECON	360/ Lockheed and Math Division	Math Division	AEC/OIS requested we operate RECON.
1971	Commerical SDI	University of Georgia	EISO Information Division Math Division	Began getting SDI from UGATS.
1971	Directory	360/CTC	EIS	Based on RSIC's Directory capability.

1972	RECON/ Library	Math Division	Library	Got first user terminal at ORNL for on-line bibliographic retrieval.
1972	MARK IV	Informatics	Math Division	File Maintenance system.
1972	UGATS	360	EISO Math Division	Got in-house use of modified system for SDI batch retrospective searching.
1972	MEDLINE and TOXICON (TOXLINE)	National Library of Medicine	TIRC	Access to NLM's major on-line bibliographic retrieval system. These systems have grown until today, TOXLINE includes six major files in bio-medical information.
1972	AVOCON	Infodata (Washington)	EISO (ICC) CSD	System purchased to develop the Environmental Terminology Index. Exists as a thesaurus development and maintenance program.
1972	Name-Match	Chemical Abstracts/ NLM	CSD	Brought in as a modified subsystem of CA's Green System to access two CA files - Hash Codes and Registry Nomenclature File. These files are available and CSD is developing tailored programs for ORNL and NLM users to access the 3.8M compounds.
1973	ADTABLE	360	EMIC	First ADSEP compatible tabular format display used.
1973	SPSS	National Research University of Chicago	RUSTIC	This is a comprehensive statistical analysis package for social science.
1974	ENSDF	360	NDP	Data retrieval capability added.
1974	MARK IV/ RUSTIC	Informatics	RUSTIC	Used to maintain tape library, i.e., for housekeeping functions.
1974	NUTIS	360	ESD (EDFBIC)	For storing, cataloging, and retrieving numeric data sets. Not for editing numeric data.
1974	TSO	360/IBM	CSD Systems	This is the part of the operating systems which manages interactive use of the computer. It replaced CRBE.
1974	RECON/NDP	360	NDP	Nuclear Structure References (bibliographic) put into ADSEP format.
1974	AM748	PDP-10	Information	Preparation of input to AM748 typesetter.
1974	Chemline	NLM	TIRC/CSD	Obtained access to NLM's data base of chemical information. Accesses information on chemicals in TOXLINE enriched with others from Consumer Products Safety Commission Chemical Dictionary.
1975	ADSEP/RSIC	360/CSD	RSIC	Conversion program from SARIS to ADSEP developed to allow ORLOOK access to RSIC bases.
1975	DIALOG	Lockheed (Commercial)	Library	First commerical retrieval system available in Library. Followed by ORBIT (1976) and New York Times Data Bank (1976).
1975	ENSDF/ Calculations	360	NDP	Capability to manipulate data libraries for complex calculations of nuclear effects.
1975	ENSDF/ Production	360	NDP	Production of photo-ready copy of Nuclear Data Sheets. Process fully computerized to eliminate need for extensive proofing, drawing, and consistency checking.
1976	COM	CSD	Library	Circulation files printed on fiche to save paper and money.
1976	JOSHUA	360 Savannah River and CSD	Neutron Physics	Management system of modules of programs and numeric data bases.
1976	On-line Book Announcements	CSD	Library	First library on-line in-house application.
1976	SAS/RUSTIC	North Carolina State	RUSTIC	Used for statistical analysis as a second system to SPSS (above). Used because available.
(1976)	SACRD	360/CSD	Neutron Physics	(Safety Analysis Computerized Reactor Data) system to retrieve evaluated physics and engineering data. Operates within JOSHUA.

Looking again at the pre-1970's we note that each center as well as the library system went about developing individualized software packages. As indicated on Table 1 some of the systems were developed by the staff of the centers themselves; others were programmed by either the programmers at the Computing Technology Center (CTC) at ORGDP or by the then Laboratory's Mathematics Division.

Among the centers there was of course resource or at least knowlege sharing under the guidance of the Information Center Coordinator. This was to a large extent effective and among the centers that were set up in the late 1960's many indicate contact and discussions with the older centers for the purpose of defining their processing system. For specific example, in 1967 Nuclear Fuels Technology Information Center (NUFTIC) indicated they used NSIC and its computer systems as a model.[2]

After about 1970 when the new types of information centers with their increasing emphasis on systems and computerized retrieval began to develop in the environmental area, this created new needs for computer development and a new opportunity for a more generalized software system. The concept of a generalized computerized system for technical processing was first conceived in 1967 in the old Computing Technology Center at ORGDP. However, it was not until 1970 that a commitment to such a system was made by a user group (EISO) and then it was not until 1971 that it was implemented by EISO and its affiliated centers. In the early stages, this adoption was made possible because of the personal commitment of individuals who were strongly convinced of the long-range utility of such a system in a growing technical information program at the Laboratory. These included A. A. Brooks who pushed the concept of a generalized package and guided and coordinated the programming commitments, G. U. Ulrikson who provided a committed user base and J. L. Liverman who offered management encouragement and support. Actually at first, the environmental program's information group brought in a

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[2]*Information Centers at the Oak Ridge National Laboratory,* Francois Kertesz, ORNL-TM-996, 1964.

system called BIRS from Michigan State University to build its data bases. This was intended to be a stop gap measure to start operations. The original document ordering system which later became EISO's document acquisition and control system as well as the first energy and regional modeling data bases were first developed with the BIRS system.

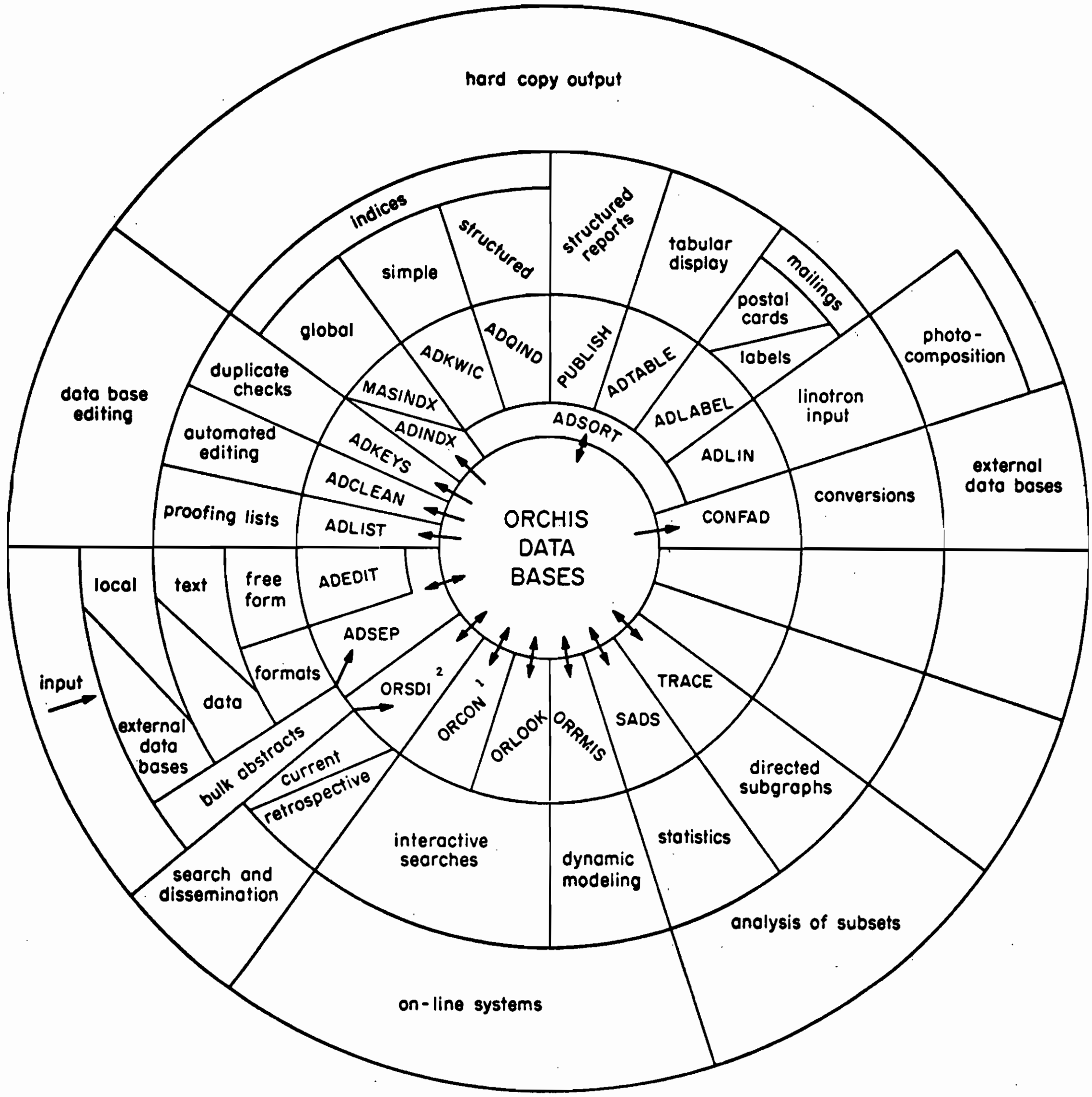
In 1971 EISO converted over to the ORCHIS (Oak Ridge Computerized Hierarchical Information System) format and the commitment necessary to the long-range development of a generalized system was actualized. Fairly rapidly after this initial commitment was made new capabilities were added and related software was subsumed into it until a quite powerful and versatile system evolved. Figure 1 describes the ORCHIS system as of 1973.

Concurrently, most of the older centers continued to use their specialized systems. However, as new applications arose which could make use of ORCHIS capabilities some began to do so. For example, in 1972 after examining various alternatives the Health Physics Information System organizers decided to adopt the ADSEP format for its processing. In 1974 the Nuclear Data Project began putting its bibliographic reference file into ADSEP format to make it accessible through RECON, ERDA's nationwide retrieval system. In 1975 a conversion program was written to convert SARIS input to ADSEP format for RSIC.

The bibliographic and text handling capabilities of the generalized ORCHIS system has been the most used due to past user needs and demands. There has also been ORCHIS applications used for reference-type alphanumeric data for which retrieval and display is as important as computation. For those centers which deal with massive amounts of computational numeric data, which for the most part are centers functioning in the research divisions, specialized applications programs remain dominant. For example, RUSTIC's data files are tied to the MOD program of National Dual Laboratories; Controlled Fusion Atomic Data Center's in-house program has served the center's needs and will remain. The Nuclear Data Project has developed their ENSDF system to meet their highly specialized needs in numeric data processing.

Since about 1974, just as some information centers have become freestanding projects, the latest thrust in information processing work seems to indicate that the program in information systems development

ORNL-DWG 73-11043



Pictorial of ORCHIS System.

Figure 1

[1]ORCON is now called RECON.

[2]ORSDI is the ORNL/University of Georgia SDI system.

under the Computer Sciences Division has been recognized both internally and by our sponsors and has evolved into a significant component of technical information processing at the Laboratory. With the centralization of computer service in 1973, information applications have a visible focal point. Today a new center can use this expertise as well as have the advantage of the generalized system already available. If the generalized system doesn't suit a specialized need then a specific extension for the application can be developed by the information applications group based on their experience and this can be kept compatible with the generalized system. This allows all users to benefit from the investment of money and programming effort. Although the interface between the centralized applications department and users has had some difficulties there is an increasing trend toward better communication.

The future development in systems capabilities, especially the generally available, widely used system, now seems to be increasingly dependent upon the hardware that is forthcoming. The next step in advancing the ORCHIS generalized system will be to meet real time data management needs. This requires more text processing compatible configurations and increased hardware capacities. In addition, now that a major versatile system with over 20 subsystems which allows merging of data and data bases regardless of original sources exists in ORCHIS, a more formal funding mechanism which allows for continuing maintenance of the system is necessary in addition to funds for continuing development work. It is significant to note here that by its very success, the creation of a generalized systems eliminates the need for putting money into systems development by new centers. The paradox this has created has left the ORCHIS system without continuing incoming revenue for development or an acceptable means to obtain ongoing support.

For those centers who need specific help, the centralized information applications expertise should be increasingly effective in helping to define needs, the potential and the solutions.

In addition to these basic processing systems for information centers, four other types of processing systems which are included on Table 1 are worthy of note. They are the RECON system, the access to bulk data bases and selective dissemination of information (SDI) system, the library applications, and the on-line access to data bases produced and maintained outside the Laboratory. Each of these add special capabilities to the equipment of the information specialist. Some, which were originally developed as independent applications like the SDI and RECON, have been incorporated with other subsystems into the integrated ORCHIS system.

RECON

RECON is an ERDA-wide computerized information retrieval system designed to provide users with remote terminal access to data bases. The concept was first initiated by Lockheed for NASA in the mid 1960's; in 1970 it was purchased by AEC to support *Nuclear Science Abstracts* and a small number of terminals. AEC assigned ORNL's Mathematics Division, which presently is included in CSD, the job of further developing and operating the system for the AEC in 1970-71. Over the past six years significant modifications have been implemented and use of RECON as a national ERDA information resource has grown. Today RECON supports 44 terminals as well as a dial-up system with access to major national data bases including *Nuclear Science Abstracts*, ERDA's Energy Data Base, *Water Resources Abstracts*, NSIC's Nuclear Safety File, *Engineering Index*, Chemical Abstracts Service's data tagged file, as well as some in-house produced bases of ERDA-wide interest. An interface program has also been written so that ADSEP data bases can easily be reformated and made accessible through RECON. Output from RECON may be provided in ORCHIS format so that other ORCHIS programs can be used to further manipulate the results of such searches. Work is also underway to convert the RECON linear files to ORCHIS format so that they are accessible by all ORCHIS subsystems.

Retrospective and SDI Access to Bulk Data Bases

Off-line access to major international abstracting and indexing services has also developed as a major capability for ORNL information processing. Availability of tapes and development of the required software has allowed retrospective bibliographic searches on a query-response basis as well the development of a SDI system capability to write user specific profiles for biweekly lists of new articles of interest to the researcher. The first computerized search system available to ORNL through CTC in about 1969 was the RESPONSA system for the ERDA Technical Information Center, then the AEC/Division of Technical Information Extension. This allowed computer searching of *Nuclear Science Abstracts* 1962-1969 cumulative index. In about 1971 the Environmental Information System Office began using the University of Georgia SDI system to submit our user interest profiles. After about a year of negotiation, in 1972 we obtained the tapes for some of the large data bases including *Chemical Abstracts*, *Biological Abstracts*, *Chemical-Biological Activities*, *et al.* and the software package used in Georgia to implement the system in-house for both retrospective and SDI searching. Besides the advantages of faster response and direct control in-house, this availability gives us the added capability of getting output in the form of machine readable subsets. Since then programs have been rewritten so these subsets can be made into new data bases and further manipulated or searched by other ORCHIS subsystems without rekeying. Over the past few years the selection of data bases available has increased, thereby increasing the potential for major bibliographic searching. It is worthy to note that ERDA's new energy data base at TIC was formed by using these programs to search the major machine readable data bases for citations within the new ERDA scope. The machine selected citations were then reindexed and upgraded by TIC. The system is supported at the Laboratory through the Information Division and maintained by the Computer Sciences Applications Department.

The Library System

Perhaps the first computer applications to technical information processing was the development of the key-word-in-context (KWIC) index to titles of documents. This technique was first conceived by H. P. Luhn, an early pioneer in information science and computerized information retrieval, at the end of the 1950's. In about 1960 a program to do KWIC indexing became available through Bell Labs. The ORNL Library at that time brought the program here to do some experimental development with it. The first product in information using computerized manipulation was the first annual keyword index to Laboratory reports produced in 1961. This is still issued as an annual publication of the Library System.

At the time the Library management saw significant potential in the future use of computers in library work and created a separate library systems department in 1962. This separate development office still operates in the Library as an independent systems group although there is some interaction with the Computer Sciences Division.

The first task of the new department was to computerize the Library circulation system. The system first became operational in 1964. In 1964 a project to automate the journal ordering, acquisitions, check-in, claiming, union listing (i.e. listing of locations of journals in the Oak Ridge-Knoxville area), and journal routing was initiated. Once the material was in machine readable form, the KWIC indexing capability was applied to the data to produce indexes to journals available throughout the area.

Based on the machine readable listing of books in the Library resulting from the automated circulation procedures, in 1968 book catalogs of ORNL's holdings were produced and printed on microfiche for distribution. Thus multiple copies of our library's holding could be made and any library in the area could have a copy of our book catalog.

In 1976 as computer output microform (COM) was made available in the Nuclear Division, the Library transferred its printing of circulation files from hard copy to microfiche. Beside saving paper it is estimated that this saves the Library $20 per work day in computer costs.

The most recent development in library systems which has just been initiated is the first on-line library system application. It is the on-line book announcement project which allows terminal editing and production of the listings of new books received.

The future developments now projected for the Library include increasing use of COM systems and a revision of the old circulation system to reflect state-of-the-art trends in input.

<u>On-Line Access to External Data Bases</u>

All of the above library systems described can be viewed as housekeeping systems. That means they are oriented toward keeping track and organizing the physical materials handled by the library system. In addition to housekeeping functions the Library also began adding new types of access to materials in 1972 when the first on-line bibliographic retrieval capability became available to the Library. This was the RECON system discussed above. Access to such systems provides the information specialist more rapid access and greater search capability to large international bibliographic files. In the same vein, access to the major international abstracting and indexing services in science and technology became available commercially through the next few years. The Laboratory began subscribing to Lockheed's DIALOG in 1975 and System Development Corporations's ORBIT in 1976. A final extension of on-line access to major external data bases, although not scientific bibliography, was the acquisition of the New York Times Information Bank in 1976. This allows access to the information in the *New York Times* as well as about 60 general circulation periodicals which are indexed by the data bank. The access to such information reflects the growing interest in social, political, and legal issues that now affect the Laboratory.

In addition to on-line access to major bibliographic data bases which have become part of the Library's services, the Toxicology Information Response Center has also gained access to on-line retrieval systems through the National Library of Medicine's information system. First in 1972, TIRC was given terminal access to the MEDLINE and TOXICON (which later became TOXLINE) systems. These are still available through TIRC. Since then TIRC has added on-line access to CHEMLINE, CANCERPROJ, CANCERLINE, and EPILESPY.

General Trends

In addition to these broad historic thrusts and histories there are a few significant trends that can be seen in information processing at the Laboratory.

> In general there is increasing use of computers for all aspects of work in information from internal housekeeping functions, to information storage and retrieval, to document production. Whereas some of the earlier centers found it uneconomical and ineffective to computerize, a new center of any size today will find the means, the expertise, the state-of-the-art and the cost such that the use of computers will be the obvious course to take.

° There is a general trend toward generalized or at least generally available systems such as RECON and ORLOOK (both part of ORCHIS) to increase user on-line access as well as availability of more data bases.

° Since the control of bibliographic data has been fairly well developed there is increasing interest in controlling and accessing the *content* of documents. This has led to a growth in interest in data tagging and numeric data retrieval.

° There is an increasing emphasis and demand for on-line systems both for file maintenance and for information retrieval.

° There is a growing capability for document production to be fully automated beginning with on-line input and editing and ending with computer formating and computer tape driven photocomposition.

° Spin-off products such as directories of experts from specialized mailing lists are in increasing demand. There is also an increased interest in special projects such as inventories of people, organizations, and research in progress which can be computer manipulated.

° The Laboratory is increasing its access to major scientific and technical abstracting and indexing bases through on-line systems available from the outside including both government sponsored and commerically available. In some cases this creates duplication of effort and conflict of intent with development of in-house systems.

In each case there were precursors to the current interests. Examples of some precursors include: In the numeric data areas one of the earliest activities, the NDP, has had 25 years experience with numeric data although its automation has been accomplished much more recently. In the area of on-line systems and selective dissemination of information NSIC has been working with them since the mid 1960's. In the case of directories, RSIC has already began in the mid 1960's using its newlsetter mailing list as an experts directory for the shielding field.

APPENDIX 2: ROLES OF PERFORMING POSITION DUTIES

APPENDIX 2

ROLES FOR PERFORMING POSITION DUTIES

	Line	Coordinating	Advisory	Service
Duty	Delegated through chain-of-command to provide, in accordance with established policies, procedures and plans, product(s) service(s): business: to a customer at a profit. functional: to an internal client at cost.	Delegated through chain-of-command to provide policy, procedure, or plan that impacts on others.	Delegated through chain-of-command to inform a coordinator, a supplier of service or a receiver of service.	Delegated through chain-of-command to offer to provide service(s) to internal client. Duty to provide is contingent upon client agreement.
Authority	Sole right (monopoly) to conduct business or provide functional service. Client of functional service does not have option to provide service himself or to have it done elsewhere.	Monopoly right to recommend constraints (policies, procedures) or objectives (plans) for others, who cannot ignore them. Both coordinator and coordinatee have right to escalate conflicts. May also be delegated the right to approve-before-the-fact the actions of others.	Right to have your information and viewpoint considered.	Right to develop a capability to provide service(s) and to solicit clients. Client has option to provide service himself or to get it done elsewhere.
Accountability	Business: for profit performance. Functional: for meeting needs of client at competitive costs.	That the objective of a common or integrated approach across components is achieved.	That communication is necessary and sufficient to permit line and coordinating roles of others to be done well.	For quality, content and appropriateness of service provided. Not for reaching objectives for which service is provided.
Identification in Position Charters	"To administer...."	"To develop and recommend...."	"To provide information...."	"To provide service as requested...."

FIGURE 3
(Reprinted from Manager's Manual)
410-200

A51

APPENDIX 3: NEW OPPORTUNITIES FOR TECHNICAL INFORMATION WORK AT ORNL

VI.3. NEW OPPORTUNITIES FOR TECHNICAL INFORMATION WORK AT ORNL

New opportunities for information work at the Laboratory come under four main headings:

1. Subject Areas for New Specialized Information Centers
2. Special Information Projects and Support
3. Specialized Service to In-House Research Programs
4. Applied Research in Information Processing

Each of these will be discussed separately in the sections that follow.

Subject Areas for New Specialized Information Centers

In discussions with various staff members at the Laboratory many areas of research that will or presently have information processing needs were identified. Some of these were suggested based on experience with earlier unsuccessful attempts to set up a center in a given field where the staff member still felt there remained an unfulfilled need. In other cases staff members suggested new subject areas for centers based on their positive experiences with specialized centers in other areas. Finally some of the subject areas were suggested based on a staff member's perceived need in a fast growing field where control of the information seems falling short of the research needs. It should be noted that these are suggested subject areas that might be further investigated. Inclusion does not necessarily reflect any conclusions about the potential of establishing a center beyond the suggestion that further investigation should be initiated. If a Technical Information Coordinator were appointed, the Coordinator could work in cooperation with interested staff in pursuing the identification of specific needs and justifications and then in assisting the divisions locate sources of support for such work. This was one of the functions that the previous coordinator fulfilled quite effectively.

Mechanical Properties. There has been an expressed need and some active attempts to establish a mechanical properties information center at ORNL. R. L. Stephenson heard about the study of information processing at ORNL and was anxious to have such a center considered in the analysis. He indicated that the concept was supported by Keith Booker and members of the Metals and Ceramics Division. The need for such a center was based on the fact that tensile, creep, fatigue, etc. properties of various materials are voluminous and scattered. It is impossible to locate and critically digest such information in a timely fashion, yet many critical engineering design decisions depend on adequate data of this type. Stephenson states that ORNL has both the technical capability as well as a good start into the software and data base development which could form the basis of such a center. What they need is help in identifying a funding source so they can devote the necessary resources to the project. Stephenson felt that although we now have good advantages to do the work, the initiative is slipping from the Laboratory.

Special Matrices. The idea for such a center was first proposed in 1969 by V. P. R. Uppuluri in cooperation with the work being done by F. Kertesz as coordinator of information centers at ORNL. Since nothing materialized at that time, the idea was again proposed for initiation as a seed money project in 1974 by Uppuluri. It was rejected for seed money funding but not on any technical grounds according to Uppuluri. He remains of the opinion that this would be a valuable undertaking. The following justification for the need of such a center is excerpted from his seed money proposal:

"Matrices are found to be useful in almost all branches of science. Because of the special features of a particular problem on hand, one is naturally led to use special types of matrices. For instance, nonnegative matrices are found to be useful in physics and chemistry. With the advent of the application of Markov Chains to biological phenomena along with other areas in science, the properties of stochastic matrices and special types of them that arise with particular models become important. Network theory has enormous applications of matrices with zeros and units as elements. Such matrices with zeros and units as elements also appear in the study of the design of experiments and some problems studied by physicists. If one wishes, one can perhaps enumerate at length where special matrices are found useful. More often than not, a scientist will be interested just in the properties like the eigenvalues, eigenvectors, spectral resolution, invertibility, higher powers, decomposability or some other properties of the special matrices that are encountered. It is often said that it is easier to derive the properties of the special matrix on hand than to hunt for it in the vast amount of available literature; and even then, it is unlikely that one would find the properties that are relevant to the problem on hand. But the catch is, it takes a tremendous amount of time and energy to get the results, under the (questionable) assumption that one has the technical know-how. The availability of this kind of information at a central place, prepared by a few, is no doubt of great value and will eliminate the duplication of the efforts of lots of investigators at lots of places. With the innovations in computer uses and the access of modern communications, the role of a Special Matrices Information Center will be of great service to the scientific community at large."

Again what is needed is a well founded decision on whether the center would be worthwhile and if the answer is yes, then help in the identification of funding sources for such work should be given.

Waste Isolation. Although not a Laboratory administered program, ORNL could provide the information expertise and help build the information focal point for the new Office of Waste Isolation (OWI) (some $30M) that is being put together in the Nuclear Division. Cooperation has already been initiated in this area between the Laboratory and OWI. It was also pointed out that ESIC is doing some work in the area of waste management. OWI is still formulating needs and staffing up in the area of data management and is not clear on what the scope of their work in this area should be. It would probably be appropriate for the OWI to set up a specialized information center in waste isolation or perhaps a network of centers in various specific areas such as geological data, rock mechanics, waste transportation, etc. They are also in need of a mechanism to keep abreast of the numerous reports that are being generated within as well as outside their own contracts. Such things as an abstracting journal for waste isolation similar to the type of project TMIC was carrying out for the EATC program would be valuable in administering the R&D program. Special state-of-the-art reviews and abstracts aimed at policy and public analysis and decision makers patterned after the Energy Information Center's "Energy Abstracts for Policy Analysis" would also be worth pursuing. Interfacing with NSIC to avoid duplication of effort in some safety areas would also be necessary. In general ORNL could seek to get a subcontract to set up a waste isolation information center.

Information Center for Internal Exposure. This was a previously existing center at ORNL which lost its funding a few years ago. Drs. Snyder and Bernard, Health Physicists associated with the old center, feel there is still a need for centralized, evaluated data collections. Indeed, some of what was done under formal Center funding continues as a personal research effort. ORNL continues to have both the technical and information expertise, as well as the data base current to 1973, to reestablish the center.

Fuel Cycle Technology. In a discussion with A. L. Lotts about an earlier center called Nuclear Fuels Technology Information Center, Lotts indicated that there is a need for a central integration of the information on the fuel cycle including economics, reprocessing, fabrication, enrichment, mining and waste isolation. As the ERDA program becomes administratively fragmented, the need for integration of the available knowledge becomes all the more vital. Lotts felt that our expertise in many areas of the fuel cycle in combination with our experience in information work puts us in the best position to establish such an information center.

High Temperature Structural Design. In discussing the success of technology transfer through the Radiation Shielding Information Center, Fred Maienschein suggested that a similar kind of technology resource should be integrated into the high temperature structural design program. He has suggested this to the people involved but there has been no further follow-through in this area.

Others. In general, where ORNL will have a leading role in a technical area an organized technical information effort should be considered as an integral part of the overall program. This will help the ongoing program as well as facilitate transfer of the results through information links to other researchers and to potential users in the public and private sectors. Specifically, as soon as it looks like a major program might materialize, an investigation should be undertaken by an information specialist in cooperation with the potential lead ORNL research staff in the area.

Special Information Projects and Support

The range of special project work that could be developed based on current Laboratory capabilities is large. Our experience in computer produced directories and referral services has been significant and could be broadened to meet the needs of ERDA as well as the programs under various assistant administrators. ERDA has already recognized the need for basic information on research in progress ERDA-wide and is currently developing a Work In Progress Directory (WIPD). The potential duplication of effort between this and other activities such as the Smithsonian Science Information Exchange and our own Energy Inventory project has been recognized and ORNL is already to some extent involved in WIPD. In addition to an ERDA-wide directory, disciplinary or subject oriented as well as biographical and organization directories for expert identification and referral have been recognized as useful. Many of these are spin-offs from other technical information products and should be made more accessible. There is a lot of potential work to be done in this area and we should be prepared to seek out some of these activities more specifically.

In addition to special projects of a specific product oriented nature, discussions with ORNL staff yielded recommendations for the expansion of the scope of activities of some already existing centers.

> *Socioeconomic Computer Code Collection.* This idea came from the recent Energy Division Information meeting when Eric Hirst presented his work on energy modeling. There are many computer codes being developed around the country in socioeconomic modeling.[1] Looking at the success of Radiation Shielding Information Center (RSIC) code package work it might be worth pursuing a similar development in the socioeconomic area. Such a project could be coordinated under the Energy Information Center. ORNL could become a center for energy prediction models which would aid in such areas as decisions on research directions (which technologies to pursue), policy formulation (what would the effects of national policy be) and commercialization potential (what would be the industrial implications of product decision given our supply and demand predictions).

> *Plutonium Numeric Data Base.* S. I. Auerbach suggested the need for expanding information work on Plutonium into the numeric data area. Some work is already being undertaken to identify data tagging and data manipulation in various environmental centers. The ESIC should investigate becoming involved in this numeric data analysis area. Integration of all of these functions and their close interaction with ongoing R&D would make ORNL a total technology resource in this area.

> *Regional Modeling-Geographic Data.* Our potential to be a leader in information work in the area of regional modeling and especially geographic data manipulation is growing at ORNL under the work presently being done in the Oak Ridge Regional Modeling Information System. At present this system is inseparably tied to the ongoing regional modeling research in the Energy Division. The software is still under development as a function of the research work.

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[1] It was noted that Brookhaven seems to already have the lead in supply and demand modeling, but there are other socioeconomic areas that should be pursued.

Because of the voluminous nature of the geographical data that is necessary for modeling work, current emphasis has been on extremely small geographic regions. As a very rough guess, a nationally comprehensive data bank would cost about $3-4M to create. However, if ORNL's regional modeling programs grow, a more user oriented component of the ORRMIS could be investigated. It would require additional personpower and a different organizational structure than what presently exists. Specifically a user interface and coordinator between this interface and the current research/computer science components would have to be established. There is potential for coordinating this with RUSTIC activities.

It must be stated that Richard Durfee carefully cautioned against diverting the efforts of the present staff from development to production type of activities in the near-term since this would be premature in terms of the development of the system. But there is significant long-term potential for a nationally significant specialized information system.

Information Services for Technical Meetings and Workshops. The opportunities for increased activity in this area have already been recognized based on the Ecological Sciences Information Center's successful experiment with providing on-line information sources to the *National Council on Radiation Protection, Committee No. 31,* Plutonium workshop meeting in Seattle, Washington in July 1975. Following that effective experiment the Environmental Resource Center was asked to support a Coal Combustion Workshop which was recently held in Knoxville for the purpose of producing a definitive document covering research needs in the coal area. Indeed, this type of activity forms one of the motivating concepts behind the Information/Conference Center proposal. Information support service to public meetings which are becoming increasingly important to ERDA's mission, is another fertile area for using our information capability. Being able to provide facts and answer questions as they arise during public debate is vitally important for ERDA in developing public understanding and acceptance of its goals and plans.

Specialized Service to In-House Users

Not only is there significant opportunity for growth in technical information work in response to needs from outside the Laboratory, but there is also significant potential for refining and broadening the services that are available to our own research staff. It is estimated that the average scientist spends 7% of her/his time in literature searching.[2] Information support work can help to cut down on this time or make it more efficiently used. This would contribute to making the overall conduct of research a more effective and efficient process. Researchers can be aided in their information seeking activities by specialized expertise in information retrieval in some of the following ways:

Task Group Approach to Major Publication Activities. In writing technical documents there is always a considerable amount of background information that needs to be identified, collected and reviewed. This is especially true with major publications such as books, monographs and critical reviews. To make such an undertaking most efficient the expertises of the subject specialist, the information specialist and the publications support staff should be brought together in a team effort. Such an approach could be developed at the Laboratory and should be encouraged on a experimental basis to assist scientists in the research divisions who undertake such projects.

Refinement and Broadening of the Selective Dissemination of Information (SDI) Program. At present it is estimated that the Information Division is now servicing only about 5% of ORNL staff with SDI services. A reasonable saturation level for such service would be 15%. Thus, there still is a considerable unexplored clientele who could benefit by more aggressive marketing of this service.

Retrospective Searching. The library now has considerable capability to do automated retrospective searches on the major national abstracting and indexing services in science and technology. This includes batch mode searching of bulk data bases as well as on-line searching through the DIALOG or ORBIT systems. The potential usefulness in aiding researchers do literature searches is only beginning to be recognized by the divisions. Increased publicity could help in making these services more widely known and used.

Library and Information Consulting Services. As new programs develop and as suburban sprawl continues at the Laboratory, easy

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[2]*Report of the Task Group on the Economics of Primary Publications*, National Academy of Sciences, Committee on Scientific and Technical Communications PB-194400 (Conyers Herring, Chairman) 1970.

access to information both in a bibliographic and in a geographic sense becomes more difficult. This problem, combined with new retrieval and dissemination tools that are unkown to the divisional research staff creates underutilization of available information resources. These resources could be better utilized and increased staff awareness could provide new opportunity for some initiatives on the part of information staff. Other information opportunities would arise if the functional arrangements described in the section on organizational changes is pursued.

In-House Education Programs. There is considerable opportunity to make the research staff more efficient information users and thereby more efficient in their research effort. As noted in a National Science Foundation analysis, there is inadequate preparation of scientists in locating and using existing information tools during their educational training. ORNL, although with a history of information consciousness and excellent library service, could still benefit by better user education in information access and availability. A good opportunity for providing educational service in information, similar to the kind of programs the Computer Sciences staff offer in computing technology tools, would be to offer a short course through the In-Hours Education Program in information tools and resources. In addition special short courses for technical and clerical assistants should be developed to educate them in the available information sources and services.

Applied Research in Information Processing

Throughout this report the discussion of issues repeatedly points to the lack of knowledge and understanding of the technical information transfer process which goes beyond our own internal considerations. There is considerable opportunity for ORNL to get involved in helping to solve its own problems and at the same time make a considerable contribution to the larger information community. Just as other service divisions like Analytical Chemistry and Instrumentation and Controls must maintain a component of ongoing development work to keep their service functions up-to-date with new technology, an argument should be made to support improvements in information processing to better provide information services. The special potential ORNL has to do applied research should not be underestimated. It is based on the depth and breadth of our ongoing activities as well as a tradition of rigorous analytical research not always available in environments where traditional information research has been carried out. We have all the components and interfaces in-house including the scientist (both as user and producer), all varieties of specialized information centers from the technical institute to the bibliographic center (both embedded and centralized), technical libraries (both branch and centralized), and significant work in computerized systems (both interactive and batch oriented). This provides an ideal experimental situation for the study of many gaps in knowledge of the technical information transfer process. NSF now funds work, $82M worth, to help fill such gaps. As a case in point one grant to Metrics, Inc. of Atlanta to study the cost/benefit of information centers, used the Information Center Complex (ICC) as a case study. The President of Metrics concurred in the belief that the Laboratory has special potential to become actively involved in such research, perhaps most effectively on a joint basis with either a university or a private contract organization. Some specific areas which could effectively be studied at ORNL include:

- How to put a value on information services.
- What is the most effective interrelationship between technical libraries and specialized information centers.
- Effectiveness of computerized SDI services.
- Various studies of information seeking behavior among researchers.
- How best to educate the scientific user of information sources and services.
- Analysis of the effectiveness of analysis centers, bibliographic centers and other specialized information projects to the R&D process.

DISTRIBUTION

1-2. Central Research Library
3. Document Reference Section
4. ORNL Patent Office
5-6. Laboratory Records Department
7. Laboratory Records (RC)
8-48. Program Planning and Analysis Office
49. T. M. Albert, ERDA/AES
50. S. I. Auerbach
51. P. S. Baker
52. M. Bender
53. J. L. Biles, ERDA/OTI
54. A. A. Brooks
55. F. R. Bruce
56. E. D. Copenhaver
57. W. B. Cottrell
58. F. L. Culler
59. R. R. Dickison
60. R. C. Durfee
61. W. B. Ewbank
62. G. G. Fee
63. E. L. Galyan
64. M. P. Guthrie
65. E. B. Howard
66. J. E. Huff
67. J. K, Huffstetler
68. E. B. Johnson
69. A. S. Klein
70. J. A. Lenhard, ERDA/ORO
71. L. R. Lewis
72-75. J. L. Liverman, ERDA/AES
76. R. S. Livingston
77. A. S. Loebl
78. F. C. Maienschein
79. B. F. Maskewitz
80. H. F. McDuffie
81. R. L. Metter, ERDA/ORO
82. J. S. Nunley
83. C. J. Oen
84. J. S. Olson
85. H. Postma
86. C. E. Price
87. W. R. Ragland
88. M. E. Ramsey
89. C. R. Richmond
90. M. W. Rosenthal
91. R. L. Stephenson
92-97. B. C. Talmi
98. D. B. Trauger
99. D. R. Trubey
100. G. U. Ulrickson
101. J. S. Wassom
102. A. Zucker