THE DESIGN OF A SPECIALIZED INFORMATION CENTER FOR THE MARINE RESOURCES PROGRAM

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ABSTRACT

This research presents the design of a specialized information center which will respond to and complement a broad, social or multi-disciplinary program. The model has been developed within the framework of the marine resources program of Texas A&M University. The primary goal of the center which has been developed is to provide a focus for information activities within the Sea Grant Program.

The major effort of the center is directed to three areas: (1) resource information, (2) the information distribution system, and (3) auxiliary services. Computer and microform technologies are utilized where practical. Major files associated with the resource information systems include: (1) a microfiche file of technical information, (2) an expertise file, (3) an activities file, and (4) a facilities file.

Projections for future research which would improve the availability of marine resources information are discussed.

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CHAPTER I

INTRODUCTION

Information activities form one of the most important elements of any business or other organization. While in many cases they are so routine as to become almost unnoticed, in others their importance and complexity dictate special attention. The information needs of an organization or program depend, for a large part, on the nature of its objectives. For example, the information activities of a diversified, dynamic program will vary considerably from those of one which is sedate and routine. The requirements of a new, emerging program will differ considerably from those associated with one which is established and ongoing. The inherent need for information is present in all operations. Information usage may vary from routine to occasional and the type of information required may be general or very specific. The vehicle for information transfer may vary from a casual conversation to a technical report, while the source may be personal knowledge or a technical library.

Although the importance of information has changed very little, the need for having information on a timely basis has increased with the growing complexity and ever-changing nature of diversified programs which are undertaken today. The increased need for a focus of

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The citations on the following pages follow the style of the *Journal of the Association for Computing Machinery*.

information activities is also due, in part, to the growing mass of information which is currently available. Our ability to handle or process this increased volume of information on a timely basis has been enhanced by the advent of new technologies which enable us to store and retrieve information in a more efficient and effective manner than ever before has been possible.

Significant developments, which improve the availability of information, center around advances in computer and microform technology. While the conventional library is still our primary source of technical information, new innovations in information processing techniques have fostered the beginning of what might be called a revolution in the availability of all types of information.

A specialized information center which utilizes the data processing capabilities of the computer and the miniaturization of microfilm with its inherent economies is described in this paper. This center has been designated as the Marine Resources Information Center and is designed to serve the newly-emerging Sea Grant Program of Texas A&M University. This program is a major, multidisciplinary effort intended to accelerate the development of our nation's marine resources.

Data acquisition, processing, and distribution procedures are operational and three information sub-centers are now in use by the Texas A&M University marine resources community. Although the present data collections for these systems are somewhat limited, the expansion of information coverage in each area is now in progress.

CHAPTER II

THE STUDY

This research addresses the problem of designing an information system which will respond to and complement a broad, social or multi-disciplinary program. Such programs will, in all probability, lack an encompassing, coherent body of knowledge. Communication channels must be capable of bridging the gap between a number of disciplines, as well as various sections of the population. While the resulting model should be adaptable to numerous major programs, it has been developed within the framework of the Texas A&M University Sea Grant Program.

A literature survey failed to reveal an existing information system design which would satisfy the diversified requirements of this marine resources program. There are some marine oriented services, such as the *Oceanic Citation Journal* and the *Oceanic Index*, which attempt to solve a portion of the technical information problem. O'Connor [18], in a dissertation written while at the University of Rhode Island in 1965, described an information retrieval center for the aquatic sciences which utilized input material based on data from the *Current Bibliography for Aquatic Sciences and Fisheries*. Various other individual systems are directed to the cataloging of research activities and personnel, but none provides all of the services envisioned as information requirements of the Sea Grant Program.

The University of Rhode Island, with support from its Sea Grant Program, has established the New England Marine Resources Information Program (NEMRIP) which is similar in some ways to the information center proposed by this study. Their program is designed to link marine related information sources and the information user. The NEMRIP plans to provide responses to specific requests for information from the New England marine community, as well as to conduct marine oriented extension work. It is to serve a community of users which is similar to that served by the Texas A&M University program.

The scope of this research is limited to the design of a series of systems which will assist in the identification and availability of both technical and non-technical information. The files utilized by these systems include material on technical literature, personnel, facilities, and activities. The systems described utilize a practical combination of both computer and microfilm technology.

The Information Problem

This is an age of unprecedented technological development. There are more scientists today than there have been in all previously recorded history. The recorded work of these researchers is published and made available for the continuation of technological development. The process of maintaining state-of-the-art knowledge in one of the rapidly developing areas is becoming increasingly difficult. The dangers associated with wasteful duplication of

effort demand an increased awareness of current activities within a specific field. As the technology transfer rate is increased, the time span from introduction to obsolescence of new products and techniques is becoming increasingly shorter.

In order for the businessman to keep pace with his competition, he must maintain an increased awareness of the latest technological developments in his field. In order for the academic institutions to continue to provide quality education, educators themselves must maintain an awareness of the continuing developments in their respective fields. In order for the public to maintain an awareness which will justify continued support of technological development efforts, it must be well informed. A key factor in each situation is the availability and proper utilization of an effective information system.

The product of information systems is, of course, information. What is information? Swanson [27] suggests that information is an exploitable commodity. Wilson and Wilson [33, p. 22] state that "information is the *capacity* for increasing knowledge." Rosove [21, p. vii] states that "Information is the essential ingredient in decision making." He [21, p. 3] further states that "Information is the concept relating data which are otherwise meaningless to some specified human purpose or objective."

In an attempt to cope with the increased volume of information and information users, the number and size of our libraries have been increased. In an attempt to make more effective use of the available

information, new technologies have been introduced in an effort to provide new and improved information services. Although these information services are establishing a position as an integral part of the industrial, research, and academic environments, they are in an operational category similar to that of the library in that they are not by nature self-supporting.

Many difficulties are associated with the information problem, including the large volume of relevant material, the fixed information habits of potential users, the variety of user needs, the funding of information services, and the legal problems imposed by existing copyright laws. Continued development of information processing methods and procedures, which are more effective from the viewpoint of the user, will assist in minimizing the problems associated with his increasing information requirements.

The Sea Grant Program

Large interdisciplinary programs are not new. One such program that should be noted here, started with the Morrill Act which was enacted on July 2, 1862. This Act was designed to strengthen the nation's agricultural capabilities through a combination of academic, research, and extension activities. The fact that today the United States is the most advanced agricultural nation in the world, illustrates the success which may be partially attributed to this program. A similar program, enacted by the Senate and House of Representatives, is the Pell-Rogers Act, Public Law 89-688, The National Sea Grant

College and Programs Act of 1966 [29]. The National Science Foundation [20, p. 1] points out that:

> The purposes of this Act in summary are: initiating and supporting activities that will result in the "gainful use" of marine resources by providing "greater economic opportunities, including expanded employment and commerce; the enjoyment and use of our marine resources; new sources of food; and new means for development of marine resources" through programs of research, education and training of skilled manpower, and advisory services.

The National Science Foundation identifies the three major categories of effort to be conducted under the Act as follows: (1) Training--to train personnel as participants in the fields which are relevant to the development of marine resources; (2) Research--to provide for research, involving practices, techniques, and equipment design, which will accelerate marine resource development; and (3) Extension and advisory services--to develop programs which will provide for the transfer of information and technology to the scientific community, the business community, interested persons in the related fields, and the general public.

The Sea Grant Program, then, has been initiated under the concept that it will have an impact on marine resource development which is similar to that which the agricultural programs have had on agriculture. As indicated, the Sea Grant Program conducts major activities in the areas of research, education, and extension and advisory services. The population to be served ranges from the research scientist requiring access to highly technical information, to the shrimp boat operator who needs improved hardware to harvest various marine crops, to the citizen who needs to understand the activities of the program.

One might visualize a significant intermediate focus of this system as being the "salty" port agent, who must be to the fisherman what the county agent has been to the farmer.

Conventional information systems do not have the capability of providing services to such a diverse population. The information required and which should be made available includes marine resources represented by people, activities, and facilities. In addition to providing information about those resources represented by our oceans and the areas that are adjacent to them, provision must be made for handling informal knowledge, routine services, and a variety of published material which is made available by major information systems.

The Study in Perspective

Large multidisciplinary activities, such as the Sea Grant Program, have extensive requirements in the area of information acquisition, processing, and transfer. Facilities such as the university library, or departmental libraries, are not flexible enough to provide services which may be tailored to the needs of such activities. Their major role is one of serving as a depot for published material. Large federal information resources, while extremely valuable, are not readily accessible to the researcher and the various user groups associated with the program. They are physically remote and have no real association with the user population. They are not adaptable to activities such as extension and advisory services. In short, the

information needs of this type of program seem to go far beyond the mission of existing library and information facilities.

It must also be pointed out that at the present time there is no recognized or codified body of information available to form a data base for a marine resources information system. There is no single academic unit or field which will encompass the many areas of interest. The relevant information exists as a part of many disciplines and has not been assembled into a single collection. The National Agricultural Library [32] provides a document repository for all published agricultural information. The Agricultural Information Service [31] provides a mechanism whereby the extension services of each state can disseminate the results of research and development to the agricultural community. These facilities illustrate a portion of the organized information activities utilized by the Land Grant Program. The Sea Grant Program is new, and a variety of information activities must develop in parallel with its various research, extension, and educational services.

The basic information problem which will be considered in this dissertation is perhaps best described by Figure 1. The marine resources information which represents personnel, activities, and facilities, must be identified and descriptive information must be made available. These areas form the basis of much informal knowledge. In addition, conventional information in the form of available knowledge represented by standard publications and that contained in major information systems must be identified and made available. The

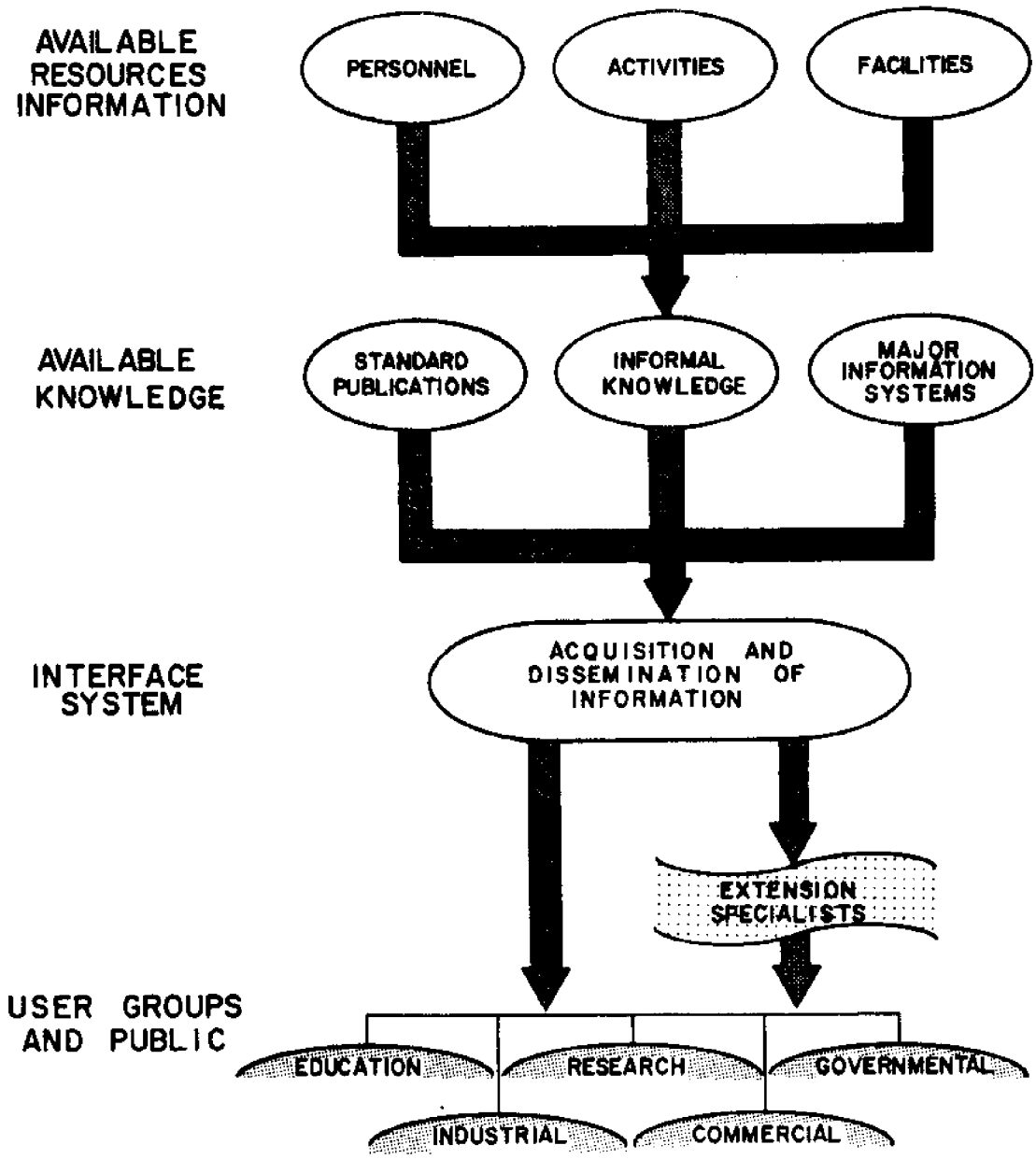


Fig. 1. Resource Information and Potential Users

primary goal of the specialized information center, as outlined in this study, is to provide a focus to satisfy current information requirements of the Sea Grant Program participants and to serve as a base for future growth of information services. Major objectives of this center are: (1) to facilitate communication to and among those who actively participate in the program, those who have a special interest in or may benefit from the program, and the general public; (2) to provide access to such items as expertise, marine resource activities, and facilities which are available to support such marine resource activities; (3) to provide access to a significant sub-set of technical marine resources information; and (4) to provide limited auxiliary services such as specialized assistance in information and computer technology to program participants.

In discussing the many new information services which are being made available, the Committee on Scientific and Technical Communication (SATCOM) [24] points out that: "Frequently, all that keeps the user from complete bewilderment is his ignorance of what is available. We badly need a tool, or tools, that will provide guidance to users of diverse backgrounds and with varying requirements for completeness of coverage." In short, there is a growing need to bridge the gap between the user and available services, as well as providing selected supplementary information and advisory services. This is the projected role of the Marine Resources Information Center.

CHAPTER III

TECHNICAL INFORMATION SERVICES--AN OVERVIEW

The federal government sponsors the development and operation of several large information services. In many cases these services are mission oriented, in line with the activities of the sponsoring agency. Professional societies also have recognized their responsibilities in the area of information processing and are working to minimize the information problems which face their members. In addition to the usual technical journal, many societies are providing secondary services oriented to the material being published in their respective fields.

In 1966 the National Academy of Sciences and the National Academy of Engineering established the Committee on Scientific and Technical Communication (SATCOM). This committee had a mandate to study the ways in which information is handled and technology is transmitted, and to formulate recommendations to private organizations and the federal government in regard to information activities. A recent summary [25, pp. 7-8] of their three-year study pointed out that:

> . . . Scientific and technical information is the main product of research. . . . This information . . . is the base for further steps ahead; it is the lifeblood of progress. The effectiveness of future work in universities, government laboratories, and industry depends on maintaining a vital flow of scientific and technical information, a task for which efficient means of transfer are needed.

There is no doubt that the fifty-five major recommendations made by

this prestigious committee will have a significant impact on the acceleration and upgrading of information activities in this country.

Technological advancements in the fields of computers and micrographics are far ahead of the application of existing capabilities to information processing. While the degree of application varies from center to center, it is safe to say that the utilization of computer and micrographic technologies in information systems is considerably lower than that possible with state-of-the-art hardware. The lack of proper utilization of computers can probably be attributed, in part, to a shortage of technical expertise in our primary information storehouse--the library.

Types of Information Centers

According to Salton [23, pp. 4-6] information centers may be categorized into three general types: (1) depots and libraries, (2) abstracting and indexing services, and (3) information analysis centers. A brief description and example of each of these types of centers will serve to provide some indication of the scope and limitations of their services.

In the category of depots and libraries, federal agencies provide support for many large centers which have the responsibility for maintaining large collections of published material. One such center, possibly the largest now in existence, is the Clearinghouse for Federal Scientific and Technical Information which provides a central location where one may obtain information on the results of

research sponsored by the government in the areas of science and technology. Two publications of this center, the *U. S. Government Research & Development Reports* and the *U. S. Government Research & Development Reports Index*, provide a semimonthly announcement service to identify recent acquisitions. This type of center has the function of acquiring and storing selected published materials and then making this material available to some limited user population.

The Water Resources Scientific Information Center (WRSIC) is a good example of an abstracting and indexing center. It issues a semimonthly publication entitled *Selected Water Resources Abstracts* covering the field of water resources. This center was established by the Secretary of the Interior in 1966 as the first component of the Natural Resources Scientific Information Center. The services of such centers are normally restricted to the preparation and dissemination of abstracts and indexes.

One example of an information analysis center is the Nuclear Safety Information Center which is supported by the U.S. Atomic Energy Commission. This center is described by Buchanan and Hutton [2] as one which provides specialized analyses in the field of nuclear safety. Although a number of publications are offered by this center, the normal function of such centers is to provide in-depth analytical studies in specified subject areas. Swanson [27, p. 50] indicates that a recent survey lists twenty-two such centers established by the Department of Defense and fourteen established under the Atomic Energy Commission.

A fourth significant type of information center, which should be included in any categorization, is the data center. The National Oceanographic Data Center, supported by marine oriented federal agencies, maintains information of an unpublished but scientifically significant nature. The type of data collected by this kind of center may be in digital or analog form and is usually collected in such volume that it may need to be processed so that only raw summary data may be stored. Researchers may publish findings based on analyses of the data, but the raw data could serve as a valuable resource for other researchers at a later date. This type of center then, has the function of maintaining data which most centers would not have the capabilities to store and process with their conventional techniques.

The emphasis being placed on the problem of information acquisition, storage, processing, and dissemination indicates that the governmental, industrial, and academic communities recognize the fact that there is a problem to be solved. The book by Maria Dembowska [7] outlining information problems and trends in Poland and the *World Guide to Science Information and Documentation Services* [35], sponsored by the United Nations Educational, Scientific and Cultural Organization (UNESCO), give some indication that scientific information problems are being recognized on a world wide basis. The Food and Agriculture Organization (FAO) of the United Nations is very active in work directed toward the international use of marine oriented information. O'Connor and Saila [19, p. 151] cite *The*

Current Bibliography for Aquatic Sciences and Fisheries, produced by the FAO, as being the most comprehensive abstract journal in the aquatic sciences in terms of the scope of subject and journal coverage.

Information Systems

A considerable number of major technical information centers of various types are being initiated. These information centers are designed to supplement the traditional sources such as libraries, personal collections of information, and personal contacts. Each information center offers services which are provided through the operation of various information systems. While information systems may vary greatly in terms of the available output, Figure 2 presents a general overview of the basic processes associated with a typical technical information system.

A variety of material must be screened for the selection of that which is to be included within the data base. A conversion process is required to develop a surrogate which is suitable for the selected material. This conversion, in most cases represented by abstracting and indexing procedures, requires the involvement of a technical specialist in the associated field of study. A desirable tool for this process is a thesaurus, which lists a predetermined vocabulary that insures a reasonable degree of uniformity in the indexing and retrieval of subject material. The surrogate may take the form of author or specialist generated abstracts, index tables, index terms,

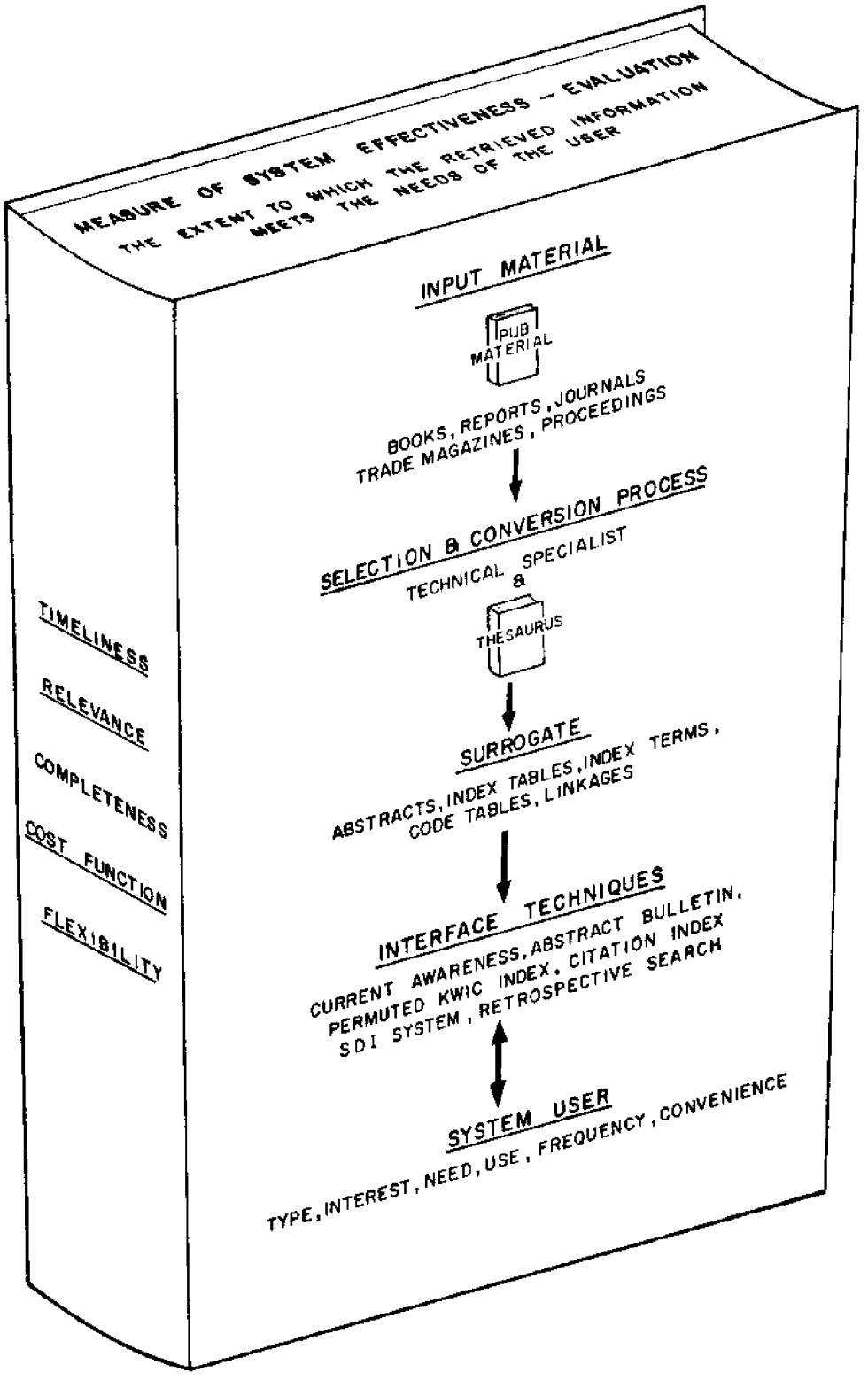


Fig. 2. A Technical Information System

code tables, linkages and various combinations of these types.

The interface techniques represent the user access mechanisms for the available services. Current awareness services may include abstract bulletins, permuted key-word-in-context (KWIC) indexes, citation indexes and selective dissemination of information (SDI) notices. Retrospective search services include the manual search of material received under current awareness services by the user, as well as automated searches of a large historical data base. Predetermined profiles, which specify the interests of a particular user or class of users, are normally used in both the current awareness and retrospective search procedures.

The major determining factors affecting the services offered involve the system user and his needs. System evaluation, or a measure of system effectiveness, must consider the elements of: (1) timeliness, (2) relevance, (3) completeness, (4) the cost function, and (5) the flexibility of the system.

It may be noted that variations in the input, such as replacing published material with information covering personnel, activities, or facilities, could result in similar selection and conversion processes, the surrogation processes, and interface techniques. This use of input data, which describes something other than printed material, introduces a new element into the evaluation process. This element is one of validity, insuring that the referenced item is, in reality, as described.

It is probable that the personnel, or expertise, file would be

more susceptible to validity problems than either the activity or facility files. This possible inaccuracy could result from one of a number of reasons.

1. An individual may sincerely feel that he is highly qualified in some specialty field. His qualifications may be considerably better than those of others in his own organization. However, when compared with other individuals who routinely work in this specialized area, he may, in fact, be considered a novice.
2. A person may have impeccable qualifications on his vita sheet, reflecting extensive academic and research work in some specialized area. This individual may not be able to produce results when faced with a realistic problem.
3. As a result of modesty, the most capable and qualified individual in a given field may feel that he really doesn't know enough about this field to be considered an expert. Many highly qualified individuals may be overlooked and, consequently, not be included in the file.

Although item 3 could be included in the "completeness" element which was previously listed, it is important that such files reflect a true picture of available resources.

While there may be many possible solutions to this problem of validity, only two will be discussed. First, it would be possible to assemble a group of experts in each general area of interest and have them suggest candidates that should be included for a number of

specialties. Only those individuals chosen by the experts would be asked to participate in the data base.

A second approach would be to use recommendations of the panel of experts to assign a weighting factor to selected individuals in the various specialties. A person would not have to be picked by an expert to be included in the file, but his expertise would not have the same ranking as someone who had been selected. This process would allow flexibility within the file while insuring a certain amount of accuracy in the data.

Similar procedures could be used for assuring the validity of the activity and facility files if this seemed to be necessary.

The Rationale for National Information Centers

The federal government, which sponsors a large part of all basic research, has recognized a need for a clear government policy on technology and information transfer. Dean Harvey Brooks [1, p. 2] of Harvard, chairman of the National Academy of Science's Committee of Science and Public Policy, described this need as early as 1966 by stating that:

> . . . a rapid rate of technological innovation is an important ingredient of economic growth, and that henceforth federal agencies engaged in the support of R. & D. should attempt to shape their policies with due attention to their economic impact--including particularly the horizontal transfer of technology from the immediate purposes of the agency to other purposes and to the civilian economy.

President Johnson, in a 1967 message [30, p. H3648] covering the sixteenth annual report of the National Science Foundation, encouraged

the development of national information systems with these words:

> To be fruitful, scientific and technical information must quickly reach those who can use it. As the volume of research grows, this becomes harder to achieve. . . . The Foundation will, therefore, institute new programs to devise improved systems for handling scientific information, and will work with other government agencies to establish standards for federal technical information programs.

Thus the government recognizes the current need and ultimate payoff associated with the availability of adequate major information centers. From a practical viewpoint, the very nature of these information centers demands that in order to avoid duplicate processing of all covered material, the major functions must be centralized.

It may be seen that a variety of major federal and nonprofit information centers have been developed to assist the storage, dissemination and current awareness activities associated with technical information. Each center is designed to serve a particular group of users by way of specialized information services. While these centers do not provide the complete solution to technical information problems, they do represent a reasonable approach which eliminates excessive duplication of effort.

Support for information activities of the marine resources program at the national level could take the form of a center as illustrated by Figure 3. Such a center could provide a variety of services which would be impractical to maintain at a lower level. These services include an abstract bulletin, a selective dissemination of information (SDI) service, and a retrospective search service.

This national center would receive support from and provide

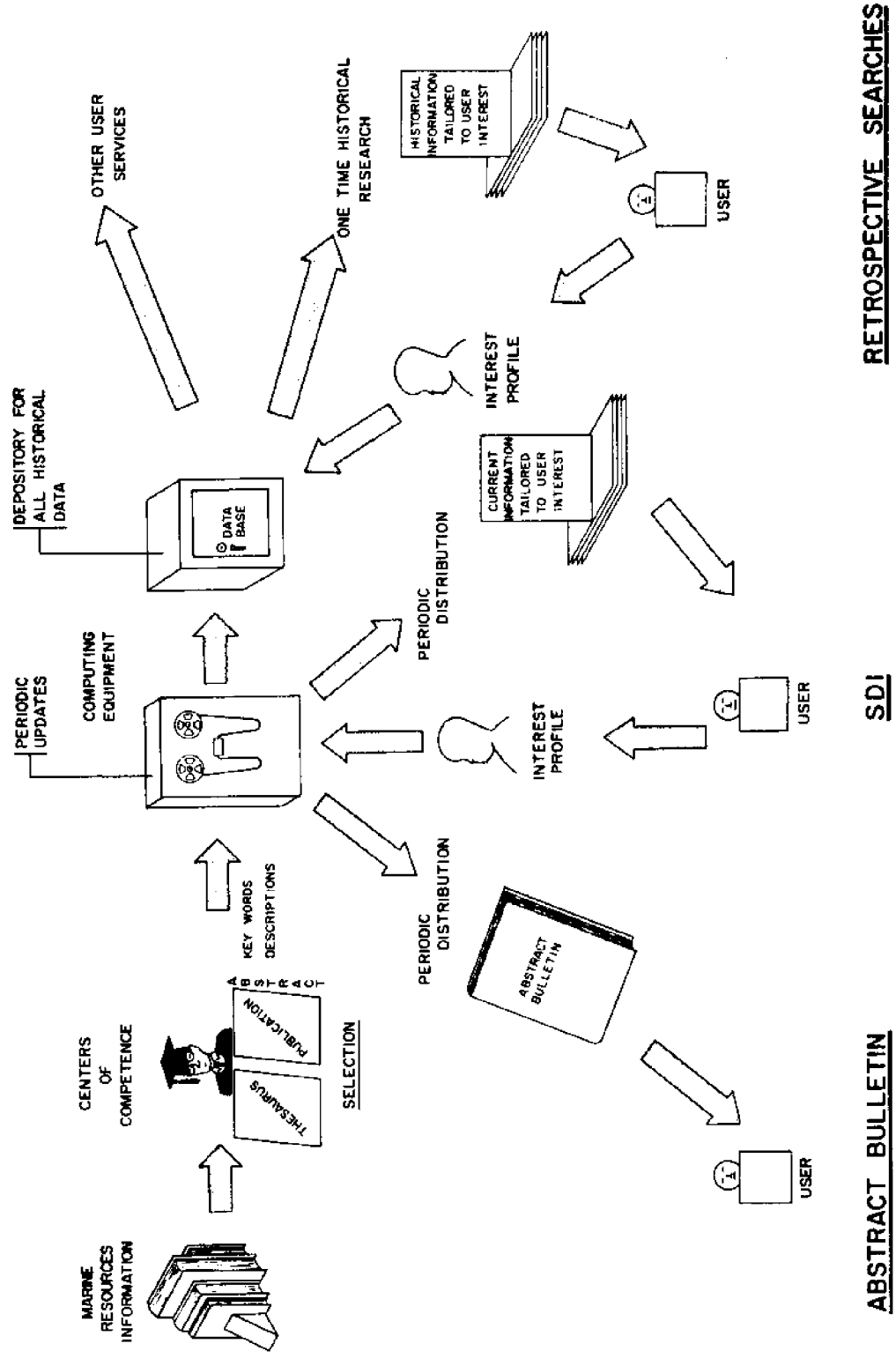


Fig. 3. Overview of a National Information Center

support to a number of regional specialized information centers. It would provide a framework within which there could be a uniform development of national marine resources information activities. Such a center could provide a basis for standardization of the common information activities of each institutional program.

CHAPTER IV

THE SPECIALIZED INFORMATION CENTER CONCEPT

An information center is described by Barbara Frautschi [10, p. 382] as being "an organization for acquiring, processing, and disseminating technical information." The processing and dissemination functions are accomplished by a series of information systems which she also defines as "a network of information services providing facilities by which information and data are processed and transmitted from originator to user." Each information system utilizes a data base which consists of a collection of data concerning some particular fact, subject, or event.

The term "specialized," when used in conjunction with the words "information center," may be somewhat misleading since it is difficult to imagine an information center which is not specialized to some degree. As previously mentioned, information centers were categorized into four general types based on their function. It might also be said that information centers may be classified as either general or specialized depending on their relationship with the user, subject matter coverage, or flexibility with respect to user needs. The general information system represented by Figure 4 could very well be a national mission oriented center which covers a broad information spectrum in the area of marine resources. A large system such as this could be capable of serving thousands of users

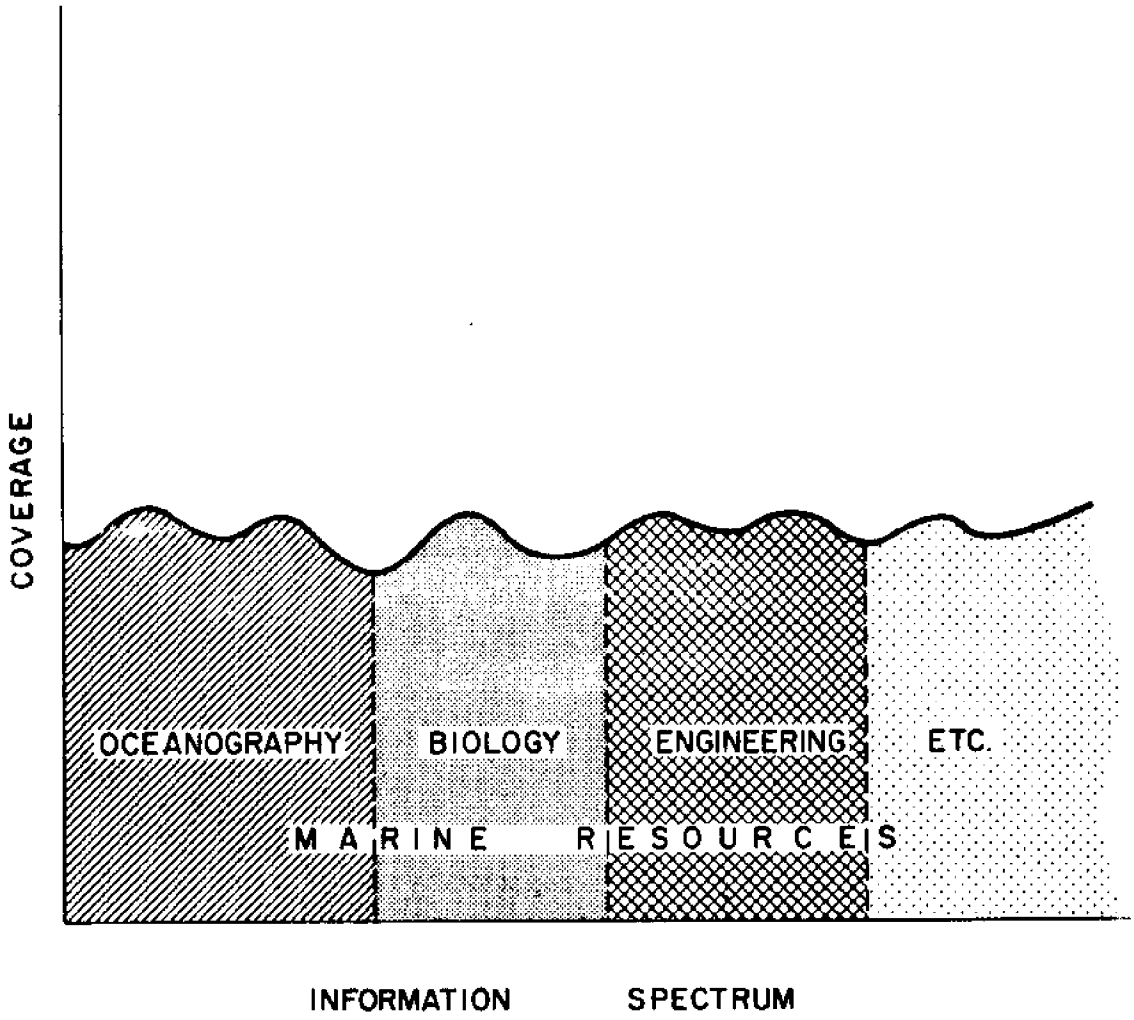


Fig. 4. Scope and Coverage of a General Information System

by utilizing highly sophisticated and efficient automated systems. Such a center could effectively serve as a clearinghouse for a number of smaller satellite operations and effectively minimize unnecessary duplication while accomplishing those tasks which would be uneconomical on a small scale.

While one must acknowledge the requirement for large mission oriented general information systems there is still a definite need for the development of small specialized information centers which can serve the local interests in a responsive manner. Figure 5 illustrates what might be considered a specialized information system for a group of sea grant activities which have special interests in the areas of the shrimp fishery, dredging and sea food technology. It should be noted that while the large information center would serve a broad spectrum of interests with broad coverage, this specialized center would contain spikes or groups of spikes representing high coverage in certain areas of marine resources.

System Methodology

In the process of accomplishing the stated goal of providing a focus for the information activities of the Sea Grant Program, the specialized information center would serve both as a recipient and an initiator of marine resources information. The role of recipient would include the selection and acquisition of available information concerning marine resources. The role of initiator would involve the collection of marine resources information concerning: (1) personnel--

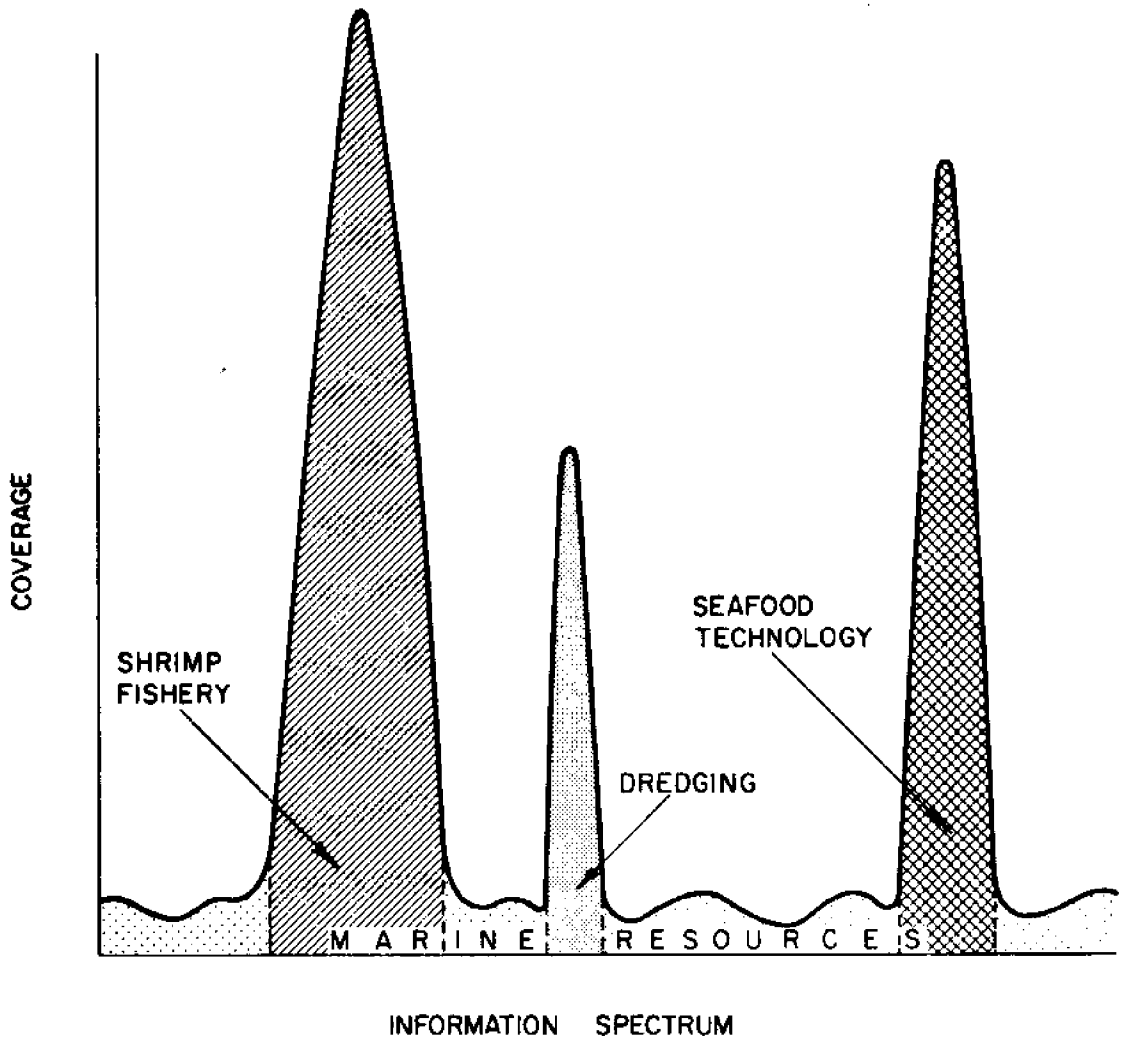


Fig. 5. Scope and Coverage of a Specialized Information System

personnel within the geographical area covered by the program, who have a prime interest in some specific field which would provide support for the marine resources program, (2) activities--ongoing activities such as research projects, extension demonstration projects, and other activities which would be of particular value to this program, and (3) facilities--facilities such as research centers and/or laboratories, research and training vessels, and such items as major information resources as well as listings and descriptions of marine related associations and organizations.

Within the geographical area to be covered by the specialized information center, several "centers of competence" would be designated for areas such as those previously mentioned--the shrimp fishery, dredging, and sea food technology. These "centers of competence" would serve as a vehicle for the identification and acquisition of expanded resource information.

The information thus assembled into various files would be made available in the form of listings and microfiche copies to a limited number of sub-centers which would be serviced by the local specialized information center. The primary role of these sub-centers would be to make the collection of information more readily available to groups of users or participants in the Sea Grant Program.

An additional major function of the staff associated with the information center would be to serve as an interface on matters regarding information services and resources. Assistance would be given in such activities as locating information regarding specific

problem areas, providing referrals of available marine expertise, and technical assistance in the area of information science. One example of technical assistance during the current project year involved the preparation of a computer generated bibliography utilizing data which was collected by a participating researcher.

A third major function would involve the maintenance of a distribution system centering around a mailing address service. Those users requiring access to a mailing list that identifies people having an interest in the marine resources could participate in and utilize this system as required. This system would regularly serve as a mechanism for the distribution of general newsletters and news release items, both of which would assist in keeping the public alerted to developments within the Sea Grant Program.

It should be noted that the major functions which have been outlined are designed to provide a service to the Sea Grant Program as it exists today. It is recognized that as the program develops, more emphasis will be placed on the extension function and therefore the services required to support this activity will show a corresponding increase as this change takes place.

System Parameters

In its role as a service organization the Marine Resources Information Center must strive to provide the very best information services, consistent with available resources. The factors which limit the performance of such a center include available funding,

technical capabilities, lack of a recognized body of information, available technical information, legal restrictions, and user considerations.

In the area of funding, there are no strict guidelines as to the amount of money which could or should be set aside for information activities. It is safe to say, however, that the level of funding will in all probability always amount to some small percentage of the overall program expenditures. It should be pointed out that such an information center is more than just a supplementary library facility. When functioning in its full capacity the center will serve as an aid to the management function, the public relations function, the extension function, and the advisory services function. In the final analysis, the level of funding should be decided by an enlightened program management and should be based on the value of services provided to the overall program.

Technological capabilities, as such, should impose only minor limitations to the development of adequate information services. The technologies associated with computers and micrographics seem to be most applicable and they are currently developed to an extent which far exceeds our abilities to use them at this time. In both areas the level of use will be limited to some extent by the level of sophistication which can be justified. The area of micrographics currently suffers from a lack of standardization, both in hardware and media. It might also be pointed out that one of the major deterrents to the extensive use of micrographics is the lack of a quality, low

cost reader.

The current lack of a recognized body of information and the lack of a clearinghouse or library for such information can best be solved at the national level. The absence of a thesaurus will severely limit the indexing and subsequent storage and retrieval of marine oriented publications. Facilities similar to the National Agricultural Library (NAL) and the Water Resources Scientific Information Center (WRSIC) will probably be established for the marine resources program in the not too distant future.

Current copyright laws, in existence since 1909, have never undergone major revision. This failure of the legal basis for some types of information usage to keep pace with the changing information environment imposes severe restrictions on certain information services. The problems center around the question of an author's rights versus public interest. The SATCOM report [24, p. 232] has summarized the main issues as follows:

> 1. The need to provide for and facilitate the free flow of information by every possible means.
> 2. The need to assure merited recognition and, where applicable, material returns to an author for his efforts.
> 3. The need to protect the equity held by those who venture resources on assuring the availability of information.
> 4. The need to protect the identity and integrity of an author's work.

While much study and discussion have been directed to this problem the last three to four years, there is no clear solution in sight at this time.

It is likely that the most formidable limitations of such a

specialized information center involve user considerations. The user needs must be identified, a determination must be made regarding the best method for satisfying these needs, and the resulting services must be presented in such a way that they will be accepted. In many cases the information habits of the user must undergo some change before the service will be of significant value. Factors which can contribute to such a change include an awareness of available services, the ease with which the service may be used, and the results obtained by utilizing this service.

System Advantages and Limitations

Positive considerations covering the specialized information center concept are primarily based on the fact that a small, local information facility can provide a significant information service to the individual user. It can tailor the information content of its services, the scope of its data base, and to a certain extent, the format in which its information products are presented, to the characteristics of the local user population. The existence of such a local center should also provide considerable benefits in the area of user education in the techniques of modern information processing.

In terms of overall benefits to the marine resources program on both the local and national levels, the existence of such information activities should help to provide an identity and visibility to the program and its accomplishments. This type of center should be of considerable value in the establishment of a national center for the

marine resources program. It would be extremely useful in the establishment of numerous "centers of competence" and could provide the basis for the development of a national inventory of expertise, activities, and facilities in the area of marine resources.

Many limitations which will affect this type of specialized information center were discussed in the section on system parameters. Proliferation of several small information centers could result in much unnecessary duplication which could be minimized by the establishment of a national information center. It is also safe to assume that without the existence of such a national center the information resources of smaller specialized centers will be severely limited.

It is evident that numerous informal information activities will exist in a program of this size if there is no formal channel within which they may be developed. A major premise of this study is that the development of marine resources can be accelerated by a small, user oriented information structure.

CHAPTER V

THE MARINE RESOURCES INFORMATION CENTER

In keeping with its role of providing a focus for information activities within the marine resources program, the Marine Resources Information Center is designed to initially function in three major areas. These areas and their related systems are:

1. Resource Information
   - The Microfiche Technical Information System
   - The Expertise Information System
   - The Activities Information System
   - The Facilities Information System
   - The Information Sub-Center
2. Information Dissemination
   - The Information Distribution System
3. Auxiliary Services

All systems of the center are now operational and are being utilized by the Texas A&M marine community. A discussion of each system will serve to provide an insight into the capabilities and potential offered by such a specialized information center.

Resource Information

Four major systems and their related files have been developed to provide coverage for various types of available resource

information. Each of these systems, including a description of their individual data base, as well as input, processing, and output procedures and formats, is presented.

The Microfiche Technical Information System

The primary purpose of this system is to provide a mechanism wherein a significant sub-set of relevant printed information may be made available to the users of the system. This system makes use of microform technology to provide a means of storing the available information. An overview of the various procedures representing the selection and conversion process, the surrogation process, and the mechanism provided as a user interface is shown by Figure 6.

The selection of microform as the primary medium for storage and distribution of technical information was based on its cost and space saving characteristics. Microfiche was selected over other types of microform because of its inherent flexibility and adaptability to a unitized set of information. It provides an efficient storage vehicle for most printed material and technical reports in their use as reference tools.

Microfiche has become a generally accepted medium for the recording and distribution of technical information by major federal information centers. Barbara Frautschi [10, p. 383] defines microfiche as a "transparent sheet film containing micro or miniaturized pages arranged in a grid pattern by rows." These sheets of film usually contain a title and associated reference number which can be read without

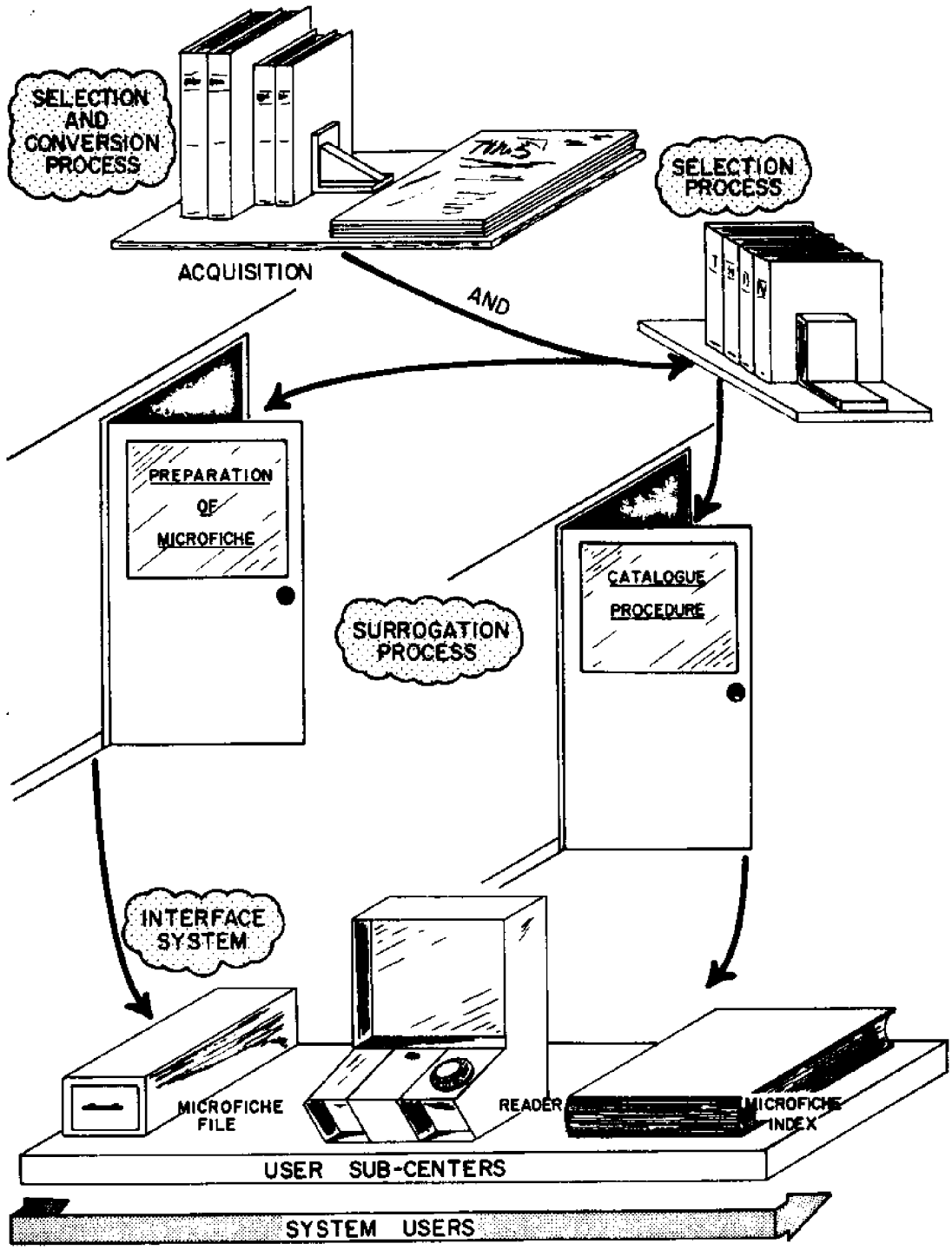


Fig. 6. Microfiche Technical Information System

magnification. A standard microfiche is described by the Committee on Scientific and Technical Information (COSATI) specification as a sheet of film which is 105mm x 148.75mm, or approximately four inches by six inches in size. Each sheet of film is intended to provide for sixty images or frames, which are arranged in five rows of twelve frames each.

Input Procedures

Material is accepted for inclusion in the data base in either of two forms. First, hardcopy of any reasonable size may be accepted and photographically converted into microfiche form, and second, material which has already been converted to microfiche form may be routed through the catalog procedure for inclusion in the file. To qualify for inclusion in the file, material must be relevant to the marine resources program and its use in this system must not violate existing copyright laws.

Procedures have been developed to allow anyone to submit hard-copy for inclusion in the file. Sources of material which has already been converted to microfiche form are somewhat limited; however, the volume and scope of this material is significant. Two major sources are the Clearinghouse for Federal Scientific and Technical Information and University Microfilms.

While University Microfilms has exclusive contractual arrangements for microfilming a great number of major periodicals, the actual acquisition of this material in microfiche form has been disappointing.

Factors contributing to the difficulties involved in using University Microfilms as a primary source include: (1) their basic recording medium is 35mm film, (2) material is apparently filmed annually and therefore not available on a current basis, and (3) it is extremely difficult to obtain periodicals in microfiche form.

Government-sponsored research development reports and translations of foreign literature constitute the primary types of information available through the Clearinghouse for Federal Scientific and Technical Information. The availability of material is announced through a semimonthly publication entitled *United States Government Research Development Reports*. A more selective semimonthly announcement medium entitled *Announcements in Science & Technology* provides information in a subject oriented format. This service identifies available material in a variety of specific categories. The user may subscribe to the listings which cover those categories of particular interest.

Preparation of Microfiche

A pictorial representation of the steps involved in the preparation of microfiche from hardcopy is given in Figure 7. The facilities being used in this process are those maintained by the Information Science Laboratory of the Texas A&M University Industrial Engineering Department. The control forms which are utilized in this process are shown in Appendix A, along with instructions for their use.

Microfiche are generated in the laboratory by what is known as

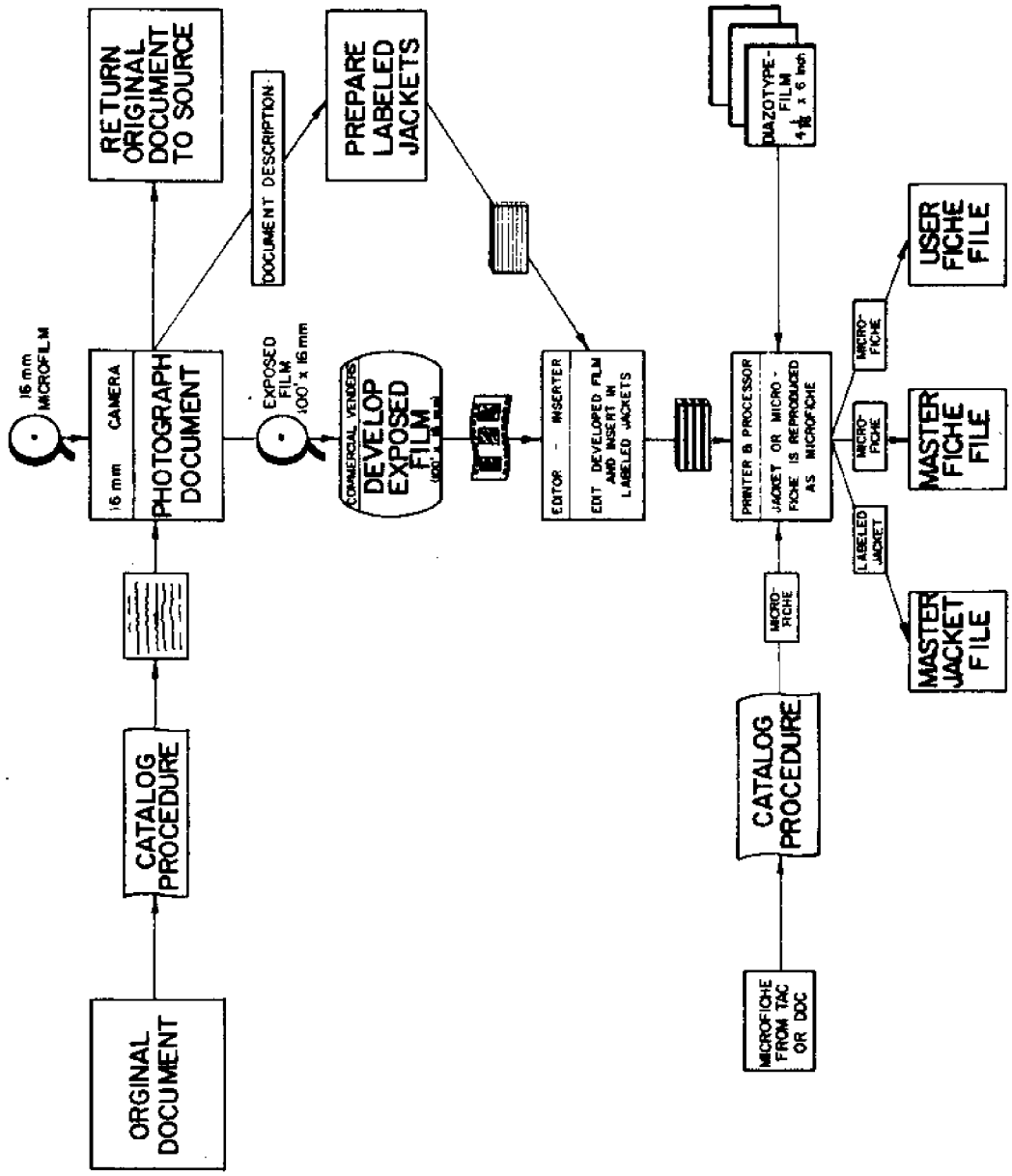


Fig. 7. Preparation of Microfiche

a jacket system. As may be seen from Figure 7, the original document is photographed by a 16mm camera. After being photographed, the original documents are temporarily filed until such time as the film has been processed. As the film is inserted into the jackets it is checked for quality and completeness. At this time the documents are disposed of as directed by the individual who submitted them.

Film is normally purchased in either 100- or 200-foot rolls and the purchase price includes developing of the film by the vendor. While the exposed film is being developed, the jackets into which the film will be inserted must be labeled to provide a visual identification for each particular fiche. The microfiche accession number and an abbreviated title are typed along a narrow opaque strip at the top of the jacket. This identifying information permits the selection of the desired microfiche by the user of the file. The jackets used in this process are transparent microthin mylar which is approximately 4" x 6" in size and contain horizontal chambers for the insertion of 16mm film either in strips or single frames. Each 4" x 6" jacket can hold approximately sixty 8-1/2" x 11" documents.

A piece of hardware known as a reader-filler is used to combine the film and its associated jacket. In this process the film is visually edited just prior to its insertion into the horizontal chambers of the jacket. The completed master jacket is now ready to be processed for distribution.

The next step involves the creation of duplicate copies of the material and it is at this point that the microfiche obtained from

other sources are included in the process. In the printing process the original or master copy and a sheet of diazo film are inserted into a piece of equipment which exposes the film by means of a mercury vapor lamp system. A separate processing unit is then used to develop the exposed film. The original microfiche or the microfiche jacket is filed in a master jacket file. One copy of this fiche or jacket is placed in a master fiche file and one copy of each fiche is distributed to the various user files which are maintained in the information sub-centers.

Microfiche Catalog Procedure

The catalog procedure as shown in Figure 8 results in a set of indexes which permit the user to access the microfiche file. Sample coding forms and instructions for completion of these forms are shown in Appendix A. The work described in this section may be performed in parallel with the preparation of the microfiche.

Basically the process used to catalog the various entries permits the collection of six types of information. These are: (1) type of reference, (2) author(s), (3) complete title, (4) descriptive material, (5) descriptors, and (6) abstract. Only the first four of these items are required. The descriptors and abstract may or may not be included, depending on their availability.

The available data is typed on a microfiche data keypunch form as shown in Appendix A. A coding scheme allows the assignment of a code which is typed in columns 61 through 75 of the keypunch form.

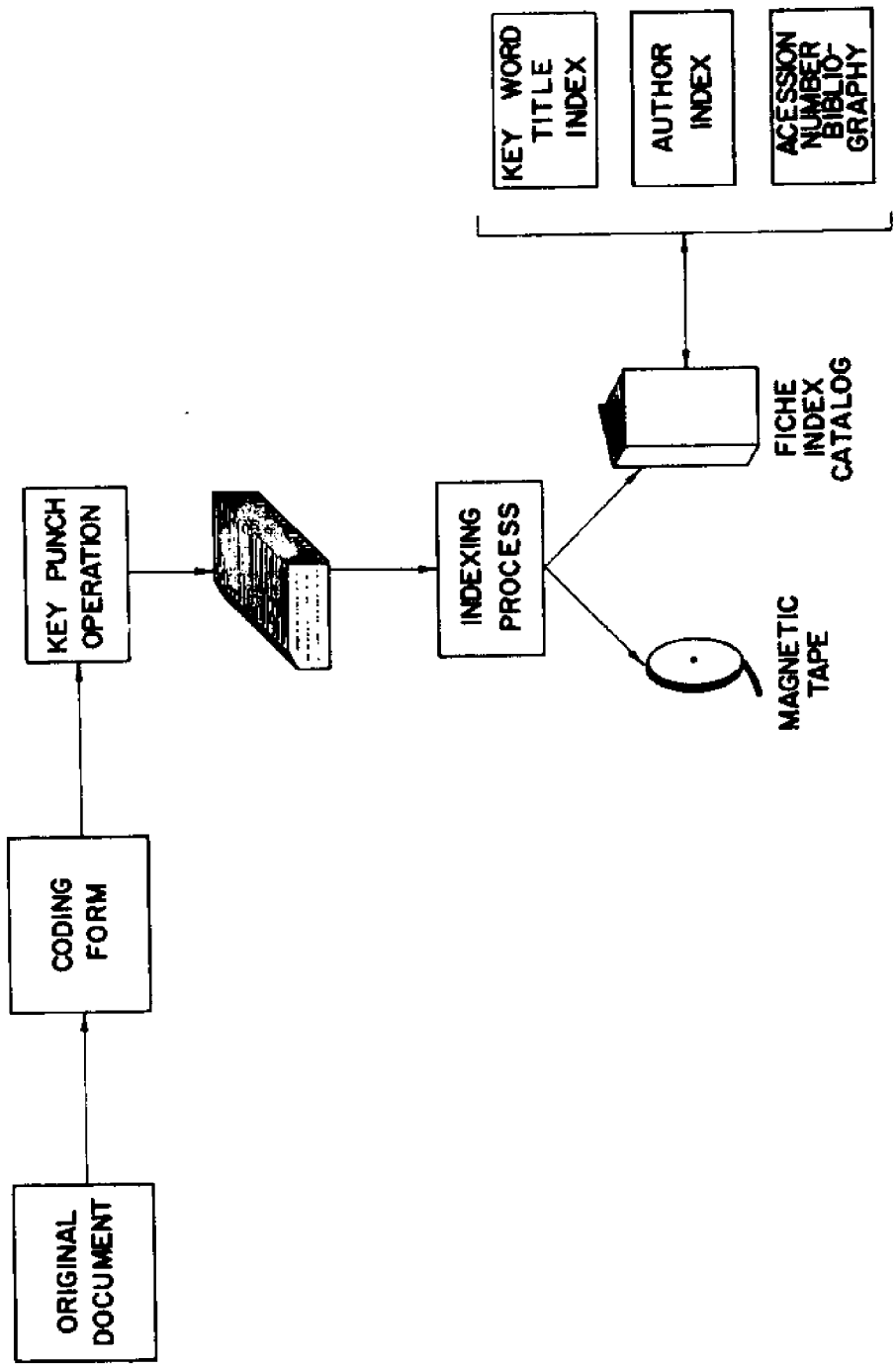


Fig. 8. Preparation of Microfiche Index Catalog

This unique code is assigned to each microfiche and is primarily an accession number used as a cross reference in the microfiche index. This reference number is also used to locate the desired microfiche within the file.

The primary output of the microfiche catalog procedure is a computer generated index prepared in a standard key-word-in-context (KWIC) type format. This index contains a bibliography listing, an author listing, and a key word listing, as illustrated in the Appendix.

Cumulative indexes that reference all material in the file are prepared annually. Supplementary indexes containing new material added to the file, as well as all previous material for that particular year, are prepared on a monthly basis. The microfiche file and index are located adjacent to microfiche readers in the various sub-centers for convenient access by the user population.

The Expertise Information System

Of the many information resources which may be utilized in conjunction with marine related activities, one of the most important is that body of information which identifies individuals and their particular area of expertise. The President's 1969 Report to Congress on Marine Science Affairs [13] indicated that "progress in marine sciences in the 1970's depends in large measure on an expanded base of manpower. . . ." The specialized interests and capabilities of our available manpower are not now being utilized to the fullest extent

possible. The availability of expertise information should serve to expand the current manpower base.

Large organizations maintain "people" lists serving a variety of purposes. The personnel department maintains an employee file containing information regarding an employee's personal history, academic background, previous employment data, and possibly performance evaluation by the employee's supervisor. An aggressive sales department would maintain records of past and potential customers. A retail credit department would maintain data to evaluate the financial responsibility of customers who may wish to charge purchases.

Information regarding specialized capabilities and interests of available personnel is not being collected and made available as it should be. The routine informal sources of information, center around the so-called "invisible colleges." These are characterized by a group of individuals having a personal knowledge of the detailed abilities and activities of a limited number of associates who are active in their field of endeavor. In a more formal setting, the professional societies and trade associations maintain membership lists which may be used to identify the members according to primary training or current occupation. Among the major efforts in this area one must include the National Register of Scientific and Technical Personnel which is sponsored by the National Science Foundation. The purpose of this register is to provide a central clearinghouse for scientific and technical resources.

Is this type of information regarding expertise, of value, and

would it be used if it were available? Possibly not, if one were to consider a small, closely knit organization where each individual has knowledge of the capabilities and interests of everyone in the group. However, in a large, interdisciplinary undertaking such as the Sea Grant Program, a detailed knowledge of the activities and capabilities of other individuals associated with the program is not possible to any great degree. It would be desirable to have some formal mechanism for making information available regarding the skills of a large number of individuals with an interest in marine resources and supporting areas. Such an information resource, in the form of a usable data base, should assist in providing a more optimum utilization of existing manpower.

Specific examples which illustrate the potential usage of such a file within the Sea Grant Program might include the following: (1) use of the file by the program director for the establishment of a project team to work in a particular problem area, (2) use of the file by an industrial firm to identify an individual who has knowledge and experience in a specific technical area, and (3) use of the file by a researcher to identify individuals who are currently working in an area of particular interest to the person making the query. Given the availability of a good expertise file, one may project many additional uses of this nature.

The major problem areas associated with making this type of information available are the acquisition of adequate, valid information and the maintenance of this information on a current basis. The

acquisition problem includes the selection and identification of those individuals who will be requested to participate by responding to a questionnaire. The questionnaire must be carefully prepared to minimize the time and effort involved in its completion. Once a questionnaire has been developed the actual collection of the information is difficult. People are continually deluged with a variety of paperwork and it is natural to take care of only those items which seem to be of greatest importance. In many cases, the response rate for questionnaires is generally quite low.

Individuals who are asked to complete the questionnaire and be listed in the file must understand the utility and value of the file. They must be able to see how such a file may be used and why it is better than currently available information. As discussed in Chapter III some procedure must be established to insure the accuracy and completeness of expertise information. Once a good data base has been established its value will rapidly decrease with time unless adequate update procedures are used. It is imperative that this type of information be updated on at least an annual basis to insure current, valid data.

Expertise Data Acquisition

The population considered for initial development of this expertise file has been limited to employees of Texas A&M University. A letter and initial questionnaire were sent to 987 faculty and staff members. To date a response has been received from 182, or 18.4

percent, of those contacted.

Some five months later a machine generated letter and detailed listing of existing data was distributed to each individual in the file. The purpose was twofold: (1) to provide a validity check on the information in the file, and (2) to obtain two additional items of information which seem essential for better file utilization. The response to this query was 82.1 percent and many corrections were made to the data.

Based on the data obtained from the first two contacts with participants, a new questionnaire was designed to combine the previous ones and to be used as new names are added to the file. This questionnaire, as shown by Figure 9, may be used for direct keypunching of the data for the file. A limited amount of editing and additional coding by the staff of the information center is required.

The form is short as well as easy to complete and return in a minimum amount of time. Data is requested in six major categories.

Identification.--Basic information is requested to facilitate the identification and location of each participant.

Expertise.--The individual is asked to specify up to six areas of expertise which do not necessarily relate to marine activities. These areas of expertise, expressed in the person's own words, serve as the basis for a sort in the processing of the data and provide one major entry to the file.

Broad expertise categories.--In this section the individual is

MARINE RESOURCES INFORMATION CENTER
PERSONNEL EXPERTISE FORM

IDENTIFICATION:

NAME _____

TITLE _____

BUSINESS ADDRESS _____
Department

_____
Organization

_____
City State Zip

Phone: (xxx-xxx-xxxx) _____

EXPERTISE: (indicate up to 6 areas of expertise - not necessarily relating to marine activities)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

BROAD EXPERTISE CATEGORIES: In order to provide a broad categorization of personnel, please identify the area(s) which best describes your expertise by checking up to 3 of the categories shown below. Use numbers 1, 2, or 3 to signify them in order of decreasing importance.

___Resource Management
___Engineering Design
___Marine Engineering
___Marine Biology & Fisheries
___Mineral Exploration & Recovery
___Chemical Processes
___Food Technology & Processing
___Personnel & Training
___Physical Oceanography & Meteorology
___Product Development, Marketing & Finance

EDUCATION: DEGREE MAJOR

_____ _____
_____ _____
_____ _____

WORK EXPERIENCE: Briefly indicate type and number of years.

_____
_____
_____

Current Position: _____

MARINE RELATED ACTIVITIES: Please indicate your current involvement in marine activities.

_____
_____

WHEN COMPLETED, PLEASE RETURN THIS FORM TO:

Marine Resources Information Center
Office of the Sea Grant Program
Texas A&M University
College Station, Texas 77843

Fig. 9. Personnel Expertise Form

asked to specify categories describing up to three areas of expertise, in order of decreasing importance. The latitude of this categorization is recognized as being limited and may be expanded slightly at some future date. The previous section was intended to give almost unlimited freedom in the description of one's expertise while this section is designed to give a more restricted grouping of the individuals included in the file.

Education.--Information is requested regarding the degrees received and major areas of study. This provides the user of the file with a brief summary of the formal training of the individual.

Work experience.--The person is asked to summarize his previous work experience in terms of type and number of years. He is also requested to provide information regarding his current position.

Marine related activities.--This question was included to provide an indication of current involvement, if any, in marine activities.

It should be noted that only a minimal amount of information is requested under each category. This file is not designed to provide a complete vita sheet on all participants, but is intended as a quick reference to individual expertise information.

The data sheet is edited by the information center staff to insure completeness of the data. During this editing process a departmental code is assigned, numerical codes representing broad

expertise categories are assigned, and general occupational codes based on the information regarding current position are assigned.

In order to simplify the file maintenance procedures, special computer programs have been written which will automatically generate a form letter designed to assist in periodic updating of the file. These letters are personalized to the degree that the individual's name and address are printed in the upper left-hand part of the letter. Mailing labels are also printed at the same time to assist in the distribution of the printed material.

Expertise Data Presentation

Once the data has been converted to machinable form, it is then processed into a format designed for easy access by the potential user. This information is made available in the form of a variety of computer listings, which are supplemented in many cases by biographical data sheets on the individual participants.

Typical copies of each type of listing are shown in Appendix B. A brief discussion of each listing is given below.

Detailed listing.--This list is the basic reference portion of the expertise data file. It is the only section which contains all of the data on each individual included in the file. All other listings refer to this basic format in order to eliminate a gross duplication of material. The reference code, presented as the first item of data on the detailed listing, provides a vehicle for all references to the file. In addition to this reference code, all

lists also show the name of the referenced individual for the convenience of the file user.

Alpha listing.--This list provides a means of accessing the file alphabetically according to last name.

Departmental listing.--This list provides access to the file by department. The listing could be changed to reflect organization rather than department as the file is expanded and the scope of the population is enlarged.

Specialty listing.--The organization of this listing is according to the broad expertise categories which were designated by the participant on the revised questionnaire. As previously mentioned, the number of areas in this group may be expanded as circumstances warrant.

Occupational listing.--Categorization by occupation is accomplished by the information center staff and is based on information provided under the section which shows the current occupation of the individual. The categories currently in use are: (1) teaching, (2) research, (3) extension, (4) program planning, (5) administration, (6) technician, and (7) other. The processing procedures allow for the assignment of up to three categories for each individual in the file. One person could therefore be listed under the "teaching," "research," and "administration" categories if his work involved all three of these areas. Expansion of the file beyond the university

setting would necessitate expansion of the number of areas accordingly.

Expertise listing.--This breakdown should prove to be one of the most useful entries into the file. It is derived from the listing of up to six areas of expertise, which do not necessarily relate to marine activities. It is obvious from the data collected to date that these expertise areas are very specific and, as a rule, not many people will be listed under each category.

It is recognized that there are limitations to the various categories and classifications which have been chosen to serve as entry points to the file. Normal usage of the file should provide feedback which will assist in modifications designed to improve file access.

The Activities Information System

The activities information system is designed to provide the various users with an increased awareness of what is being done in the area of marine resources. While the term "activities" could be construed to mean everything from informal discussions to professional meetings and even to construction of facilities, the definition which has been used for initial file development is limited to ongoing research and extension projects. The procedures developed for the acquisition and presentation of this information are flexible and could be adapted at a later date to process additional categories

of activities.

The total federal marine science program budget for fiscal year 1969 amounted to approximately $516 million. This expenditure represents federal activities being conducted in twenty-four bureaus of eleven departments and agencies. A significant number of additional activities are funded by state agencies, commercial and industrial organizations, as well as by public and private academic institutions. The size and scope of such a program makes it extremely difficult, if not impossible, for any one group to maintain an awareness of the various projects and activities which are in progress.

Perhaps the most significant inventory of research projects available to the scientific community is maintained by the Science Information Exchange (SIE) of the Smithsonian Institution. Each year the Science Information Exchange registers over 100,000 research projects which are in the planning or operational stage. These include activities which are funded from all sources of support, both public and private. Information maintained on these projects is designed to identify the source of project support, the principal investigator of the project, where the project is being conducted, the date of the project, and a technical summary of the planned work.

This information is made available for a modest fee. An elaborate search algorithm and coding scheme are used to make information available by subject content, location, performing organization, principal investigator, supporting agency, and time period. The descriptive information is presented in a computer generated format

and its use is restricted to the extent that it is not for publication or publication reference.

With such an elaborate service available at a reasonable cost, one might justifiably question the reasoning behind the establishment of a small system, which will, in a sense, compete with this type of larger systems. In many ways a small regional operation could provide a better service to its users. This could result from the collection of data which was more complete, more current, and better oriented to the group it was intended to serve.

The local activities system is not intended to compete directly with the Science Information Exchange, but it is intended to supplement and make use of this service on a modest scale. Informal contacts within this geographical region should facilitate the collection of a reasonably complete set of data relating to marine oriented research projects and extension activities.

Activities Data Acquisition

Information regarding marine resources activities must be obtained from all possible sources. The services offered by the Science Information Exchange are utilized to the extent possible, on a regular basis. In keeping with the policy of the Science Information Exchange, it would seem prudent to restrict the use of this information to the extent that it may not be used for publication or publication reference.

The main purpose of this file is to provide an awareness of

ongoing activities in the area of marine resources development and to assist in the elimination of unnecessary duplication of effort. Therefore, only a minimal amount of descriptive information is recorded for each activity. When the user desires additional information on a project of particular interest he may contact the designated principal investigator.

While the material is recorded in a free form format for computer processing, the information is structured into six major types. These are: (1) source of support, (2) principal investigator, (3) title of project, (4) recipient institution, (5) descriptor terms, and (6) project summary.

As the data is received by the information center it is recorded on a form, as indicated by Figure 10, for keypunching. It may be noted that the data keypunch form is designed for the recording of descriptive data on the left and coded information on the right side of the page.

The recording of data on the keypunch form is relatively simple provided all of the data is available. While it would be advisable to have data for each type previously specified, it is likely that in many cases the descriptor terms and the project summaries may not be available. Either or both of these items may be omitted and the balance of the data will be processed. A detailed listing of the classification used for the various activities is given in Appendix C.

All descriptive data is recorded in a relatively free form format. This data will appear on the output sheets exactly as it is

MARINE RESOURCES INFORMATION CENTER

Activities Data Keypunch Form

Sheet 1 of 1

1 — 60	61 — 67	73 — 76	80
NATIONAL SCIENCE FOUNDATION	NSFSG1 TAMU14	010 1231	3
OFFICE OF SEA GRANT PROGRAMS		020	
WIERSIG, DONALD O.		011	
PESTICIDE RESIDUES IN GULF COAST FISH		012	
TEXAS A&M UNIVERSITY		013	
INSTITUTIONAL SUPPORT - 69/70		023	
THE PURPOSE OF THIS INVESTIGATION IS TO:		015	
(1) DETERMINE THE LEVEL OF VARIOUS CHLORINATED HYDROCARBON		025	
PESTICIDES IN VARIOUS TISSUES OF GULF COAST MARINE FISH;		035	
(2) DETERMINE THE BRAIN ACETYLCHOLINESTERASE LEVELS OF		045	
GULF COAST MARINE FISH;		055	
(3) DETERMINE THE SITES OF GREATEST PESTICIDE POLLUTION OF		065	
GULF COAST ESTUARIES BY THE VARIOUS RIVERS OF TEXAS AS		075	
INDICATED BY 1 AND 2 ABOVE;		085	
(4) EVALUATE THE POTENTIAL PUBLIC HEALTH HAZARD AS A RESULT		095	
OF PESTICIDE LEVELS IN MARINE FISH AND THE ESTHETIC ASPECTS		105	
OF PUBLIC CONSUMPTION OF FISH THAT MAY BE AFFECTED BY		115	
ACETYLCHOLINESTERASE INHIBITION.		125	
THESE PROCEDURES COULD RESULT IN EARLY RECOGNITION OF		135	
CHRONIC POLLUTION SO THAT REMEDIAL ACTION COULD BE		145	
INITIATED. IT WILL ALSO IDENTIFY ESTUARIES THAT ARE SO		155	
POLLUTED AS TO BE A PUBLIC HEALTH HAZARD.		165	
NATIONAL SCIENCE FOUNDATION	NSFSG1 LSUL08	010 P270	3
OFFICE OF SEA GRANT PROGRAMS		020	
KNIGHT, H. G.		011	
COMPILATION AND SYSTEMATIZATION OF LOUISIANA LAWS AFFECTING		012	
ESTUARIES AND MARSHES		022	
LOUISIANA STATE UNIVERSITY		013	
PROJECT SUPPORT - 69/70		023	

Fig. 10. Activities Data Keypunch Form

recorded on the keypunch forms. Although each line is limited to sixty characters, a total of ninety-nine lines could conceivably be used for each data type.

The coding scheme incorporates a variety of information into each reference number. Included are a supporting agency code, a recipient institution code, a data type code, a project type code, and a project category code.

Activities Data Presentation

The information maintained in this data file is made available through a series of computer generated reports or listings. An example of each listing identified below is given in Appendix C.

Sponsor summary listing.--This list identifies each sponsor included in the file and shows the code associated with that sponsor. The user is provided with a means whereby he can quickly determine whether or not a particular sponsor is providing support for any activity included in the activities file.

Recipient summary listing.--Each recipient institution which is represented in the file is shown along with the four-digit code which identifies that particular institution. This list provides the user with a quick reference to those institutions participating in the program by having activities included in the file.

Activities classification summary.--The activities classification scheme is presented in outline form and the user of the file may

determine which classification he should check in order to review those activities which may be of interest.

Each of the three previous listings have provided a summary information for some particular categorization used by the file, with no mention of individual projects or activities. The following listings make reference to individual activities and each list provides a different reference index for accessing the file.

Activity summary by source of support.--This summary contains all of the information which is maintained in the file for each individual project or activity. It serves as the main reference source for each project and is referred to via the individual project code number which is shown in each of the other listings.

Activity listing by recipient institution.--The recipient institutions are listed in alphabetical order and each institution is followed by a listing of the titles of the activities being conducted within that institution. Each title has an associated code number which may be used as an entry to the activity summary in order to obtain additional information about each particular project.

Activity listing by type of support.--The activities are listed according to type of support. At present the types of support used are NSF institutional support, NSF project support, and non Sea Grant support.

Activity listing by principal investigator.--The principal

investigators are listed alphabetically and each is followed by the title and reference code of those activities which he is conducting.

Activity listing by category.--Each category is listed and followed by the title of those activities within that category and their associated reference numbers.

Activity listing by descriptor terms.--Each descriptor term is listed along with the activity titles relevant to that particular term and their associated reference numbers.

Each of the several listings provides an entry which may be used to access the information contained in the file. The utility of the file is limited by the quality of the categorization, descriptor terms, and the completeness of the information contained in the file.

The Facilities Information System

The organization of the facilities information system is very similar to the activities information system. The primary purposes of this system are to provide an awareness of available facilities, to identify who may use these facilities and to indicate the restrictions and requirements associated with their use.

Facilities to be maintained in the data base include: (1) general research facilities such as the Activation Analysis Research Laboratory and the Texas A&M University Data Processing Center, (2) major information facilities such as the National Oceanographic Data Center and the Clearinghouse for Federal Scientific and Technical

Information, and (3) marine oriented facilities such as the Galveston Marine Laboratory and the Ocean Engineering Laboratory.

All major facilities included in the data base have specialized resources which should be of value to some phase of the marine resources program. These items could be equipment or information which are expensive and would, in most cases, be difficult to obtain or duplicate. The knowledge of what is available and the requirements for its use could save considerable time, effort, and money in various extension and research projects.

For example, the availability of a wave tank within the Coastal Engineering Laboratory could enable an engineer in some Houston area firm to test the design of a new piece of gear. The existence of a shrimp pond in the coastal marshes, which has been developed for an extension study, could provide a controlled test site for the development of a new shrimp food product or predator control chemical. While these illustrations cover large items, smaller types of equipment could fall into the same categories. Essentially this file results in an inventory of specialized resources. If it were possible to share these resources, their utilization would be improved. Shared usage could minimize unnecessary duplication of specialized equipment and/or information. In many cases work which would have been considered impractical due to a lack of facilities might now be worthwhile.

It would seem that at least within the university setting, such an inventory of facilities and specialized resources should be available. However, such a system does not exist. It is probable that all

major pieces of equipment are recorded in one of several inventory files, but these files are not available in a usable form. The best currently available information may be found in the descriptive brochures, which are distributed by most major facilities.

The National Referral Center for Science and Technology of the Library of Congress provides some information of this nature. One publication which covers a part of the information resources is entitled *A Directory of Information Resources in the United States - Federal Government*. Each entry contains information regarding: (1) areas of interest, (2) holdings, (3) publications, and (4) information services.

This facilities information system should help to fill an existing information void and be of service to the participants of the marine resources program.

Facilities Data Acquisition

The most practical way to establish the facilities information file is to utilize available brochures or to make personal contacts to obtain the required information. All relevant information is recorded on a form as shown by Figure 11 and later keypunched.

A computer listing of this information is then distributed to the responsible party within the facility who is requested to verify the information and make necessary corrections. When the corrected listing is returned, the file is updated as required. Each facility must be contacted once each year to obtain updated information and provide

MARINE RESOURCES INFORMATION CENTER

Facilities Data Keypunch Form

Sheet ___ of ___

	1 — 60	61 — 70	80
*	*Type:*		
	DATA CENTER	F-70-1400001011	6
*	*Name:*		
	NATIONAL OCEANOGRAPHIC DATA CENTER	012	
*	*Responsible Party:*		
	DR. THOMAS AUSTIN, DIRECTOR	013	
*	*Address:*		
	NAVY YARD ANNEX, BLDG. 160	023	
	WASHINGTON, D. C. 20390	033	
*	*Phone:*		
	202-693-3700	093	
*	*Resource Descriptors:*		
	BATHYTHERMOGRAPH DATA	014	
	OCEANOGRAPHIC STATION DATA	024	
	SALINITY-TEMPERATURE-DEPTH DATA	034	
	SURFACE CURRENT INFORMATION	044	
	BIOLOGICAL DATA	054	
	BOTTOM SAMPLE INFORMATION	064	
	SPONSOR(S): ATOMIC ENERGY COMMISSION, BUREAU OF COMMERCIAL	015	
	FISHERIES, COAST GUARD, COASTAL ENGINEERING RESEARCH	025	
	CENTER, DEPT. OF THE NAVY, ENVIRONMENTAL SCIENCE	035	
	SERVICES ADMINISTRATION, FEDERAL WATER POLLUTION	045	
	CONTROL ADMINISTRATION, GEOLOGICAL SURVEY, DEPT. OF	055	
	HEALTH, EDUCATION AND WELFARE, NATIONAL SCIENCE	065	
	FOUNDATION	075	
	MISSION: TO PROVIDE AN EFFICIENT MECHANISM FOR PROCESSING,	085	
	EXCHANGING, AND STORING GLOBALLY COLLECTED MARINE DATA	095	
	AND INFORMATION.	105	
	SCOPE: ACQUIRE, PROCESS, STORE AND RETRIEVE PHYSICAL,	115	
	CHEMICAL, GEOLOGICAL, GEOPHYSICAL, AND BIOLOGICAL DATA	125	
	AS RELATED TO OCEANOGRAPHY.	135	
	SERVICES: ANSWERS INQUIRIES ON TOPICS WITHIN SCOPE OF	145	
	CENTER, CONDUCTS LITERATURE SEARCHES, AND PROVIDES	155	
	SCIENTIFIC OR TECHNICAL DATA OR DATA COMPILATIONS,	165	
	PUBLISHES STATE-OF-THE-ART REVIEWS, COMPILATIONS OF	175	
	INFORMATION AND DATA, DATA PROCESSING FORMS AND	185	
	MANUALS, AND CATALOGS OF HOLDINGS.	195	
	FURNISHES TECHNICAL EVALUATION OF ACCURACY, QUALITY,	205	
	AND/OR SIGNIFICANCE OF INFORMATION AND PROVIDES	215	
	TECHNICAL CONSULTATION SERVICES. EXCHANGE SERVICES	225	
	PROVIDED TO THOSE ORGANIZATIONS FURNISHING CODED DATA	235	
	TO THE CENTER.	245	
	STAFF: 71 PROFESSIONALS, 14 TECHNICIANS, AND 43	255	
	ADMINISTRATIVE, CLERICAL, MACHINE OPERATOR, AND OTHER	265	
	SUPPORT PERSONNEL.	275	
	AVAILABILITY OF SERVICES: SERVICES ARE AVAILABLE TO	285	
	EVERYONE, WITH CHARGES BEING DETERMINED ON A COST	295	
	BASIS.	305	
	* *These lines are included for clarity only and should not be included on forms to be keypunched.*		

Fig. 11. Facilities Data Keypunch Form

the necessary data required for file maintenance.

The types of information collected, as shown in Appendix D, are: (1) type of facility, (2) name of facility, (3) responsible party, address, and phone number, (4) an itemized listing of major resources or services available within the installation, and (5) descriptive information. Within the category of descriptive information a variety of sub-headings may be used. The primary criterion is that the information be brief, provide a reasonable description of the facility, and indicate the availability of any services.

A limited facility classification scheme, as shown in Appendix D, has been established. The type which best describes the facility will be selected and entered on the coding sheet by the information center staff. These categories will provide one means of accessing the data in terms of broad groupings. The "major resources" section is intended to include major items of equipment and services available through the facility.

Facilities Data Presentation

A series of computer generated reports is used to make this collection of information available. Each listing is described below and an example of the output listings is given in Appendix D.

Detailed summary listing.--This summary contains all of the information in the file about each facility. It serves as the detailed reference for each of the other listings. The summary is printed in "type of facility" order.

Alphabetical listing.--This section includes a listing of the facility names in alphabetical order. A reference number is printed with each entry to permit reference to the detailed summary listing.

Major resources listing.--Each individual entry is listed and followed by the names of those facilities which have this particular resource. A reference number permitting reference to the detailed summary listing is printed with each facility name.

Descriptive brochures and other information collected during the data acquisition phase are filed and can be made available upon request.

The Information Sub-Center

The existence of the files which have been described is in itself of little value to the Sea Grant Program. The potential users of the information must be aware of its existence and the information must be readily available for use. One mechanism designed to assist in making this type of information available is the information sub-center.

Each sub-center contains a copy of each of the four computer generated indexes, a file containing all of the available microfiche, and one or more microfiche readers. To date three of these information sub-centers have been established. One of these centers is located in Galveston at the Texas A&M University Galveston Marine Lab, another is located in the joint library maintained by the

Oceanography and Meteorology Departments, and the third sub-center is located in the Sea Grant Program office. Individuals at each location have a knowledge of the files and how to use them and can provide routine file maintenance, as well as assistance in the use of the files.

A limited number of additional sub-centers of this type will be established in central locations where there is a demonstrated interest in the available services. Each of these sub-centers must obtain additional microfiche readers which can be made available on a loan basis if the microfiche file is to be utilized to any large extent.

The Information Distribution System

One major function of any large, diversified program is that of communication. The information distribution system of this center is intended to provide a convenient and effective procedure for maintaining and utilizing files of names and addresses which may be used as an aid to communication. Given files of this type, the center can provide mailing labels or listings by two methods: (1) according to groupings designated at the time names are entered into the file and (2) by use of the logical selection feature which utilizes predetermined categorization of individual names.

The utility of this type of a file is almost completely dependent upon the imagination of the user in his selection of individuals to be included and the acquisition of accurate and complete information.

Like any other file which contains information that is subject to change, the importance of file mainentance cannot be overemphasized.

Mailing Address Data Acquisition

The procedure for adding names and addresses to the file utilizes the keypunch form which is shown by Figure 12. This form has been designed for use in a standard IBM selectric typewriter, which has a horizontal spacing of twelve characters per inch and a vertical spacing of six lines per inch. The data recording process is illustrated by the item descriptions and sample name and address sets shown in Figure 12. It may be seen that an alpha code is assigned to each set and this code appears in the first five characters of each line. The four sample name and address sets illustrate the placement of the address lines and zip code on the form.

The alpha code for each name and address set is made up of the first three characters of the last name, followed by the first character of the first name and the middle initial. The purpose of this code is to provide a mechanism for the sorting of the name and address set into approximate alphabetical order. File maintenance is simplified with the card sets filed in order by this code and the major listings being available in the same order. Column 80 contains a card code which is utilized to validate the data cards.

A brief description of the coding and classification schemes will serve to illustrate the flexibility which is provided by this distribution system.

Mailing Address Keypunch Form

Date 2/5/70
Sheet 1 of 1

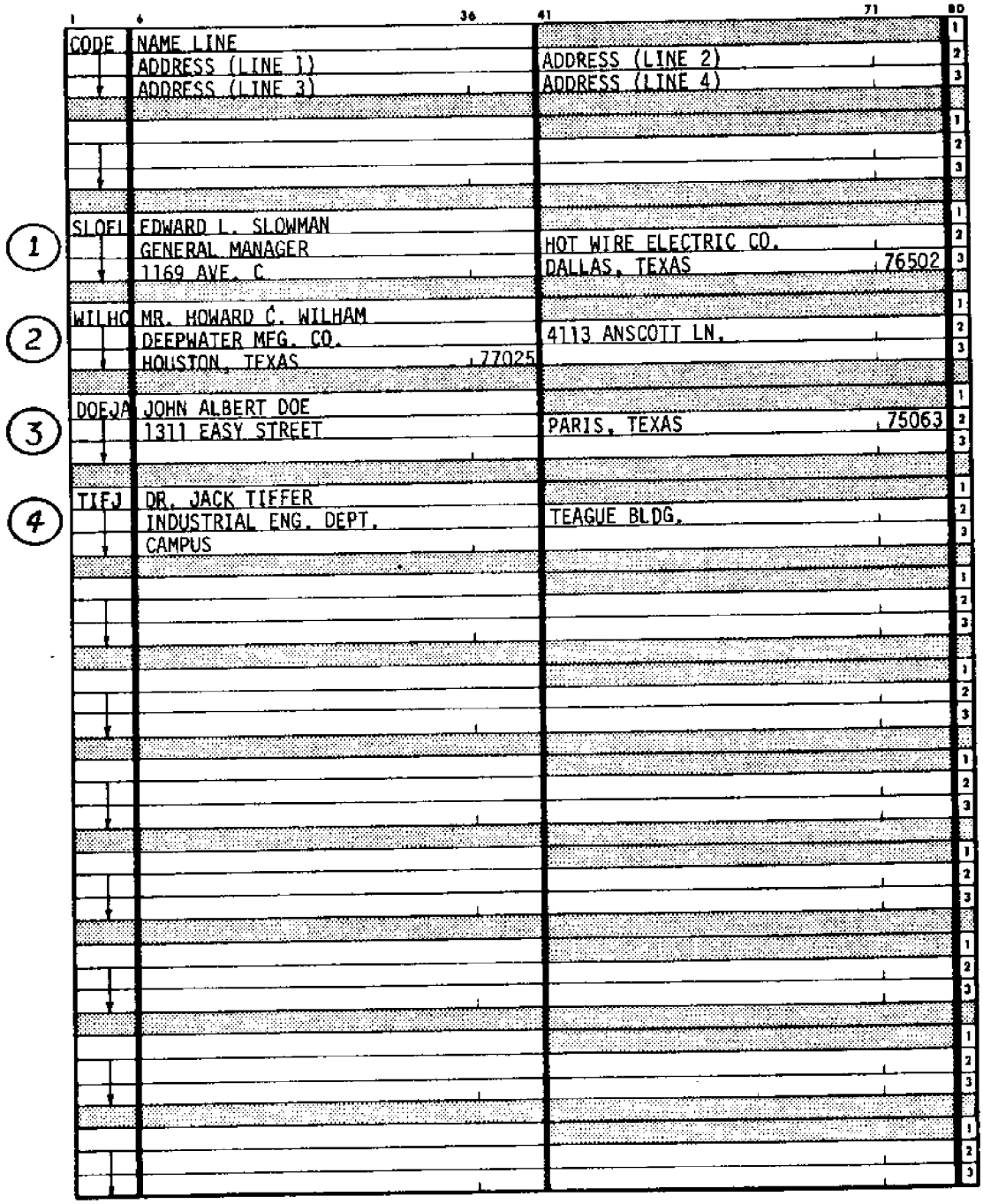


Fig. 12. Mailing Address Keypunch Form

Coding and simple selection.--Normal, routine usage of the file will involve the preparation of listings or mailing labels according to a predetermined list. Provision has been made for the establishment of a total of seventy-four different lists within one master file. Any name may appear on one or as many as seventy-four of these individual lists.

Once it has been determined that a new list is to be added to the file, the information center will assign a code for use in the establishment and maintenance of this list. Each name to be included in this particular list will be assigned this unique code. The user who requests the creation of such a list must then provide the name and address information on the mailing address keypunch forms as previously described. Subsequent requests for listings and/or labels for a particular code, result in the selection of all names associated with that code.

Typical uses of this portion of the system would be to provide a set of mailing labels for the distribution of the monthly newsletter or for periodic distribution of material to activity leaders who are associated with the program.

Classification and logical selection.--Provision has been made for the utilization of up to thirty-nine different classifications in categorizing the names which are maintained in the master file. A list of classifications has been established and is shown in Appendix E. This list contains three groups of categories: (1) class of employer, (2) nature of duties, and (3) area of marine resource

interest.

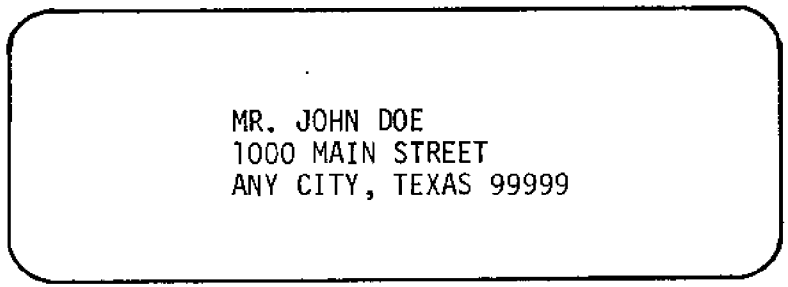
As individuals are added to the list, it is intended that the various classifications which are applicable be specified. The availability of such a list in which these various classifications have been specified will facilitate the selective contact of a large group of individuals with an interest in marine resource development. Selection by classification may be made on the basis of the logical operators "AND," "OR," and "NOT."

A typical request might be to select all "commercial/industrial" types who are involved in "marketing" and who have an interest in "fisheries--shrimp" and "sea food technology," but do not include those with an interest in "coastal recreation and sport fishing." The information center staff would then convert this narrative request into an algorithm which is acceptable to the computer program. The resulting output, in lists and/or label form would provide the names and addresses of all individuals meeting the selection criteria.

This selective capability could be used to distribute notices to individuals who may have an interest in attending a specialized workshop or conference. It would also be useful in the dissemination of research results and technical reports to selected individuals.

Information Distribution Output Formats

The output from this system consists either of a series of type "B" labels, a listing of names and addresses, or both, as shown by Figure 13. The labels produced by this system are 4" x 1-7/16" in



TYPE "B" LABEL

```
     LIST ID SPL-LST-LBL                                  010000000002 PG 41

ALPHA **              NAME              ****          DATE RUN - 012070        **
*   * ***             ADDRESS           ******            TYPE CODE            ***

SMIJE  DR. JOHN E. SMITH                  1000001000000101000000000000000000000000
       OCEANOGRAPHY DEPT                  1234567890123456789012345678901234567890
       TEXAS A&M UNIV.                    1001000000000000000000000000000000000000
       COLLEGE STATION, TEXAS          7784312345678901234567890123456789012345678900
                                          0000000000000000000000000000000000000000
                                          1234567890123456789012345678901234567890
SLOEL  EDWARD L. SLOWMAN                  0100001000000010000001000000000000000000
       GENERAL MANAGER                    1234567890123456789012345678901234567890
       HOT WIRE ELECTRIC CO.              1010001000000000000000000000000000000000
       1169 AVE. C                        1234567890123456789012345678901234567890
       GEORGETOWN, TEXAS               7650200000000000000000000000000000000000
                                          1234567890123456789012345678901234567890
```

NAME AND ADDRESS LISTING

Fig. 13. Label and List Output

size. The individual groups of labels are printed in zip code order to facilitate the sorting and bundling operation required by current postal regulations. The sample list entry, as shown on Figure 13, will serve to illustrate the listings which are produced by this system.

After the keypunching of names and addresses, a listing is produced. This listing is returned to the list initiator for verification of the data. As changes and modifications are made to the list, revised listings may be obtained upon request. The first three lines of the list form a heading and are used primarily for identification purposes. Line 1 contains the coded file request and the page number of the list, and line 2 contains the date on which the list was prepared.

Lines 4 through 9 represent the information maintained for a typical name and address set. The alpha code is printed to the left of the page, followed by the name and address entries. The right side of the page provides the list code and classification information for that individual.

The numbers printed on lines 5, 7 and 9 are provided solely for assistance in the identification of list and classification codes. The zeros and ones shown in lines 4, 6 and 8 indicate the possible and actual codes assigned to this name and address set. Line 4 contains thirty-nine positions which are used to represent the thirty-nine possible classification categories. The first entry shown in Figure 12 has a "1" in positions 1, 7, 14 and 16, of line 4 indicating

that this individual is employed in the educational field, his duties involve research and development, he has an interest in the shrimp fisheries, and he also has an interest in marine biology.

Lines 6 and 8 contain seventy-four positions which may be used for assignment of this individual to a maximum of seventy-four different lists. It may be noted that this individual is included in groups 1 and 4. This indicates that he is on the newsletter distribution list and is also a Sea Grant project leader, or at least receives the material distributed to this group.

These brief examples serve to illustrate some of the flexibility and utility associated with this distribution system.

Auxiliary Services

The auxiliary services function of the Marine Resources Information Center is an informally structured activity; however, it carries at least as much importance as any of the other systems previously described. It is within this portion of the program that activities involving user interface, technical assistance, new system developments, and limited user education will be conducted. It is these areas which will cause the center to develop into a dynamic, useful tool for the marine resources program.

The user interface function involves direct contact with the user whereby assistance is given in the use of the local or some external information service. This may involve acquiring specified information for the user or advising the user of a possible source

where the desired information may be obtained. Due to the possible nature of the requests, it is not anticipated that this center would provide any financial assistance in the use of outside services. The atmosphere, however, should be that of a clearinghouse wherein the user could seek and expect to obtain assistance in the pursuit of information in the area of marine resource development.

The technical assistance function is envisioned as being one in which the staff of the center will provide advice and limited assistance in the areas of computer and information science. It should be clear that the actual assistance must be limited because of budget restrictions; however, this is not to say that such assistance would be without value.

The new system development function will provide an avenue whereby the services of the information center can be expected to grow and change as the marine resources program develops. Routine user contact, coupled with an awareness of continuing developments in the field of information science, should provide an agressive staff with the direction for continued development of information services.

A limited amount of continuous user education is desirable. This education could take place in the form of informative articles in the newsletter distributed by the Sea Grant Program, periodic technical presentations at meetings sponsored by the Sea Grant Program or related groups, and individual consultation with participants in the program in order to explain the types of services which are available.

The potential benefits which can be obtained by the conduct of these four activities serve to illustrate the significance of the auxiliary serivces function within the overall information center.

CHAPTER VI

A FRAMEWORK FOR SYSTEMS EVALUATION

The specialized information center described by this study must be evaluated by an analysis which includes three major factors. These are: (1) cost considerations, (2) systems performance, and (3) value considerations. It is impossible to conduct a valid evaluation of this system based solely on objective findings.

The technical feasibility of the computer and microform technology is a demonstrated fact. The economic feasibility must be based, for a large part, on the value of information. What is information worth? In most cases, the value of information has never been adequately quantified and its value remains an intangible item. Thus there is no established methodology which will provide an overall evaluation of the services proposed.

Cost Considerations

The costs associated with such an information center vary considerably with the type and volume of services performed. These costs may be discussed in terms of manpower, supplies, and equipment.

Minimum manpower requirements involve the employment of a systems analyst and a clerk-typist. An analyst with a knowledge of microfilm and computer techniques is needed to maintain existing services and initiate new developments. Additional clerical help will be required

as the volume of data cataloged and filmed on a local basis increases.

Supply costs will vary considerably with the volume of processing. Table 1 presents a summary of microfiche supply costs.

TABLE 1

MICROFICHE SUPPLY COSTS

Description	Cost
Film - 100 feet of 16mm film (includes processing and developing)	$5.00
Jacket - 4" x 6" mylar jacket	$ .07
Microfiche - 4" x 6" diazo film	$ .05
Film - 5 - 6" strips of 16mm film	$ .12
Jacket	.07
Microfiche master	$ .19
Microfiche master	$ .19
Copies (4 @ $.05)	.20
Microfiche master and 4 copies for distribution to sub-centers	$ .39

Preparation of a microfiche master with up to sixty pages of information costs approximately $.19 if labor costs are not included. Once the master is available, it may be seen that this same document can be distributed for about $.05 per copy. One Xerox copy of this document would cost approximately $3.00. These costs are in line with those of the Clearinghouse which normally charges $.65 for microfiche copies and $3.00 for Xerox-type copies. Under this arrangement no consideration is given to the actual number of pages involved.

Equipment costs, with the exception of maintenance and lease considerations, are one-time expenses. Although costs may vary considerably with quality of equipment, the figures shown in Table 2 should provide a guide to costs which would be considered reasonable.

TABLE 2

MICROFICHE EQUIPMENT COSTS

Description	Cost
Reader (desk top)	$ 360
Reader (portable)	165
Reader-Printer (copies - $.10 each)	280
Reader-Printer (copies - $.05 each)	1,600
Reader-Filler	1,400
Printer-Processor	3,600
Planetary Camera (16mm)	950

The items shown represent equipment which is of high quality. Desk top readers vary in cost from $50 to $500. The one indicated at a price of $360 has the image rotation feature and provides a good, readable image. Portable readers vary in price from $3 to over $200. The reader shown at a price of $165 is housed in a sturdy carrying case and can be converted to a projector.

The reader-printer, reader-filler, and printer-processor items are rather expensive and are produced by only a few companies. The prices shown are typical for quality equipment. The planetary camera listed is versatile and should produce quality prints of material

which does not exceed 9-1/4" x 12" in size. Specialized cameras, such as the rotary type at about $5,000 and the indexing type at about $25,000, do not seem suitable for the volume and type of material to be photographed.

A minimal set of equipment for a center which is actively filming material, preparing master jackets, and duplicating microfiche, would include a desk top reader, a reader-printer (costing $1,600), a reader-filler, a reader-processor, and a planetary camera. The total cost of this equipment would amount to approximately $7,910.

Each user sub-center should have at least one desk top reader and two portable readers which could be available to users on a check-out basis. In most cases it would be advisable to also include the inexpensive reader-printer in order to provide a limited hardcopy capability. This would amount to a total cost of about $970 for each user sub-center.

Computer charges are based on hourly rates and vary considerably, depending on the type of machine which is used. It is estimated that the charges for computer time will vary from $2,000 to $5,000 per year.

The figures given should provide a guide which could be used to estimate the probable cost of an information center under a given set of conditions.

Since the final justification of such a center must be based, to a large extent, on the value or benefit received from the expenditure of operating funds, several assumptions should be made to set the

stage for such an evaluation.

1. Assume that the center has been in full operation for one year, with no extensive system development responsibilities.
2. Assume that the files are reasonably well developed and that the overall data base is at least representative of the regional marine resource information.
3. Assume that microfiche equipment has been made available and no funds are to be expended on capital equipment.

Based on these assumptions, a reasonable gross estimate of the annual operating budget would be:

Salaries (systems analyst and clerk-typist)	$17,000
Fringe benefits and indirect costs	8,500
Supplies and other expenses	9,500
Total	$35,000

At this level of funding the following assumptions have been made concerning a reasonable level of activity for the various systems.

1. Microfiche Technical Information System--Annual entries--3600
2. Expertise Information System--Annual entries--2000
3. Activities Information System--Annual entries--1200
4. Facilities Information System--Annual entries--600
5. Number of Sub-Centers--5

   (Actual number would have little effect on the cost of operation.)
6. Information Distribution System--Annual entries--5000

A breakdown of estimated costs corresponding to these levels of

activity is shown below:

1.	Microfiche Technical Information System	$16,000
2.	Expertise Information System	4,000
3.	Activities Information System	4,000
4.	Facilities Information System	4,000
5.	Information Distribution System	5,000
6.	Auxiliary Services	2,000

A graphical representation of investment versus level of activity is shown by Figure 14. These costs allow the calculation of unit entry costs for a given level of activity as well as expected activity level per level of investment. The estimates are based on operating experience to date and can be revised at a later date to more accurately reflect costs.

An analysis of these estimates provides some insight into the costs associated with acquiring and maintaining one unit of information. Using the reasonable activity level shown as a basis for calculations, the total costs per entry are as follows:

1.	Microfiche entry	$4.44
2.	Expertise entry	2.00
3.	Activities entry	3.33
4.	Facilities entry	3.33
5.	Distribution entry	1.00

It should be noted that approximately one-fourth of the microfiche entries are estimated to be filmed locally and the balance would be received in microfiche form. Computer charges are included in the

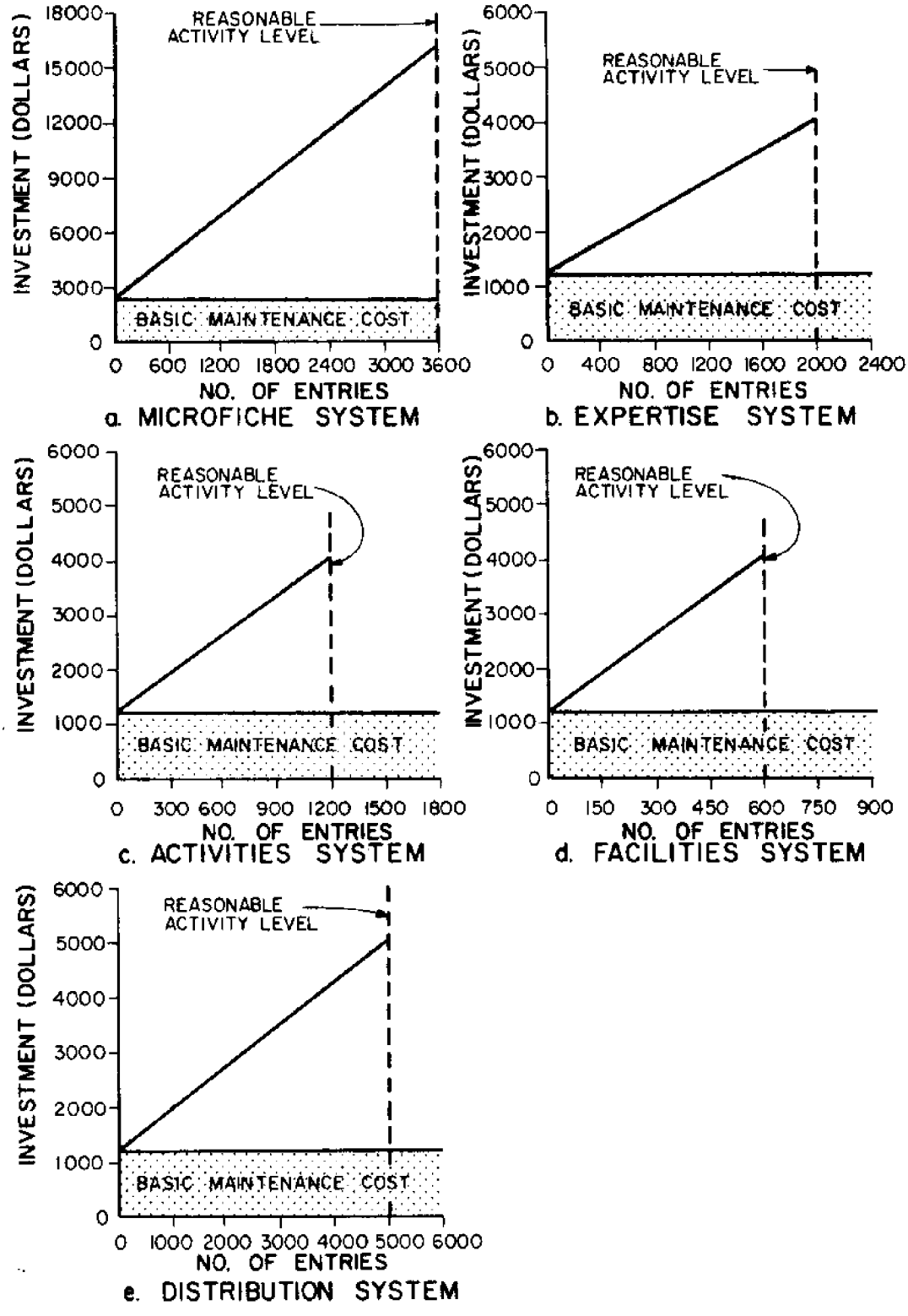


Fig. 14. Investment/Activity Level Estimates

distribution system but the cost of the labels would be passed on to the user.

Systems Performance

Many studies have been conducted in the last few years concerning the performance of selective dissemination of information and retrospective search systems. The most common method of performance measurement for these systems seems to involve a calculation of recall and precision. These measurements are possible since there is a formal query and subsequent response which may be analyzed.

The system described by this study primarily involves a direct use of the available services through the information sub-center. This type of use precludes any methodical analysis of user query and system response.

The most significant factors affecting system performance are: (1) quality of available information, (2) level of information coverage, and (3) relevance of available information. Information of this type can be obtained by use of a periodic user questionnaire. Results of such a questionnaire could be used as a basis for performance evaluation and subsequent modifications to available information services.

Value Considerations

As previously mentioned, it is difficult to establish an exact measure of the value of information. Since information is the product

of this specialized center, some approximate measure of the output must be available to properly evaluate the worth of the services.

Max Mueller [17] has reported on one study of significance in this area. His study dealt with value factors associated with the retrieval of information from a technical library service. An estimate of the value of an information retrieval was established by this study in two ways. It was determined that as an alternative to the use of the technical library, an individual would be involved in consultation with some other person for one hour. This resulted in an expense or cost of two man-hours for the equivalent of one retrieval.

The second phase of the study involved a survey in which random documents were returned to the last user, who was questioned about the time saved by this use. An analysis of the data obtained indicated that an average user saved an estimated 1.2 man-hours with a probable error of .3 man-hours.

Based on these figures one could assume that the average user of the Marine Resources Information Center might save 1 man-hour each time he used the center. The resulting value of this use would amount to about $14. The cost/value estimates shown by Table 3 indicate that a total of 10 users per day or 2 users per sub-center would be required to justify an annual expenditure of $35,000.

While these figures are based on a value which was obtained under different conditions, they should provide an estimate of cost/value factors associated with the center. A user survey conducted after one

year of operation would provide information which would greatly improve the accuracy of this type of an evaluation.

TABLE 3

COST/VALUE ESTIMATES

Value per use--one man-hour	$14
Annual operating expenses	$35,000
Break even point--users per year	2,500
Available days per year	250
Break even point--users per day	10
Number of sub-centers available	5
Break even point--users per day per sub-center	2

Funding Considerations

Information centers, as a general rule, must be put in the same class as libraries when considering a source of financial support. While the library is an essential part of the academic, research, and extension functions, it is not a self-supporting activity. If the existence of the library was totally dependent on direct charges, it is doubtful that many would survive. It is difficult for the library user to think of information in terms of money. Since there is little reason to believe that this specialized information center can maintain financial independence on direct charges, it must receive support from some outside agency.

At what level should such an activity be funded and how should the budget estimates be made? Wilson and Tauber [34] indicate that

within the framework of the university library, annual budgets could be developed by considering past expenditures, by evaluating the work program, and by use of arbitrary standards.

State supported institutions in Texas receive library funds based on a formula developed by the state College and University Co-ordinating Board. This formula considers the number of credit hours in the undergraduate, masters, and doctoral level courses. A general rule of thumb used by some librarians regarding the level of funding specifies that the budget should be at least 5 percent of the operating budget of the university.

Thus no discrete figures are available for determining an exact amount or level of funding. Those who manage the marine resources program must decide subjectively if the services are needed and, if so, the level of expenditures which can be justified to provide these services.

CHAPTER VII

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This study has presented the design of a specialized information center for the marine resources program. This center is unlike others since it considers all areas of available information resources. In addition to coverage of technical information, it has systems for the processing of expertise, activities, and facilities information. Provision has been made to develop and extend normal communication channels by use of the distribution system.

The value of the system will be realized by managers, planners, beneficiaries of the marine program, and the general public, as well as by research and academic communities. The center is flexible and can develop new extension information services as the Sea Grant Program places more emphasis in this area.

Initial efforts in the collection of data have been primarily limited to the campus of Texas A&M University. Plans include an expansion of data collection activities to include the state of Texas and later the geographical region adjacent to the Texas Gulf Coast.

All of the proposed information systems have been developed. Computer and microform technologies have been utilized where practical. Procedures have been developed for the acquisition, processing, and presentation of the various types of resource information.

A framework for evaluation of the various systems has been

presented. Estimates of reasonable operating levels and operating costs have been made to assist in an evaluation of current services.

Conclusions

A model for a multifaceted information center has been proposed. This model is suitable for use in any large interdisciplinary program. It could be useful in accelerating developments in areas such as pollution, criminal justice and urban problems. Formal information activities are essential to provide a mechanism which will permit the collection and announcement of that body of information associated with any large undertaking of this type.

The Marine Resources Information Center can play an important role in accelerating the development of research, extension, and academic activities. The center can provide assistance in the transfer of research findings to the commercial and industrial communities which utilize these new developments. It can also assist in the communication of program activities and developments to the general public, which must support such an interdisciplinary program if it is to be successful.

The future growth, development, and continued existence of such a facility depends on its ability to provide a useful and valuable service to the user. Such a center must be flexible and have the ability to grow, while meeting the changing needs of the various users.

Recommendations

Several areas which seem to have merit and should be considered for future development are discussed below. The recommendations should increase the value and availability of information services in the marine resources community.

Data Base Expansion

It is recommended that first priority be given to the expansion of the various data files. Systems and procedures have been developed to handle a variety of data. It must be recognized that a specialized information center, as described, will be of limited value unless the scope and depth of coverage is significant. Every effort must be made to collect data regarding expertise, activities, and facilities on a regional basis.

User Sub-Center Development

It is recommended that the number of user sub-centers, consisting of microfiche equipment and the basic data files, be expanded as rapidly as possible. One major value of the system results from the user having ready access to all available information. The most convenient vehicle for this access is the user sub-center and its various files.

Advisory Committee

It is recommended that an advisory committee be established to

provide guidance in the operation and development of information services. Such a committee could serve several purposes, including those of providing an increased awareness of available services within the user community and providing feedback regarding user acceptance of the services. This committee should be as small as possible but large enough to represent the diverse user population.

Extension Activities

It is recommended that close contact be maintained with those individuals involved in extension and advisory activities. Every effort should be made to develop services which will assist this section of the program.

Thesaurus Development

It is recommended that a marine resources thesaurus be developed at an early date. Such a thesaurus will provide a valuable tool which is essential for adequate indexing and retrieval of marine resources information.

National Marine Resources Information Center

It is recommended that a national marine resources information center be established. Such a center could be patterned after the Water Resources Scientific Information Center (WRSIC) which was established by the Secretary of the Interior in January of 1966. WRSIC has been designated as the first of a series of natural

resources information centers. With the current emphasis which is being placed on marine resources, it would be appropriate to establish a marine resources information center as the second center of this type. The objectives of such a center could be similar to those of WRSIC and could be: (1) to serve as a focal point for marine resource information activities, (2) to initiate efforts to coordinate and complement existing information services, (3) to provide for the central operation of such marine resource information services as can best be accomplished at the national level, and (4) to insure the rapid flow of technical information to interested individuals and agencies.

Such a center could establish "centers of competence" to serve as input channels for information in specific areas. This center could provide a central facility which would serve as a collection and distribution agency for marine oriented information. Regional centers, such as the one described in this paper, could serve as the local interface and complement, as well as be complemented by, the existence of a national center.

Several information activities can best be handled at the national level. There have been requests for a marine oriented abstract journal. This type of publication could be developed with a national base of information and users. Microfiche distribution could be made by such a central facility. With the help of regional specialized information centers, expertise, activities, and facilities information could be collected and distributed on a national basis.

The potential for a national information center is great. The technology is available, and it is hoped that the need and value will be recognized at an early date.

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APPENDIX A

THE MICROFICHE TECHNICAL INFORMATION SYSTEM

DESCRIPTIVE MATERIAL

INSTRUCTIONS FOR USE OF THE

MICROFICHE PRODUCTION ORDER

The Microfiche Production Order form is designed to provide a mechanism for the submission of materials for inclusion in the microfiche data base. The procedures associated with this form will assure that material submitted will be filmed, processed, filed and disposed of as requested. The three sections and their use are described below. A sample copy of the form is attached.

SECTION I - This section is to be completed by the person submitting material for inclusion in the Marine Resources Information Center's microfiche data base. This form must be attached to each item submitted. The name, address and phone number is needed in case there is some question about the material. The description will provide an estimate of the work and number of microfiche involved. If it is requested that the material be returned after processing, it will be sent to the address indicated. The comments field may be used to further identify the material, to indicate certain pages that are to be filmed or make other comments about the material.

SECTION II - TO BE COMPLETED BY THE INFORMATION CENTER STAFF. The information in this section is used by the typist in the preparation of the microfiche jacket. The six digit number following the 'SG' is obtained by using the next sequential number on the MASTER INDEX RECORD. The title indicated should be an abbreviated title which must not exceed 52 characters. The number of pages to be filmed is noted from Section I and indicates to the typist how many jackets will be typed for this material.

SECTION III - TO BE COMPLETED BY THE INFORMATION CENTER STAFF. This section provides a check-list to insure that all operations are completed.

MARINE RESOURCES INFORMATION CENTER

MICROFICHE PRODUCTION ORDER

SECTION I

Material Submitted By:

Name: _____ Date _____

Address: _____ Phone _____

Description: _____ pages Disposition: O Return O Destroy

Comments: _____

_____

SECTION II

Title for Microfiche Jacket Number of Fiche Required _____

SG _ _ _ _ _ _ / _____

_____ __ of __

(Title - 52 Char. Max)

Comments: _____

_____

SECTION III

___ Select Camera: ___ Rotary ___ Planetary

___ Determine number of fiche required

___ Fiche Jackets Prepared

___ Photograph Reel ___ End Footage ___

___ Insert film in Jackets

___ Complete Keypunch Forms

___ Make two Duplicates of Jacket

___ File Jacket in Jacket File

___ File Duplicate in Master File

___ Return Duplicate to Originator

___ File Order in Order File

___ Date Order Completed

___ Distribute Fiche Copies as Required

___ Dispose of Original as Instructed

INSTRUCTIONS FOR USE OF THE

MASTER INDEX RECORD

The Master Index Record is maintained as a log of all material which is filmed as a part of the Marine Resources Information Center data base. This record is maintained by the individual who operates the microfilm camera. A discussion of the contents of this form is given below and a copy of the form is attached.

Item	Description
Date	The date on which the material was filmed.
Reference	The reference number is separated into three parts: 1) 'SG' a designation that the material is filmed by the local center; 2) '69' - a two digit number indicating the year in which the material was filmed; 3) 'nnnn' - a four digit accession number which is assigned serially.
Roll Number	The number of the roll of film used for this material. (Note: The rolls of film are numbered to facilitate recovery in the event that a roll of film is lost during processing.)
Index Point	The beginning and ending footage on the roll for the material filmed. (Note: This reading is obtained from an indicator on the microfilm camera.)
By	The initials of the individual who operated the camera.
Remarks	This field is used to list a title or identifying information which describes the material filmed.

These record forms are maintained in a log book for future reference and are not to be discarded.

THE
MARINE RESOURCES
INFORMATION CENTER
TEXAS A&M UNIVERSITY
MASTER INDEX RECORD

SECTION ____
PAGE ____

DATE	REFERENCE	ROLL NUMBER	INDEX POINT	BY	REMARKS

INSTRUCTIONS FOR USE OF THE

MICROFICHE DATA KEYPUNCH FORM

The following explanation of the attached sample coding form is intended to provide information which will permit the cataloging of material for inclusion in the microfiche data base. The coding form to be used is free format within certain limitations, although the sequence of the various types of information is fixed as indicated.

Item	Description

Type 0 — Type of Reference - The type of reference should be selected from the following list. In those cases where the term "other" must be used it should be followed by an underscore and some descriptive term (i.e. - Other - Book).

List of Types of References:

Paper	Thesis
Periodical	Journal Article
Proposal	Computer Output
Report	Other-(Specify)
Dissertation	

Type 1 — Author(s) - List the author(s) name as follows: last name, first name (or initials), middle initial, etc.

Type 2 — Title - Complete title, as it appears in the material.

Type 3 — Descriptive Material - Source, volume, date, etc.

Type 4 — Descriptors - Terms which would be of value in indicating the content of the material.

Type 5 — Abstract - To be included only if provided as a part of the material.

Accession Numbers and Other Coding Information

The identification number is a 12 digit alphanumeric field which is used to identify a unique entry into the microfiche data base. This number is followed by a 3 digit sequence and type code. The 15 digit field is broken into 8 subfields as follows:

Subfields	1 XX	2 XX	3 XXXX	4 X	5 XX	6 X	7 XX	8 X
Example 1	SG	69	0215	P	06	1	01	1
Example 2	SG	70	0136	S	03	2	04	5

Field 1 - This 2 character field is used to identify that material which was filmed locally and added to the Sea Grant microfiche file. This field will normally contain the letters 'SG'.

Field 2 - This 2 digit field is used to specify the year in which the material was entered into the microfiche file.

Field 3 - This 4 digit field is used to assign a unique sequential number to the material as it is prepared for inclusion in the file. Each year this number will be initialized to 0100. As material is added the number will be sequentially increased to a maximum of 9999.

Field 4 - This 1 character field will contain a 'P' or 'S' depending on whether the material is a primary or secondary source.
P - Primary material indicates that the material contains subtitles or articles which are also to be cataloged.
or That the material "stands alone" and is not part of a larger collection.
S - Secondary material indicates that the material is part of a larger collection.

Field 5 - This 2 character field is used to indicate either the total number of fiche used for the material (in the case of a primary source) or the number of the fiche on which the article begins within the primary source (in the case of a secondary source). (For primary and secondary source see Field 4).

Field 6 - Determines the location of the material on the microfiche.

Field 7 - This 2 digit field is a sequence number within record type (Field 7). This sequence must begin with 01 within each record type, and be numbered sequentially with no gaps.

Field 8 - This 1 digit field is used to indicate record type. Field types have been predetermined and vary from 0 through 9.

CONSTRAINTS INVOLVED IN CODING

The material specified by the six types of records indicated below is to be entered--free form--into columns 1-60 of the coding sheet.

Type	Description
0	Type of Reference
1	Author
2	Title
3	Descriptive Material
4	Descriptors
5	Abstract

The twelve digit accession number containing eight fields as previously described is to be entered into columns 61-75 as shown below:

Columns	Field	Description
61-62	1	Contains fiche source code
63-64	2	Indicates year in which material was filmed.
65-68	3	Contains unique sequence number.
69	4	Contains an indication of a primary ('P') source or a secondary ('S') source.
70-71	5	For a 'primary' source this indicates the number of fiche required for the material; for a 'secondary' source this indicates the fiche number within the primary source on which this information begins.
72	6	Location of the material on the microfiche.
73-74	7	Contains a sequence number for the record type (i.e. to indicate more than one card per type).
75	8	Contains the record type.

An example of a coded data sheet is attached.

MARINE RESOURCES INFORMATION CENTER

Microfiche Data Keypunch Form

Sheet 1 of 1

1	60 61 75
THESIS	SG690162P010010
GREENE, LEON J.	11
OPTIMUM PRODUCTION-INVESTMENT CONTROLS FOR THE	12
REPRESENTATIVE SHRIMP PRODUCTION FIRM	22
GRADUATE COLLEGE OF TEXAS A&M UNIV.	13
COLLEGE STATION, TEXAS, AUGUST 1969	23
REPORT	AD685275P040010
REID, ROBERT O.	11
DYNAMICS OF DEEP-SEA MOORING LINES	12
TEXAS A&M UNIV., COLLEGE STATION, TEXAS, OCEANOGRAPHY DEPT.	13
JULY 68 PROJECT SR-009-01-01 CONTRACT NONR 2119 (02)	23
PERIODICAL	SG690329P010010
NOT RECORDED	11
OCEAN INDUSTRY VOLUME 3, NO. 6, June 1968,	12
GULF PUBLISHING CO., P. O. BOX 2068, HOUSTON, TEXAS 77001	13
JOURNAL ARTICLE	SG690329S011010
WEEKS, LOUIS G.	11
THE GAS, OIL AND SULPHUR POTENTIALS OF THE SEA	12
OCEAN INDUSTRY VOLUME 3, NO. 6, JUNE 1968, P. 43	13
JOURNAL ARTICLE	SG690329S012010
BULLIS, JR., H. R.; THOMPSON, J. R.	11
FOOD-POTENTIAL OF THE SEA	12
OCEAN INDUSTRY VOLUME 3, NO. 6, JUNE 1968, P. 52	13

Completed Microfiche Data Keypunch Form

AD687183P010 REPORT
KNOTT, S. T. NOWAK, R. T.
A CONTINUOUS CONFIGURATION HYDROPHONE ARRAY FOR BROADBAND CONTINUOUS SEISMIC PROFILING
WOODS HOLE OCEANOGRAPHIC INSTITUTION MASS
APR 1969 PROJ NR-260-101 CONTRACT NONR 4029(00)

AD687305P010 REPORT
SEMENKO, V. E. NICHIPOROVICH, A. A.
APPARATUS FOR THE STUDY OF ALGAE
GENERAL DYNAMICS/ASTRONAUTICS SAN DIEGO, CALIFORNIA
APR. 1962

AD687403P010 REPORT
DALEY, JOHN C. RANSOME, JOHN T., JR. BURKETT, JOSEPH A.
UPWIND-DOWNWIND-CROSSWIND SEA-CLUTTER MEASUREMENTS
NAVAL RESEARCH LAB WASHINGTON D C
APR 1969 PROJ A31533-652-6

APPENDIX B

THE EXPERTISE INFORMATION SYSTEM

DESCRIPTIVE MATERIAL

MARINE RESOURCES INFORMATION CENTER
OFFICE OF THE SEA GRANT PROGRAM
PERSONNEL LISTING

DATE 01/30/70

REFERENCE CODE= P-69-WALDE01 WALDE01

ORGANIZATION= TEXAS A&M UNIVERSITY SPECIALY = 09 01 00

NAME= MR. DONALD E. WALSH

ADDRESS= SEA GRANT PROGRAM OFFICE
TEXAS A&M UNIVERSITY
COLLEGE STATION, TEXAS 77843
PHONE 713-845-3854

EXPERTISE= UNIVERSITY ADMINISTRATION
SCIENCE EDUCATION
OCEANOGRAPHY

EDUCATION= B.S. PHYSICS
M.S. OCEANOGRAPHY
PH.D. EDUCATION ADMINISTRATION (IN PROGRESS)

WORK EXPERIENCE= TEACHING 2 YRS.
PURCHASING 2 YRS.
R&D ADMINISTRATION 1 YR.
CURRENT - SEA GRANT PROGRAM ASSOCIATE
MARINE ACTIVITY - SEA GRANT PROGRAM MANAGEMENT

MARINE RESOURCES INFORMATION CENTER
OFFICE OF THE SEA GRANT PROGRAM
ALPHABETICAL LISTING

DATE 01/30/70

PAGE 1

P-69-ADABJ01	MR. B. J. ADAMS
P-69-ADAJW01	MR. JOHN W. ADAMS
P-69-ADKPL01	DR. P. L. ADKISSON
P-69-ALDDV01	DR. DAVID V. ALDRICH
P-69-ALWCW01	DR. C. W. ALWORTH
P-69-ATKRL01	DR. ROBERT L. ATKINSON
P-69-BASDR01	DR. DAVID REED BASCO
P-69-BELRR01	DR. R. R. BELL
P-69-BENED01	DR. EARL D. BENNETT
P-69-BENFJ01	MR. FRED J. BENSON
P-69-BERRJ01	DR. R. J. BERRY
P-69-BILR 01	DR. RAY BILLINGSLEY
P-69-BLAWE01	DR. WILLIAM E. BLACK
P-69-BOOJR01	DR. JAMES R. BOONE
P-69-BOTNR01	DR. NESTOR R. BOTTINO
P-69-BOUAH01	DR. ARNOLD H. BOUMA
P-69-BOWEV01	DR. ELBERT V. BOWDEN
P-69-BOYCC01	MR. CALVIN C. BOYKIN
P-69-BOYR 01	MRS. ROSEMARY BOYKIN
P-69-BRAJR01	MR. JAMES R. BRADLEY
P-69-BRELH01	DR. L. H. BREUER

MARINE RESOURCES INFORMATION CENTER
OFFICE OF THE SEA GRANT PROGRAM
DEPARTMENT LISTING

DATE 01/30/70

PAGE 1

AEROSPACE ENGINEERING

RAOBM01	DR. BALUSU M. RAO
RODCA01	DR. CHARLES A RODENBERGER

AGRICULTURAL ECONOMICS & SOCIO.

ADAJW01	MR. JOHN W. ADAMS
BILR 01	DR. RAY BILLINGSLEY
BLAWE01	DR. WILLIAM E. BLACK
BOYCC01	MR. CALVIN C. BOYKIN
DAVDR01	MR. DAN R. DAVIS
HARJB01	DR. JOE B. HARRIS
LARCF01	DR. CURTIS F. LARD
MCLEL01	DR. EDWARD L. MCLEAN
TROWL01	DR. WARREN L. TROCK
WOOAB01	DR. ALVIN B. WOOTEN

ACCOUNTING

BENED01	DR. EARL D. BENNETT
DANTE01	DR. TROY E. DANIEL
POILG01	DR. LARRY G. POINTER

MARINE RESOURCES INFORMATION CENTER
OFFICE OF THE SEA GRANT PROGRAM
SPECIALTY LISTING

DATE '01/30/70

MARINE BIOLOGY & FISHERIES

MACJG01	DR. JOHN G. MACKIN
MCCS 01	DR. STEWART MCCONNELL
MCLDD01	DR. DONALD D. MCLAIN
PARJC01	MR. JACK C. PARKER
RAYSM01	DR. SAMMY M. RAY
REZR 01	DR. RICHARD REZAK
ROLH 01	DR. HERBERT ROLLER
SANDP01	DR. DARRYL P. SANDERS
SMIJD01	DR. JAMES D. SMITH
STARJ01	DR. ROBERT J. STANTON JR.
TEEJG01	DR. JAMES G. TEER
TOLRW01	DR. R. W. TOLER
VANC 01	DR. CARL VANDERZANT

MINERAL EXPLORATION & RECOVERY

BOUAH01	DR. ARNOLD H. BOUMA
DAVDK01	DR. DAVID K. DAVIES
DIXJB01	DR. J. B. DIXON
DOWEJ01	DR. E. J. DOWDY

MARINE RESOURCES INFORMATION CENTER
OFFICE OF THE SEA GRANT PROGRAM
OCCUPATION LISTING

DATE 01/30/70

RESEARCH

GUSLF01	DR. LAWRENCE F. GUSEMAN, JR.
HADCR01	DR. C. R. HADEN
HANRW01	DR. ROY W. HANN JR.
HARH001	DR. H. O. HARTLEY
HARHW01	DR. HAROLD W. HARRY
HARJB01	DR. JOE B. HARRIS
HENJK01	MR. JAMES K. HENNIGAN
HENWK01	MR. WALTER K. HENRY
HOCRR01	DR. RONALD R. HOCKING
HOLCD01	DR. C. D. HOLLAND
HOPSH01	DR. SEWELL H. HOPKINS
HORK 01	DR. KALMAN HORVATH
HOSLR01	DR. L. R. HOSSNER
HOWJR01	DR. J. R. HOWES
HURJT01	DR. JOHN TOM HURT
ICHT 01	DR. TAKASHI ICHIYE
IRBHD01	DR. HAROLD D. IRBY
IRGKJ01	DR. KURT J. IRGOLIC
IRVRL01	DR. ROBERT L. IRVINE

APPENDIX C

THE ACTIVITIES INFORMATION SYSTEM

DESCRIPTIVE MATERIAL

MARINE RESOURCES INFORMATION CENTER
OFFICE OF THE SEA GRANT PROGRAM
SPONSOR SUMMARY LISTING

DATE 04/09/70

CODE	DESCRIPTION
ACSXX1	AMERICAN CHEMICAL SOCIETY
BCFFA1	BUREAU OF COMMERCIAL FISHERIES - FEDERAL AID OFFICE
BCFFW1	BUREAU OF COMMERCIAL FISHERIES - FISH AND WILDLIFE SERVICE
DODAR1	DEPARTMENT OF DEFENSE - ARMY HQ.
GCRLX1	GULF COAST RESEARCH LABORATORY
GSWRD1	GEOLOGICAL SURVEY - WATER RESOURCES DIVISION
NSFES1	NATIONAL SCIENCE FOUNDATION - DIV. OF ENVIRONMENTAL SCIENCES
NSFSG1	NATIONAL SCIENCE FOUNDATION - OFFICE OF SEA GRANT ACTIVITIES
OWRRX1	OFFICE OF WATER RESOURCES RESEARCH
OSWXX1	OFFICE OF SALINE WATER
SSXIX1	SOCIETY OF THE SIGMA XI
UOFTA1	UNIVERSITY OF TEXAS - AUSTIN

THE TOTAL NUMBER OF SOURCES OF SUPPORT LISTED WAS 11

MARINE RESOURCES INFORMATION CENTER
OFFICE OF THE SEA GRANT PROGRAM
RECIPIENT SUMMARY LISTING

DATE 04/09/70

CODE	DESCRIPTION
TAMU	TEXAS A&M UNIVERSITY - SEA GRANT PROGRAM
TAMX	TEXAS A&M UNIVERSITY
TSPW	TEXAS STATE PARKS & WILDLIFE - AUSTIN
TSWD	TEXAS STATE WATER DEVELOPMENT BOARD - AUSTIN
UCSB	UNIVERSITY OF CALIFORNIA - SANTA BARBARA - SEA GRANT PROJECT
UCSD	UNIVERSITY OF CALIFORNIA - SAN DIEGO
UOAX	UNIVERSITY OF ALASKA - SEA GRANT PROJECT
UODD	UNIVERSITY OF DELAWARE - SEA GRANT PROJECT
UOHH	UNIVERSITY OF HAWAII - SEA GRANT PROGRAM
UOMA	UNIVERSITY OF MAINE
UOMC	UNIVERSITY OF MARLYAND - SEA GRANT PROJECT
UOMF	UNIVERSITY OF MIAMI - SEA GRANT PROGRAM
UOMM	UNIVERSITY OF MICHIGAN - SEA GRANT PROGRAM
UONC	UNIVERSITY OF NORTH CAROLINA - SEA GRANT PROJECT
UONH	UNIVERSITY OF NEW HAMPSHIRE - SEA GRANT PROJECT
UORI	UNIVERSITY OF RHODE ISLAND - SEA GRANT PROGRAM
UORX	UNIVERSITY OF ROCHESTER - SEA GRANT PROJECT
UOTE	UNIVERSITY OF TEXAS - AUSTIN
UOWA	UNIVERSITY OF WASHINGTON - SEA GRANT PROGRAM
UOWW	UNIVERSITY OF WISCONSIN - SEA GRANT PROGRAM
VIMS	VIRGINIA INSTITUTE OF MARINE SCIENCE - SEA GRANT PROJECT
WTIW	WASHINGTON TECHNICAL INSTITUTE - SEA GRANT PROJECT

THE TOTAL NUMBER OF RECIPIENT AGENCIES LISTED WAS 57

MARINE RESOURCES INFORMATION CENTER
OFFICE OF THE SEA GRANT PROGRAM
ACTIVITIES CLASSIFICATION SUMMARY DATE 04/09/70

PAGE 1

CODE	DESCRIPTION
100	I. EDUCATION AND TRAINING
110	A. OCEAN ENGINEERING
111	1. GRADUATE LEVEL
112	2. UNDERGRADUATE
120	B. MARINE SCIENCES
121	1. GRADUATE LEVEL
122	2. UNDERGRADUATE
130	C. TECHNICIAN TRAINING
140	D. SOCIAL SCIENCE, LAW AND OTHER EDUCATIONAL ACTIVITIES
200	II. RESEARCH
210	A. LIVING RESOURCES
211	1. AQUACULTURE
212	2. FISHERIES
213	3. DRUGS AND EXTRACTS FROM THE SEA
220	B. SEAFOOD SCIENCE AND TECHNOLOGY
221	1. NEW PRODUCT AND PROCESS DEVELOPMENT
222	2. SEA FOOD SANITATION AND PRESERVATION
230	C. MANAGEMENT AND PRESERVATION OF THE MARINE ENVIRONMENT
231	1. POLLUTION
232	2. NUTRIENTS
233	3. ECOLOGY AND MARINE RESOURCE DEVELOPMENT
234	4. ENVIRONMENTAL SCIENCE
240	D. MINERAL RESOURCES
250	E. OCEAN ENGINEERING
260	F. MARINE SOCIO-ECONOMICS
270	G. MARINE RESOURCE LAW
280	H. MISCELLANEOUS
300	III. ADVISORY SERVICES

THE TOTAL NUMBER OF CLASSES IDENTIFIED WAS 27

Activity Index--Classification Summary Listing

MARINE RESOURCES INFORMATION CENTER
OFFICE OF THE SEA GRANT PROGRAM
ACTIVITY SUMMARY - SOURCE OF SUPPORT ORDER DATE 04/09/70

REFERENCE CODE NSFSG1TAMU15I250 NSFSG1TAMU15

SUPPORTING AGENCY NATIONAL SCIENCE FOUNDATION
OFFICE OF SEA GRANT PROGRAMS

PRINCIPAL SORENSON, ROBERT M.

TITLE OF PROJECT EFFECT OF SURFACE ROUGHNESS ON THE WAVE FORCES ON A CYLINDRICAL PILE

RECIPIENT TEXAS A&M UNIVERSITY
INSTITUTIONAL SUPPORT - 69/70

PROJECT SUMMARY

THE SURFACE ROUGHNESS OF PILES SUBJECTED TO WAVE ACTION (SUCH AS THOSE USED IN OFFSHORE STRUCTURES) WILL INCREASE THE FRICTIONAL DRAG FORCE AS WELL AS AFFECT THE SHAPE AND SIZE OF THE TRAILING VORTEX ZONE AND THUS THE MAGNITUDE OF FORM DRAG AND INERTIAL FORCES DUE TO WAVE ACTION. AN INSTRUMENTED PILE SECTION WITH VARIABLE SURFACE ROUGHNESS AND CAPABLE OF MEASURING WAVE INDUCED FORCES AND MOMENTS IS BEING INSTALLED IN A TWO-DIMENSIONAL WAVE TANK AND SUBJECTED TO A RANGE OF WAVE CONDITIONS IN ORDER TO INVESTIGATE THE MAGNITUDE AND VARIATION OF DRAG AND INERTIAL FORCES. ALSO, PHOTOGRAPHIC STUDIES OF THE TRAILING VORTEX ZONE WILL BE CONDUCTED IN ORDER TO GAIN FURTHER INSIGHT INTO THE EFFECTS OF PILE SURFACE ROUGHNESS.

MARINE RESOURCES INFORMATION CENTER
OFFICE OF THE SEA GRANT PROGRAM
ACTIVITY LISTING BY RECIPIENT INSTITUTION DATA 04/09/70

MARINE RESOURCES INFORMATION CENTER
OFFICE OF THE SEA GRANT PROGRAM
ACTIVITY LISTING BY TYPE OF SUPPORT DATE 04/09/70

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*** NSF - INSTITUTIONAL SUPPORT **********	
PESTICIDE RESIDUES IN GULF COAST FISH	NSFSG1TAMU14
EFFECT OF SURFACE ROUGHNESS ON THE WAVE FORCES ON A CYLINDRICAL PILE	NSFSG1TAMU15
*** NSF - PROJECT SUPPORT **********	
COMPILATION AND SYSTEMATIZATION OF LOUISIANA LAWS AFFECTING ESTUARIES AND MARSHES	NSFSG1LSUL08
MAINE MARINE RESOURCES LAW	NSFSG1UOMA01
*** NON SEA GRANT SUPPORT **********	
ECOLOGY OF WESTERN GULF ESTUARINE	BCFFW1BCFG01
EVALUATION OF ESTUARINE DATA	BCFFW1BCFG02
EVALUATION OF ENGINEERING PROJECTS AND ESTUARINE DATA	BCFFW1BCFG03
ESTUARINE INVENTORY	BCFFW1BCFS01
PLANKTON ECOLOGY	BCFFW1BCFS02

MARINE RESOURCES INFORMATION CENTER
OFFICE OF THE SEA GRANT PROGRAM
ACTIVITY LISTING BY PRINCIPAL INVESTIGATOR DATE 04/09/70

MARINE RESOURCES INFORMATION CENTER
OFFICE OF THE SEA GRANT PROGRAM
ACTIVITY LISTING BY CATEGORY

DATE 04/15/70

PAGE 1

MARINE RESOURCES INFORMATION CENTER
OFFICE OF THE SEA GRANT PROGRAM
ACTIVITY LISTING BY DESCRIPTOR TERMS DATE 04/09/70

ESTUARINE ECOLOGY	
ECOLOGY OF WESTERN GULF ESTUARINES	BCFFW1BCFG01
ESTUARINE DATA	
EVALUATION OF ESTUARINE DATA	BCFFW1BCFG02
EVALUATION OF ENGINEERING PROJECTS AND ESTUARINE DATA	BCFFW1BCFG03
ESTUARINE INVENTORY	
ESTUARINE INVENTORY	BCFFW1BCFS01
PLANKTON ECOLOGY	
PLANKTON ECOLOGY	BCFFW1BCFS02

APPENDIX D

THE FACILITIES INFORMATION SYSTEM

DESCRIPTIVE MATERIAL

RESOURCE CLASSIFICATION

The resource classifications shown below are intended to provide broad groupings of the available information. This series of categories may be expanded to include additional areas as required.

		CODE
I.	INFORMATION RESOURCES	
	A. Library or Depot	110
	B. Abstracting and Indexing Service	120
	C. Information Analysis Center	130
	D. Data Center	140
II.	RESEARCH CENTER AND/OR LABORATORY	
	A. Marine Oriented	210
	B. Peripheral Missions	220
III.	VESSELS - RESEARCH AND TRAINING	
	A. Deep Water Operation	310
	B. Coastal Operation	320
IV.	ASSOCIATIONS AND ORGANIZATIONS	
	A. Professional	410
	B. Trade	420

INVENTORY OF MARINE RESOURCES FACILITIES

CATEGORIES OF DATA TO BE COLLECTED

Type:

Name:

Responsible Party: (name & title)

Address:

Phone:

Major Facilities:

Sponsor(s):

Mission:

Scope:

Services:

Staff:

Availability of Services:

Marine Activities:

MARINE RESOURCES INFORMATION CENTER
OFFICE OF THE SEA GRANT PROGRAM
FACILITY LISTING BY CLASSIFICATION

DATE 04/07/70

PAGE 2

F-70-1400001

TYPE
DATA CENTER
NAME
NATIONAL OCEANOGRAPHIC DATA CENTER
RESPONSIBLE PARTY
DR. THOMAS AUSTIN, DIRECTOR
ADDRESS
NAVY YARD ANNEX, BLDG. 160
WASHINGTON, D. C. 20390
PHONE
202-693-3700
RESOURCE DESCRIPTORS
BATHYTHERMOGRAPH DATA
OCEANOGRAPHIC STATION DATA
SALINITY-TEMPERATURE-DEPTH DATA
SURFACE CURRENT INFORMATION
BIOLOGICAL DATA
BOTTOM SAMPLE INFORMATION
GENERAL INFORMATION
SPONSOR(S) ATOMIC ENERGY COMMISSION, BUREAU OF COMMERCIAL FISHERIES, COAST GUARD, COASTAL ENGINEERING RESEARCH CENTER, DEPT. OF THE NAVY, ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, GEOLOGICAL SURVEY, DEPT. OF HEALTH, EDUCATION, AND WELFARE, NATIONAL SCIENCE FOUNDATION
MISSION TO PROVIDE AN EFFICIENT MECHANISM FOR PROCESSING, EXCHANGING, AND STORING GLOBALLY COLLECTED MARINE DATA AND INFORMATION.
SCOPE ACQUIRE, PROCESS, STORE AND RETRIEVE PHYSICAL, CHEMICAL, GEOLOGICAL, GEOPHYSICAL, AND BIOLOGICAL DATA AS RELATED TO OCEANOGRAPHY.
SERVICES ANSWERS INQUIRIES ON TOPICS WITHIN SCOPE OF CENTER, CONDUCTS LITERATURE SEARCHES, AND PROVIDES SCIENTIFIC OR TECHNICAL DATA OR DATA COMPILATIONS. PUBLISHES STATE-OF-THE-ART REVIEWS, COMPILATIONS OF INFORMATION AND DATA, DATA PROCESSING FORMS AND MANUALS, AND CATALOGS OF HOLDINGS.
FURNISHES TECHNICAL EVALUATION OF ACCURACY, QUALITY, AND/OR SIGNIFICANCE OF INFORMATION AND PROVIDES TECHNICAL CONSULTATION SERVICES. EXCHANGE SERVICES PROVIDED TO THOSE ORGANIZATIONS FURNISHING CODED DATA TO THE CENTER.
STAFF 71 PROFESSIONALS, 14 TECHNICIANS, AND 43 ADMINISTRATIVE, CLERICAL, MACHINE OPERATOR, AND OTHER SUPPORT PERSONNEL.
AVAILABILITY OF SERVICES SERVICES ARE AVAILABLE TO EVERYONE, WITH CHARGES BEING DETERMINED ON A COST BASIS.

MARINE RESOURCES INFORMATION CENTER
OFFICE OF THE SEA GRANT PROGRAM
FACILITY LISTING BY NAME

DATE 04/07/70

MARINE RESOURCES INFORMATION CENTER
OFFICE OF THE SEA GRANT PROGRAM
FACILITY LISTING BY RESOURCE DESCRIPTORS DATE 04/07/70

BATHYTHERMOGRAPH DATA	
NATIONAL OCEANOGRAPHIC DATA CENTER	F-70-1400001
BIOLOGICAL DATA	
NATIONAL OCEANOGRAPHIC DATA CENTER	F-70-1400001
BOTTOM SAMPLE INFORMATION	
NATIONAL OCEANOGRAPHIC DATA CENTER	F-70-1400001
COMPUTER - IBM-1401	
DATA PROCESSING CENTER - TEXAS A&M UNIVERSITY	F-70-2200002
COMPUTER - IBM-360/65	
DATA PROCESSING CENTER - TEXAS A&M UNIVERSITY	F-70-2200002
COMPUTER TERMINALS	
DATA PROCESSING CENTER - TEXAS A&M UNIVERSITY	F-70-2200002

APPENDIX E

THE INFORMATION DISTRIBUTION SYSTEM

DESCRIPTIVE MATERIAL

THE INFORMATION DISTRIBUTION SYSTEM

DESCRIPTION OF CODING PROCEDURES

The information distribution service of the Marine Resources Information Center is intended to provide a convenient and effective system for maintaining and utilizing files of names and addresses which may be used as a communications aid. Given such files the Center can provide mailing labels according to previously designated lists or by logical selection from a variety of previously designated categories.

A brief outline of the steps involved in the utilization of this system is given below. Every effort should be made to avoid duplication of names and addresses and to insure adequate maintenance of the file.

1. Determine whether or not the proposed list already exists within the file.
2. Submit a list description and obtain a list identification code from the Information Center.
3. Obtain keypunch forms from the Information Center and complete them as required.
4. Check these names against a master listing which is available in the Center. Indicate which names are already in the file. This will prevent additional keypunching and facilitate the addition of the new list code.

5. Submit the completed keypunch forms to the Information Center. After keypunching, a test run is made and a complete listing is returned for verification by the list initiator.
6. Submit accumulated update information prior to requests for listings and/or labels so that the changes may be made.
7. Where possible, allow one week for preparation of listings and/or labels; although every effort will be made to provide the material as required.

Data Recording

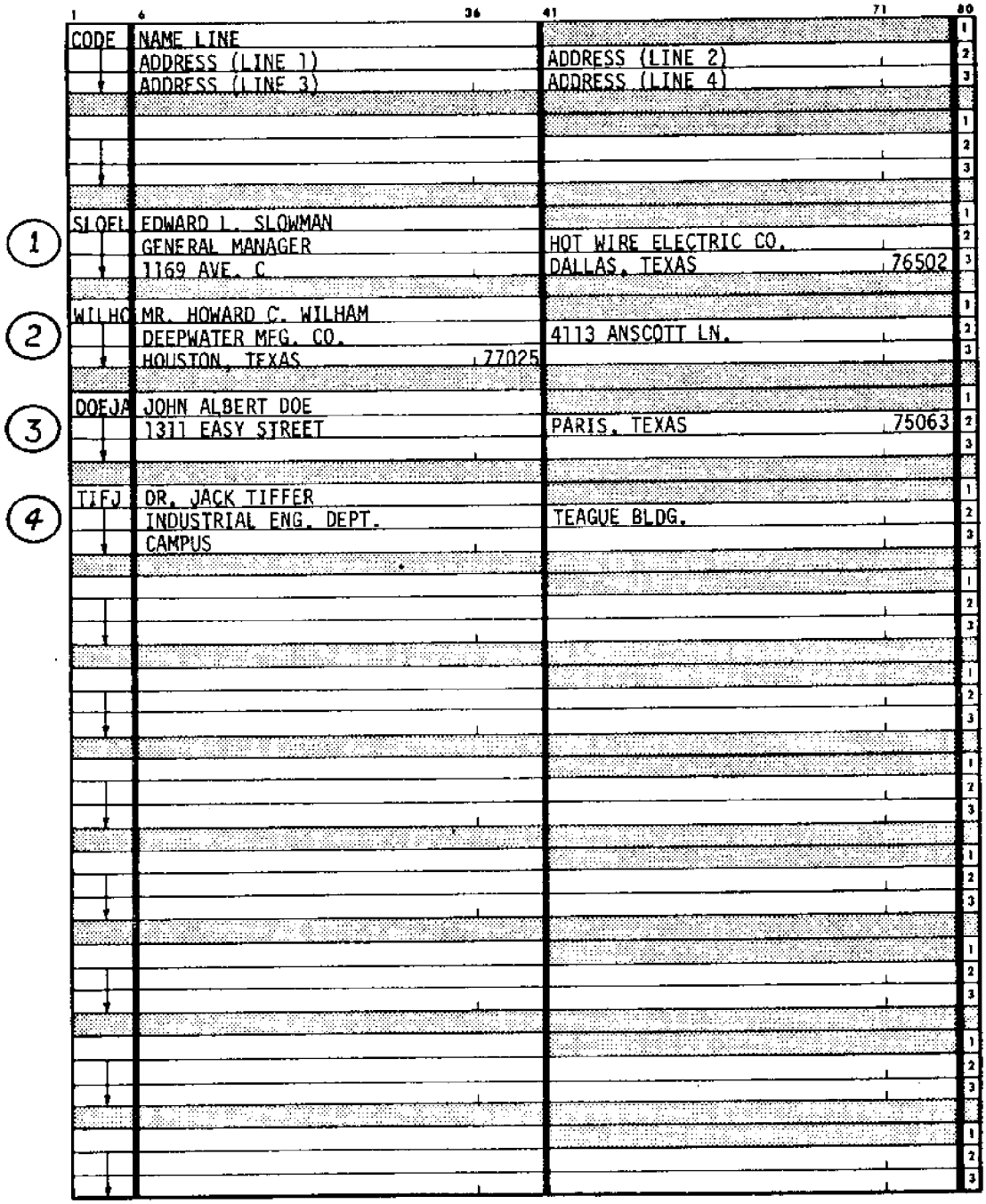
The procedure for adding names and addresses to the file involves the use of the keypunch form as shown on Illustration 1. This form has been designed for use in a standard IBM Selectric typewriter, which has a horizontal character spacing of 12 characters per inch.

Illustration 1 contains several examples which show the use of this form. In each example, it may be noted that a 5-digit alpha code is entered in the left column for each set. This code consists of the first 3 characters of the last name, followed by the first character of the first and middle names. In those cases where a character is missing it is left blank as in Example 4 where there is no middle name. The code has two major uses: (1) it provides a means whereby the names may be sorted in alpha order for listing purposes, and (2) it is used so that the name and address card sets may be filed in alpha order for ease of maintenance.

As indicated by the examples, provision has been made for one name line and four address lines. Each of these five lines may

Mailing Address Keypunch Form

Date 2/5/70
Sheet 1 of 1



	CODE	NAME LINE / ADDRESS (LINE 1) / ADDRESS (LINE 3)	ADDRESS (LINE 2) / ADDRESS (LINE 4)
1	SLOEL	EDWARD L. SLOWMAN GENERAL MANAGER 1169 AVE. C	HOT WIRE ELECTRIC CO. DALLAS, TEXAS 76502
2	WILHO	MR. HOWARD C. WILHAM DEEPWATER MFG. CO. HOUSTON, TEXAS 77025	4113 ANSCOTT LN.
3	DOEJA	JOHN ALBERT DOE 1311 EASY STREET	PARIS, TEXAS 75063
4	TIFJ	DR. JACK TIFFER INDUSTRIAL ENG. DEPT. CAMPUS	TEAGUE BLDG.

Illustration 1

contain a maximum of 35 characters. Current regulations for bulk mailings require that the material be bundled according to zip code. It is requested that the 'state' line of each address contain the 5-digit zip codes as the last item of that line. Tic marks have been provided to assist in the location of this number on the line. Those cases where the address is for internal purposes, the zip code may be omitted. However, the Faculty Exchange requires that the building be designated (see Example 4).

Columns 41 through 79 of the first line for each set are reserved for coding purposes. Column 80 for each of the three lines is used to indicate a card code. These codes are the pre-printed '1', '2', and '3' as shown on the form. Columns 67 through 79 of lines 2 and 3 of each set are not used.

Coding and Classification

The file may be accessed by a simple selection process, in which all names associated with a single list are retrieved, or by a logical selection process, which is based on selective retrieval according to preassigned classifications.

1. Coding and Simple Selection. Provision has been made for the establishment of a total of 74 different lists within the one master file. One name may appear on one, or as many as 74 of these individual lists. Once it has been determined that a new list is to be added to the file, the Information Center will assign a code for use in the establishment and maintenance of the list. Each name to be included in this list is assigned this particular code. Requests for listings

and/or labels for a particular code result in the selection of all names associated with that code.

Typical uses of this portion of the system would be to provide a set of mailing labels for the distribution of the monthly newsletter or for periodic distribution of material to the activity leaders associated with the program.

2. Classification and Logical Selection. Provision has been made for the use of up to 39 different classifications in the categorization of the names in the master file. As may be seen from Illustration 2, three groups of categories have been established: (1) class of employer, (2) nature of duties, and (3) area of marine resource interest.

As individuals are added to the list the various classifications should be indicated as applicable. Such a system would then facilitate selective contact with a large group of individuals. Logical selection may be made on the basis of logical operators 'AND', 'OR', and 'NOT'.

A typical request might be to select all 'commercial/industrial' types who are involved in 'marketing' and who have an interest in 'Fisheries-Shrimps' and 'Seafood Technology' but do not include those with an interest in 'Coastal Recreation and Sport Fishing'. The Information Center staff would convert this narrative request into an algorithm acceptable to the computer program. The resulting output, in list and/or label form, would provide the names and addresses of all individuals that met the selection criteria.

CLASSIFICATION GROUPS FOR SEA GRANT MAILING LIST
(USED IN LOGICAL SELECTION PROCEDURES)

A. CLASS OF EMPLOYER

MAXIMUM - 5 CATEGORIES

1. Educational
2. Governmental/Regulatory
3. Commercial/Industrial
4. Non-profit Organization
5. Other (Specify) _____

B. NATURE OF DUTIES

MAXIMUM - 11 CATEGORIES

1. Administration and Planning
2. Research and Development
3. Consulting
4. Instruction
5. Marketing
6. Engineering and Design
7. Production Operations
8. Other (Specify) _____

C. AREA OF MARINE RESOURCE INTEREST

MAXIMUM - 23 CATEGORIES

1. Fisheries - Shrimp
2. Fisheries - Other
3. Marine Biology
4. Marine Geology and Geochemistry
5. Marine Transportation and Port Facilities
6. Marine Economics
7. Offshore Structures and Ocean Engineering
8. Mineral Recovery (including petroleum)
9. Coastal Recreation and Sport Fishing
10. Pollution
11. Coastal Engineering, Beach Processes and Dredging
12. Physical Oceanography
13. Chemical Oceanography and Desalination
14. Instrumentation
15. Management
16. Undersea Technology
17. Seafood Technology
18. Commercial Boat Operation
19. Personnel and Training
20. Other (Specify) _____

Illustration 2

This facility might be used to distribute notices to individuals who might have an interest in attending a specialized conference or workshop. It would also be useful in the dissemination of research results and technical reports to selected individuals.

Output Formats

The output from this system is either in the form of type 'B' labels or lists as shown in Illustration 3.

1. List Description. Once the names and addresses have been keypunched they are processed to produce a listing which must be checked by the list initiator to insure correctness of the data. As updates are made to this file, revised listings may be obtained on request. These listings should be used to assist in checking changes, corrections, and additions to the file.

The first line of the listing is used primarily for identification purposes in that it shows the coded file request used to prepare the list. A page number is given as the last item of this line. The next two lines provide heading information and the date on which the list was prepared.

Lines 4 through 9 represent information for a typical name and address set. To the left of the page the alpha code is printed, followed by the name and address lines. The right portion of the page provides the code information for that individual.

Lines 5, 7, and 9 are provided to assist in the identification of the codes. The zeros and ones in lines 4, 6, and 8 indicate the potential and actual codes assigned to this set. Line 4 contains

```
                         MR. JOHN DOE
                         1000 MAIN STREET
                         ANY CITY, TEXAS 99999
```

TYPE "B" LABEL

```
                                                                          LINE
     LIST ID SPL-LST-LBL                                 010000000002 PG 41   1

ALPHA **              NAME           ****      DATE RUN - 012070       **     2
*   * ***            ADDRESS        ******         TYPE CODE          ***     3

SMIJE  DR. JOHN E. SMITH                 100000100000010100000000000000000000000    4
       OCEANOGRAPHY DEPT                 1234567890123456789012345678901234567890   5
       TEXAS A&M UNIV.                   1001000000000000000000000000000000000000   6
       COLLEGE STATICN, TEXAS       778431234567890123456789012345678901234567890   7
                                         0000000000000000000000000000000000         8
                                         1234567890123456789012345678901234567890   9
SLOEL  EDWARD L. SLOWMAN                 010000100000010000000100000000000000000
       GENERAL MANAGER                   1234567890123456789012345678901234567890
       HOT WIRE ELECTRIC CO.             1010001000000000000000000000000000000000
       1169 AVE. C                       1234567890123456789012345678901234567890
       GEORGETOWN, TEXAS            765020000000000000000000000000000000000
                                         1234567890123456789012345678901234567890
```

NAME AND ADDRESS LISTING

Illustration 3

a '1' in columns 1, 7, 14, and 16 which indicates that this individual has been assigned to these categories. Lines 6 and 8 contain 74 positions which may be used for assignment to the various lists. It may be seen that this first individual has only been included in lists 1 and 4.

2. Label Description. The labels produced by this system are 4" x 1-7/16". Labels are printed in zip code order to facilitate the sorting and bundling operation required by postal regulations.

File Maintenance

Every effort should be made to insure that this file is current. Additions and deletions should be made on the same keypunch form which is used to initiate the lists. Modifications to the file should be clearly marked at the top of the form with the word 'ADD', 'DROP', or 'CHANGE'. The list codes and categories should be noted to indicate those involved in the update. Changes of different types should be submitted on separate pages. Since changes of address may affect an entry which is on several lists, the old entry and new entry should be designated on the form so that all codes may be retained with the change.

VITA

Eugene Bartell Smith
1312 Timm
College Station, Texas

PERSONAL:
Born December 28, 1931; Houston, Texas
Parents Mr. and Mrs. Robert L. Smith
Married Altha Deon Hall
One child (Kimberly Ann)

EDUCATION:
Nederland High School--1949
Texas A&M College
B.S. Industrial Engineering--1954
M.S. Computer Science--1964

MILITARY SERVICE:
First Lieutenant, U.S. Army Signal Corps;
Two years active duty; Honorable discharge 1956

EMPLOYMENT RECORD: Academic
Texas A&M University, College Station, Texas, June 1967-Present
Instructor, Computer Science; Information Science Co-ordinator, Office of Vice President for Programs
Baylor University College of Medicine, Houston, Texas, Sept. 1964-June 1967; Instructor, Computer Science
University of Houston, Houston, Texas, Sept. 1965-Jan. 1967
Lecturer, Industrial Engineering Dept. (Computer Science)

EMPLOYMENT RECORD: Industrial
Baylor University College of Medicine, Houston, Texas, Sept. 1964-June 1967; Manager, Computer Science Program
Mosher Steel Company, Houston, Texas, March 1957-February 1963
Plant Industrial Engineer
International Business Machines Corp., Houston, Texas, Sept. 1956-March 1957; Sales Engineer-Trainee
U.S. Army, Ft. Huachuca, Arizona, August 1954-September 1956
Industrial Engineering Officer

The typist for this dissertation was Mrs. Eugene B. Smith.