Research

The Evolution of Information Resource Management

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From the beginning of its use, the term information resource management (lRM) has had a wide range of meanings. This is due, in part, to its independent development in three different sectors of the information processing community: database management, records management and data processing management. This paper traces the origins and evolution of the concept of information resource management through a review of the IRM literature over the past fifteen years. The methodology involved examining definitions of IRM along the following dimensions: disciplinary perspective, management scope, societal sector, vocabulary and goals. It was found that while the IRM concept evolved in three different arenas with little interaction occurring among them, the current view of IRM represents a convergence of perspectives. IRM, today, has three goals: to maintain a global view of corporate data, to position the chief information officer at a high level in the corporate hierarchy, and to integrate both information and the information technologies. The future success of IRM will depend upon its ability to incorporate end users into the information management framework.

Introduction

Information Resource Management (IRM) is an idea whose time has come. While the notion has existed for more than a decade, recent developments in the field of information processing have made the concept and the philosophy underlying it, not only viable but imperative. Interpreted literally, IRM suggests that information should be recognized as a valuable entity, independent of the technology that manipulates it. As such, it is recognized as a significant organizational resource in much the same way as people, machines, and capital. Therefore, information should receive serious management attention.

Two phenomena are responsible for the emergence of IRM. The notion of knowledge work was introduced in the 1960's [29], followed by the concept of the "post-industrial society" in the early 1970's [1]. Information economics contributed the argument for treating information as a resource [35]. These characterizations were popularly described in the 1970's as "the information age" [40] and the "information economy" [50]. Such phrases acknowledge that information processing has become a fundamental component of industrialized nations. Since information han-

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dling has become such an important component of economies, it is understandable that more attention is paid to it.

A concomitant phenomena is technological development. Small, inexpensive, and easy to use information technology embodied in the personal computer is accessible to everyone. This means that management approaches based on limited access to a central facility by knowledgeable individuals must be reexamined, reconstructed, and in some cases, completely overhauled. In addition, recent technological developments have served to underscore the difference between information processing *technology* and the information *itself.* In earlier times, a single technology served a single information function. Today, that is not the case. The same information can be stored or disseminated through a variety of technologies, such as electronic mail, the telephone, or video. This means that a technology can be used to support a variety of information types which can in turn be processed by a variety of technologies.

In examining IRM, two fundamental questions must be answered: What does it mean to "manage information"? and How will this concept change in the face of future technological developments? One way to answer these questions is to consider the evolution of this concept.

The Evolution of IRM

There is wide variation of opinion as to how the IRM philosophy should be implemented. By looking at the origins and evolution of IRM, we find that the seeds of IRM were planted in three disciplines: database management, records management, and data processing management. The activities of each discipline were generally independent of one another. This partially explains the wide variation in meaning of the term. IRM also grew and developed in two societal sectors: the private sector and Federal agencies. Taken together, these points of origin represent a range of interpretations which have implications for the kind of data to be addressed, the organizational structures needed to manage this information, and the degree of difficulty likely to be encountered in addressing IRM goals. This diversity of origins suggests that IRM is a response to the interdisciplinary nature of information problems.

The dimensions to be examined in tracing the evolution of IRM are disciplinary perspective, management scope, societal sector, vocabulary, and goals. *Disciplinary perspective* refers to the information processing tradition. *Management scope* refers to its intended domain: from management of centralized, machine readable data to the "Information Czar" in control of *every piece* of information in the organization. *Societal sector* refers to the distinction between IRM in the private sector and in Federal agencies. Due to its diverse origins, the *vocabulary* used to describe IRM has varied. Some use the term in the broadest sense. Others apply it more narrowly as another label for database management, data processing, or records management. Still others do not use the term IRM at all, yet are actually referring to the concept. Depending on the discipline, the *goals* are also very different. Some are so modest that use of this term must be questioned; other goals are too broad to be realistic.

Database Management

The database management perspective on IRM uses the terms *data administration* and *database administration.* This perspective is concerned with establishing and enforcing standards to support a global view and integrated use of enterprise data. The need for the coordination and control of organizational data was recognized from the start. As increasing volumes of data led to an interest in the development of more efficient information storage and retrieval methods in the 1960's [19], groups were also addressing its administration. Both the government and the private sector contributed to this effort. In the early 1970's documents describing the proper database environment described a staff function: data administration [7,22]. The management scope was almost exclusively technical. Typical functions were those necessary to coordinate database management system activities and application programs. However, this function provided little or no control over data redundancy or planning across multiple systems [14]. The primary qualifications for personnel performing this function were technical.

The 1970's and 1980's witnessed an increased growth in the use of databases and database management systems, with a gradual shift toward data management as database management sys-

terns were recognized as only one part of the management of data. The notion of treating data as a true organizational resource had emerged along with a new corporate position: database administrator. The job of the database administrator was to define the rules that control the database and to determine the manner in which the data would be stored. The scope of responsibility was, thus, the creation, design, and operation of databases.

In the 1970's, as database usage grew and became more integrated, the issues of ownership of data and programs and stewardship over the data needed to be addressed [52,53]. At this point a split between the technical and administrative components emerged, with the former remaining within the scope of *database administration* and the latter becoming the domain of *data administration [8,66].*

The data administration function interacted with the data processing department in one of several ways: from a small independent advisory group to a larger support group with technical expertise in data base applications development, database definition, and data dictionaries. Sometimes a consulting group was established to deal with database user groups. Several studies have examined this function. They provide a means of documenting the evolution of data management. The earliest surveys (1977-1980) [12,33,34,39,56, 65,67] found data management to be a new function, located within the data processing department's reporting structure and low in the organizational hierarchy. The domain of responsibility tended to be along the lines of technical database management system concerns.

In 1981, Gillenson [18] noted the shift from primary concern with the technical aspects to concern for large scale management of data. While the data administrators said they spent most of their time dealing with day-to-day operational aspects, they expected to move toward broader issues in the future. At that time, their organizational status was generally two levels down from the top data processing person.

Surveys in 1982 and 1983 documented the substantial progress made in shifting emphasis. Kahn used the term data administration to refer to the establishment of policies and procedures for managing data as a corporate resource and information resource management to refer to the top

level function [26]. Another study noted the emphasis placed on issues related to a global view of the corporate data: data dictionaries, treating data as a corporate resource, and data sharing [10]. Gillenson's follow up study [19] found that the range of responsibilities had not significantly changed, nor had the organizational placement of data administration.

These results represent a contradiction. On the one hand, there is evidence of a movement toward concern with more global issues. On the other hand, this function does not appear to have achieved the high level placement called for in the literature. This observation provides part of the explanation for the emergence of the term IRM. It can be seen as an attempt to disassociate the data administrator's role from the data processing image. IRM can be viewed in this context as the term for what data administration *would like to be.* It would like to address questions such as: What information is most crucial to the success of the company? How can the quality, timeliness, reliability, consistency, and accuracy of the information be improved? and How can data redundancy be reduced?

There is still inconsistent use of terminology to describe the goals and objectives of those functions. The following definitions are representative of such distinctions.

> Data base administration is a technical function which performs database design and development, provides education on database technology, provides support to users in operational data management-related activities, and may provide technical support in data administration.

> Data administration is the establishment and enforcement of policies and procedures for managing the company's data as a corporate resource. It involves the collection, storage and dissemination of data as a globally administered and standardized resource [26].

> ... data administration is made up of two components... One of those components, data management (DM), is primarily a planning and analysis type function. It may be responsible for data planning, accountability, training, policy development standards setting, data base design and liaison support to application development groups.

... database administration (DBA), is responsible for managing the data on a day-to-day, operational level [19].

The National Bureau of Standards played an influential role in the introduction IRM through its "Database Directions" workshops. The 1980 workshop provided managers with information to help them "evaluate, select, and effectively use information resource management tools". Information resource management was defined as:

> ... whatever policy, action, or procedure concerning information (both automated and non-automated) which management established to serve the overall current and future needs of the enterprise. Such policies, etc., would include considerations of availability, timeliness, .accuracy, integrity, privacy, security, auditability, ownership, use and cost-effectiveness [21].

While this might suggest a broader scope than data administration, the identified policies suggest otherwise; they center around the development of an architecture to facilitate long range planning for the maintenance of enterprise data. The specific tools to be employed include database management systems, languages, networks, data dictionary systems, and hardware. This involves maintaining the quality, integrity, and accessibility of the organization's data that resides in the (central mainframe's) database: i.e., machine-readable data only.

Most data administrators still see control as a fundamental component of IRM. This presents two inherent problems: the lack of accompanying authority or status to match the level of responsibility; and establishing control in an end user computing environment. With an increased number of database users, the issues of data integrity are exacerbated. Successful data sharing across organizational units requires some individual or organizational unit to maintain a global view of the organization's data.

Records Management

The records management approach to IRM has its origins in library science, records management, administrative management, and other disciplines concerned with the effective storage, retrieval, and utilization of documents in organizations. This was the first area to use the term IRM to describe a coherent and global approach to managing information.

The Commission on Federal Paperwork was established in 1974 in response to growing Federal information reporting requirements and the burden placed upon both government agencies and private citizens. At the conclusion of its work, the Commission produced over twenty documents that recommend ways to minimize the paperwork burden. This work resulted in the passage of the Paperwork Reduction Act in 1980 [47]. This Act produced a framework for the implementation of IRM.

Other efforts were also underway to present management approaches that responded to the growing problem of information proliferation. Some library schools changed their names to reflect a wider concern and to acknowledge the growing presence of more than paper documents [20].

In the database management arena, a global view was to be achieved through such technological means as data dictionaries. The records management approach, on the other hand, saw the need for a person or organization function: a high level manager - a chief information officer (CIO) - to provide the comprehensive oversight for coordination and sharing of documents. In the case of the Paperwork Reduction Act, the Office of Information and Regulatory Affairs in the Office of Management and Budget was established to perform such functions as clearing agency requests to collect information from the public, coordinating federal statistical and records management activities and facilitating interagency sharing of documents.

The goals of IRM in the Paperwork Reduction Act fall into seven major categories [62]:

1. Paperwork Reduction: overseeing agencies' information collection requests, issuing guidance on the exercise of controls, and proposing changes in legislation to remove impediments. This involved facilitating sharing in information collection, the development of a Federal Information Locator System, and establishment of central collection agencies. Finally, standards were to be set for records retention and disposal.

2. Data Processing and Telecommunications:

establishing policies for effective acquisition and utilization of computer and telecommunications resources. These included promoting the use of information processing technology and enforcing standards.

3. Statistics: developing long-range plans for improved performance of Federal statistical activities and the development and coordination of Government-wide statistical policies.

4. Records Management: correcting the deficiencies in existing records management practices and coordinating them with other IRM functions. A related objective was the development of standards for record retention for all sectors.

5. Information Sharing and Disclosure: managing decisions relative to the threat to privacy and confidentiality. Policy guidance on disclosure of information, confidentiality, and security of information would be set. To enhance general management practice, it recommended legislation to remove the inconsistencies.

6. Information Policy and Oversight: establishing a strong, central management function responsible for the development of uniform and consistent information policies. To insure success, the agencies were to be given adequate guidance in the conduct of their information management activities.

7. Organization Development and Administration: creating the steps necessary for the establishment and funding of the Office of Information and Regulatory Affairs.

The goals in the private sector centered around the elimination of redundant document processing activities and facilitating access to the information. This view reflects an awareness of the variety of media available for information storage and presentation, and proposes greater integration of people, tools, and systems in order to improve the quality of the information product [46]. In some cases, information management was also seen as the key to providing strategic planning information [5,49,51].

The domain of information management ranges from responsibility for all documents in the organization (including computer-based ones) to computer software designed to facilitate document access and use. The most common view is somewhere in the middle. The Paperwork Reduction Act represents the broadest scope.

Since information management is primarily concerned with effective storage and retrieval of documents, its scope always includes retention practices. In some cases, software is utilized to make decisions regarding the treatment of individual pieces of information [11]. In others, a "new" management discipline is described which would gain control of the expanding volume of information by defining information needs and referring users to specialists [70]. In general, this function would be responsible for the acquisition and dissemination of information and decisions regarding what information to discard and when [9]. Another aspect is the integration of technologies/functions such as data processing, publication and printing. Such an activity widens the scope [4].

One author depicted the domain of information management to include the entire organization:

> Regardless of how" traditional" a manager's primary duties are, he is either personally or indirectly. .. reliant upon good information management procedures to do his job. Thus, information management is not just the province of those designated as "information managers," but is a significant area of concern for all managers [2].

Information management has historically referred to the management of documents. Later, the information management function was seen as evolving from a technocratic function concerned with the content and quality of information products to one which gave attention to the organizational context as well [38]. What followed were calls for a holistic approach to information management [59]. Such interpretations make information management equivalent with IRM. While some authors maintained a narrow connotation by aligning this term with data administration or records management [27], it generally implied a crosscutting function which intended to address more than document/data handling.

The Paperwork Reduction Act defined "information resources" as information collection requests containing a data profile for each request. Elsewhere, it referred to "information resources management policies" which were to be established to achieve its goals. An implied definition of IRM is given in the responsibilities of each Federal Agency to:

... systematically inventory its major information systems and periodically review its information management activities, including planning, budgeting, organizing, directing, training, promoting, controlling, and other managerial activities involving the collection, use, and dissemination of information;

The General Accounting Office's review of the Paperwork Reduction Act defined information resources management as:

A concept for integrating and focusing a variety of activities on managing information throughout the life cycle - from collection or creation through final disposal - and in each segment of it in furtherance of program and agency objectives. It involves managing data and information in such a way that program and agency managers are able to obtain and use information efficiently, effectively, and economically.

The same evolutionary process evident in the database management arena can be observed with regard to information management. Marchand [32] described the stages as moving from the physical control of information, through the development of isolated data processing, telecommunications, and office automation systems and eventual integration of these, to technical management, decision making, planning, and knowledge-based systems. He further noted that the effective evolution of the information management function requires the integration of information management planning with strategic business planning.

In 1983 the GAO observed that there had been considerable success in reducing the Federal paperwork burden but less success in other IRM areas. Some of the reasons were the failure to appropriate the necessary funds for implementation, the failure to give sufficient prescriptive guidance to agencies, and the failure to incorporate IRM into the existing information infrastructure which resulted in the perception that IRM is too general and vague to be effective. When the concept of IRM resides solely in the records management arena and does not sufficiently involve the data processing or management information systems community, it is likely to meet with resistance.

Data Processing Management

The data processing management perspective arises from the fields of business administration and management information systems (MIS). It is concerned with providing better support for corporate decision making. Considerable attention has been given to the notion of information as a corporate asset [54,64].

Two frameworks are used to describe the history and development of data processing. Both culminate in the concept of IRM. The history of computers and data processing is generally presented as a series of "generations." In the third, it was recognized that management decision making could benefit from data processing but that certain changes needed to be made. Significant technological advances such as database systems and remote access, further widened the scope of those to be served by the computer. The fourth generation continued the trend. This was facilitated by the availability of small, inexpensive, and easy to use "personal" computers. By this time, it was abundantly clear to top management that the costs associated with corporate information processing were becoming a major item in the budget. The other framework is Nolan's Stage Theory [17,42,43]. Based upon data from several firms, he identified a consistent progression through which the data processing function moved: Initiation and Contagion, Control and Integration, and Data Administration and Maturity. (Nolan uses the term data resource management).

Among the other terms which are used to express the goals of IRM is the term information management [60]. Though not used as frequently here as in records management, it highlights the fact that all information needs to be properly managed. In view of this, increased attention has been given to strategic planning for information systems. Information is perceived not only as a resource but as a means whereby a firm can gain strategic advantage in an industry. As a partial overlap with database management, a global view of corporate data is described by the terms information architecture and information engineering. The former represents the enterprise's information; the latter is a technique for implementing the resulting data model.

The Business Systems Planning (BSP) approach [6,45,63], is a way of developing information sys-

terns that reflects the principles of IRM. It focuses on an overall understanding of the business and how information systems may support it. This top down approach begins with the identification of business processes and moves on to identify and associate data classes and systems. It also includes the review of existing information systems management, the definition of the information architecture and the development of an action plan. By emphasizing the relationship between business goals and information flows, it implicitly supports the view of information as a valuable corporate resource.

Where the term IRM is used, it generally represents some combination of data processing management, corporate planning, and database management, but leaves out information forms and processes that lie outside the MIS domain [15]. Unlike the database management approach, this view of IRM has the implied goal of relevance. Therefore meeting users' needs is as important as the efficient storage and retrieval of the data [3].

One notable deviation from the common definition of IRM does include records management:

> IRM is an organization and policy framework for assuring that the right information gets to the right place at the right time. It now can encompass a lot of functions which were never part of the MIS organization, such things as corporate communications, telecommunications, and even the traditional library [48].

Another view of IRM excludes data processing operations. In developing this view, Mendenhal and Cook [36] identified two interpretations. The first, which they reject, holds that IRM is the management of the information handling resources, such as data processing, telecommunications, reprographics and printing, information system design and development, software development, and document retrieval systems. The interpretation that they support distinguishes between the information handling community and the information resource management community. In their view, the data processing planning function would be part of the IRM group but not data processing operations.

The goals of IRM center around establishing appropriate fiscal measures of information value, strategic planning for information processing systems, satisfying the needs of all users, and managing information processing from a business perspective. An important component of this view is raising the senior MIS management position to the level of other senior managers. The terms information resource manager or chief information officer have been used to describe this position, which should bridge the gap between corporate planning and information processing [37]. Whereas the chief executive officer (CEO) sets the goals and performance measures for the firm, the cia is responsible for developing an information plan which articulates the success factors at all levels of the organization. An important component of this is the part that is devoted to data management. Ensuring the availability, quality and integration of the firm's data is a major goal of IRM [16,68]. Additional goals involve changing attitudes about the benefits of data processing from the focus on short-range, cost displacement, or return on investment to a higher level: longer term improvement of competitive advantage and opportunity fulfillment [28,48].

The management domain varies according to the individual information processing environment. In general, the CIO should represent a combination of technical and business expertise and be seen as a general rather than a technical manager [30]. Nolan emphasized the consistency that must exist between the MIS management style and the overall corporate management style to insure that project selection will fit into the overall corporate goals [41].

Describing a corporate information policy, Umbaugh [61] implicitly outlined the domain of IRM as:

- ensuring system integration and impartial service;
- keeping abreast of technological developments to benefit the organization;
- establishing information processing, access and dissemination policies;
- possessing the authority and responsibility for the development and maintenance of MIS operations; and
- ensuring data confidentiality, security, and retention.

In a study of corporations which successfully implemented IRM, Guimaraes [23] developed an

operational definition which highlights two key management roles. First, the senior computer executive reports directly to the CEO, is responsible for directing MIS policies, and oversees corporate data administration. Second, the company maintains a centralized MIS plan relating to equipment as well as information flows among organizational units.

Despite the identifiable benefits and the logic of the arguments in favor of IRM, few organizations can say that they have really implemented the concept. Critics have called IRM just another name for data processing and simply a way for DP to increase its power base [8]. Even its proponents have identified three significant barriers that must be overcome [31]. First, in order to attain the "global" view, fields traditionally viewed as quite distinct from one another must work' together. Second, resistance must be overcome. It can arise because of the political implications of changes in procedures and practices. As a result, units may resist perceived threats to their power bases. Resistance can also result from senior management viewing IRM as just another way for data processing to increase its budget. Finally, new accounting tools are needed in order to assess the true costs and value of information processing.

The Convergence

Throughout the evolution of IRM, there have been those in each of the three disciplines who saw their fields as providing a piece of the solution. During the 1980's the number who have reached beyond their disciplines has grown. As a result, the present stage in this evolution is the convergence of disciplines, technologies and information types.

Horton, one of the earliest to actually use the term IRM, developed his views from the information management perspective [24]. His point of departure is the information explosion and the growing recognition of the need to harness this resource. To him, the problem of information overload is as great as the lack of.information. He calls for an interdisciplinary approach that focuses on the information, the uses, and the users, irrespective of the particular information handling technologies. His management approach is based

heavily on the application of new accounting and budgeting techniques applied to information.

Synnott and Gruber approach IRM from the perspective of MIS management [57]. They see in IRM the solution to problems inherent in the traditional approach to information processing management. As such, they see a natural progression from data processing to IRM, with a strong, centralized information management function embodied in the position of CIO. Their approach is to promulgate a series of strategies regarding the various information handling components.

Nolan's approach to IRM combines his work on the stage theory with that on data administration [44]. The central theme is the shift that has occurred from managing computers to managing data. His emphasis is on understanding the nature and characteristics of this resource to achieve the goals of more efficient data utilization, exploitation of its full potential, and integration with other corporate resources. He notes the fact that the data resource pervades the entire organization and thus is an object of concern to units beyond the data processing department.

The current view of IRM is drawn from the needs expressed in each of the three fields, the problems left unsolved or unidentified, and the more recent views that attempt to respond to the information handling problems of the 1980's. While definitions of IRM abound, Wood's is representative:

> IRM is a synthesis of several approaches that have been demonstrated to be useful in managing information. It combines general management (resource handling), computer systems management, library science and policy making and planning approaches. It is the next step in the evolution of information management thought and not a panacea or a fully developed approach [69].

Underlying this view of IRM is the assumption that information can be used as a strategic weapon to gain competitive advantage for a firm. Using information in this manner requires understanding the nature and special characteristics of information, establishing a management function to conserve and efficiently utilize it, understanding the organizational implications of its use, and incorporating information management policies into other corporate policies. The focus of attention is

the information not the technology. Corporate goals and the resulting information needs should determine the way in which the technology is used. It is also assumed that the user plays a critical role in the success of IRM. This implies shifting the focus from an input-, efficiency- and short term-orientation to concern with output, effectiveness and long term gains. Finally, it is assumed that achieving IRM is an evolutionary process incorporating organizational learning and positive experiences.

According to the convergent view, there are three primary goals of IRM. First, there should be a global view of the corporate data which incorporates both database systems and documents. Quality assurance, including cost accountability and integrity should be achieved. Second, the management function should be positioned at a high level within the management structure. The CIO should possess both technological and administrative skills. Finally, both the information handling technologies and functions, and the data should be integrated. This involves reconciling the needs of various groups of providers and users.

The domain of IRM can be expressed as an "information community." What binds the community together are the types of information and the information problems encountered rather than the similarity of the technologies used [13]. An example of such a community is one focused on the corporate education function. This would include those who produce videotapes, write documentation, conduct user training and manage an information center. As suggested in this example, the boundaries of these information communities will change as needs change. The tools used by IRM are a combination of those currently in use, including top down and structured systems design, business systems planning, database modeling and data dictionaries. To say that all these aspects fall within the domain of IRM is not to say that the CIO has direct control over them. What it means is that all these functions would be taken into account during the planning, budgeting, and resource allocation process.

The successful implementation of IRM requires that several challenges be met. First, a method for measuring information, particularly its financial value must be developed. Alternate cost/benefit measures to return on investment, cost displacement and other short term justifications are

needed. Second, in order to move from a logically appealing theory to a practical tool, the policy must be translated into workable standards and guidelines and include periodic review and adjustment [15]. Third, due to the organization changes inherent in IRM, resistance and apathy must be overcome. Finally, IRM must demonstrate its ability to enhance productivity. This involves developing meaningful measures of productivity in the value-added rather than the labor displacement sense.

The Future of IRM

The future success of IRM will increasingly depend upon an organization's ability to shift its management focus from the information professionals to end users. The objective will be to achieve the benefits of end user computing without losing data consistency and integrity that information managers have worked so hard to establish.

The information processing domain of the future will be a distributed one, in which the technology, the data and operational procedures will, to some degree, be under the control of end users. Results of a survey of the management domain of MIS bear this out. Three dimensions were used to examine the new information processing environment: type of hardware, type of software applications, and type of data. It was found that, for each dimension, those which are characteristic of end user computing were less often under the direct control of the MIS department. Examples of technology and software were personal computers, decision support systems, expert systems and spreadsheets. The type of data likely to be involved in these applications, such as unstructured, temporary, personal, textual, and noncomputerized, was also found to be generally outside the domain of MIS control [58].

Given this type of information processing environment, what are the most significant issues for the success of IRM? There are five:

(1) Measuring productivity. Traditional measures are not appropriate in an end user context where the goal is the improvement of white collar productivity [55]. Better measures are, therefore, needed in order for IRM proponents to demonstrate real benefits.

(2) Determining the appropriate mix of control; coordination, and decentralization. A balance must be maintained between individual control of information processing and a level of centralization needed to achieve the goals of IRM. Control issues center around establishing and enforcing hardware and software standards and data quality assurance.

(3) Accountability. Increased user accountability should accompany increased user control. This is, in fact, one vehicle for quality assurance in cases where an end user downloads data from the corporate mainframe to a personal computer. One model suggests that the CIa function as an "information controller" for the planning and allocating of resources, and to whom the end user is accountable.

(4) Providing appropriate access. The expanded set of resources available for information access is both a benefit and a potential problem. The- ability to present information in various forms (e.g., graphic vs. textual) and the alternate technologies in existence for doing so (e.g., electronic vs. video) requires that criteria for assessing the tradeoffs be established. Given end users' ability to create personal databases, the information manager must also work with them to ensure that duplicate files do not undercut the goals of data sharing. With the ability to access numerous external databases comes a growing problem of information overload. Mechanisms are needed to help the user filter the extraneous data [25].

(5) New management roles. Since end users are becoming more involved in information handling tasks traditionally assigned to information professionals, they will increasingly be responsible for carrying out the objectives of IRM at the operational level. The information manager must therefore place increasing emphasis on user education and support.

Conclusion

The achievement of IRM represents considerable challenges to management, education, and the individual information disciplines. Nevertheless, the environment of the future demands the perspective that IRM provides. Until now, the proponents of IRM had to sell the concept on its logical merits. The increase in end user comput-

ing, however, is creating grass roots pressure for change. The traditional "fire fighting" mode of information management has no choice but to give way to a framework based upon comprehensive planning and effective feedback. The disciplinary focus on single technologies has led to information gaps, redundancies and the failure to satisfy the user community. An interdisciplinary perspective no longer must be argued from a theoretical viewpoint. The integration of technologies requires a similar perspective. If evolutionary development is accepted as an element of IRM then the efforts of the past decade can be viewed as the conceptual phase. The upcoming decade can then be seen as the implementation phase.

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