

Document-Based Systems for Management Planning and Control: A Classification, Survey, and Assessment*

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Abstract

The role of document-based information systems in management has been relatively neglected. However, during the last few years, a certain number of document-based systems for use within a management context have been reported in the literature. A framework for the classification of these systems is developed here, and the results of a literature survey undertaken to identify illustrative examples, and to classify them according to the framework developed, are reported. Twenty-two illustrative systems are identified, described, and classified along two major lines of development. The convergence and integration of data and document processing techniques in support of management planning and control is also discussed.

Keywords: Document-based systems, document base, reference-based systems, reference database, strategic planning, management control, operational control, office communications

Categories: 3.50, 3.70

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Introduction

Current concepts of management information systems (MIS) are based primarily on collections of structured data, together with models for processing this data to support management decision making. Structured data are now also often organized for processing by means of data base management systems (DBMS's). Work on these systems has led to a strong data base emphasis in management information system research.

In contrast, the role of document-based information systems in management has been relatively neglected. While documents, *i.e.*, reports, procedures, memoranda, proposals, letters, *etc.*, are the essence of written managerial communication, little attention has been paid to management information systems founded upon the notion of the document as the basic unit of storage and retrieval. Research on documents and document processing remains concentrated in library information science, and although much work has been done in this area, especially in providing new tools for scientific and technical information retrieval, its impact to date upon management information system research has been minimal [35].

Interestingly, the importance of document-based systems to management has long been recognized. (See especially the early work of Luhn [24], and the more recent treatise by Meltzer [26].) However, such recognition has not produced a substantial impact of document-based methods upon MIS designs, even though approximately 80% of the recorded business information of large organizations may be document text, and only 20% structured databases [32]. Nevertheless, during the last few years, a certain number of document-based systems for use within a management context have been reported in the literature. There is thus some reason to believe that document-based systems may at last find their way into contemporary MIS thinking.

The purpose of this paper is to develop and apply a framework for the classification of document-based systems for management. The concept of a document-based system is introduced, and the framework for classification is presented. Twenty-two document-based systems identified in the

literature are then classified and discussed in terms of the framework. Finally, the potential importance of document-based systems to MIS designs is assessed.

Document-Based Systems

An information system may be said to be a *document-based system* when it is based primarily upon a store or collection of documents, rather than a store or collection of structured data. In the case of document-based systems one may therefore speak in terms of a *document base*, rather than a database.

A *document* is an ordered set of recorded visual images constructed so as to communicate as a whole. Examples of documents are: this article, a book, a motion picture film, a bank check, an engineering drawing, and a musical score. Documents whose images consist principally of *written messages*, i.e., ordered selections of language characters, may be termed *written documents*. Many written documents are based on *text*, i.e., written messages representing a sequence of sentence expressions. The primary interest in this article is in written documents based on text as sources of managerial information.

The most obvious example of a document-based system is the traditional library. The library may be clearly contrasted with a structured data-based system, such as the accounting systems common to most modern organizations. In a library, it is the individual book or other document holding which is maintained as the primary source of information. In an accounting system, it is the individual data file or record within the file (e.g., an accounts receivable file or an account record contained in it) which is maintained as the primary source of information. For the library, it is appropriate to speak in terms of a document base, for the accounting system, a database.¹

¹The term *database* is used here to refer to any organized collection of data files, and does not imply the use of a database management system.

Distinction in data-based systems

The distinction between document- and data-based systems is not always so clear, however, as the two are often closely interrelated. For example, indexes to a document-based system may consist of structured data, organized to facilitate computer processing. Similarly, an item within a record of structured data may consist of document text. More generally, the output of data-based systems typically take the form of documents, which may subsequently be organized and maintained within a document-based system. Inputs to a data-based system may also be documents, as is the case with bank checks which, when canceled, are machine-read to update individual data-based accounts. These canceled checks are also carefully maintained as a document base, and not discarded upon the updating of the account database.

Finally, document-based systems do not always actually contain the documents. In some cases, they may simply perform a referral function, e.g., identifying but not providing, recent publications of interest to researchers in a particular field. Such systems may be termed *reference-based systems*. Interestingly, reference-based systems need not be based only on documents. A reference base may be developed for other sources of information as well, e.g., people, organizations, and data bases.² However, in the present context, the interest is in those based upon documents. A reference-based system employs a special type of database to support its referral function: a *reference database*. A reference data base contains data *about* a certain class of information sources, e.g., published documents. It is essentially an *index* to the information sources.

A Management Framework

Management information systems are traditionally described as instruments of planning

²An excellent example is the National Criminal Justice Reference Service described by Levine [20]. The application of various information science techniques, e.g. citation indexing, bibliographic coupling, associative indexing, and selective information dissemination, is made possible in this case by treating criminals and criminal organizations as if they were "accessions in a (document) collection."

and control. Robert Anthony [3, 4] has defined three levels of management activities within this context: (i) strategic planning; (ii) management control; and (iii) operational control. The Anthony framework has been widely adopted by management information system theorists (e.g., Mason and Mitroff [25], Gorry and Scott Morton [17], Lucas, *et al.* [23]). Based upon an interpretation of its implications for organizational information flows, a classification of document-based systems for management planning and control may be developed.

Strategic planning

Strategic planning is the "highest" level task of management planning and control. Particularly characteristic is the need for information relative to the organizational environment, e.g., in the case of firms, knowledge of markets, industries, consumer preferences, general economic conditions, and technological developments [18]. Of special importance in recent years is knowledge of social constraints placed upon the organization, e.g., by means of legislation, regulatory edicts, and legal rulings.

It is also necessary in strategic planning to acquire substantial internal organizational information. In particular, relative to any plans proposed, it is necessary to know the actual and potential capabilities of the organization in obtaining and allocating resources toward the ends of the plans.

Management control

Management control is the "intermediate" level of planning and control, and is the process of assuring that resources are obtained and allocated effectively and efficiently in accomplishing organizational objectives. The information required is seen here to be of two basic types. First, knowledge relative to the strategies adopted by the organization is necessary. That is, management control takes place within the context established by strategic planning, and knowledge of this context is obviously needed for effective control. Secondly, information relative to the working-level operations of the organization is needed, especially information related to the actual and potential productivities associ-

ated with the generation of products and services.

Thus, the immediate sources of information for management control are regarded as primarily internal to the organization, *i.e.*, outputs of the strategic planning and operational control processes, although information about the organization's environment may thereby be indirectly obtained.

Operational control

Operational control is the "lowest" level of management planning and control. As with both strategic planning and management control, the information needed is of two basic types. First, knowledge of the resource commitments and constraints established in management control is needed. As strategic planning provides the context for management control, so too does management control provide the context for operational control. Second, operational control requires information from the transaction processing system of the organization. The transaction processing system processes the data associated with the basic exchanges and agreements entered into by the organization with other organizations and individuals, e.g., in the buying and selling of products and services. Such transactions provide a basis for operational control, as, for example, does the procuring of purchased parts for the manufacturing plant, the discharging and charging of books by the library, and the taking on of new cases by the welfare agency.

Transaction processing

While *transaction processing* is not itself a part of the planning and control framework of Anthony, it is intimately related to it. In particular, it is an important source of information relative to that portion of the organizational environment within which marketplace exchanges take place, in that it provides for the accumulation of a history of the organization's accomplishments in making these exchanges, e.g., in the simple accumulation of an historical sales data. A summary of the primary information flows in management planning and control is portrayed in Figure 1.

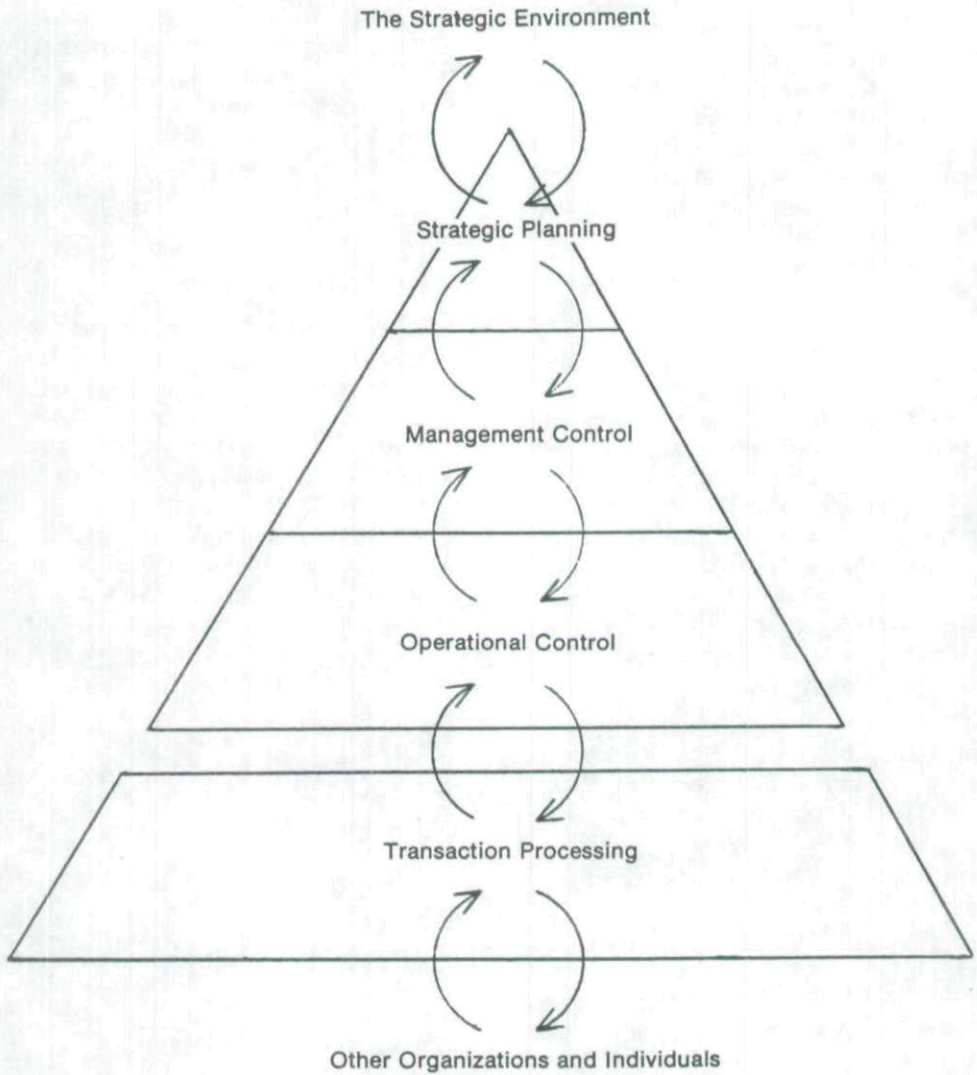


Figure 1. Information Flows in Management Planning and Control

Information sources

On the basis of the portrayal of information flows, a simple classification of organizational information sources is suggested. Sources may be either *intraorganizational*, *i.e.*, internal to the organization, or *extraorganizational*, *i.e.*, external to the organization. As may be seen from Figure 1, strategic planning and transaction processing make primary use of both types of sources. Management control and operational control, on the other hand, make primary use only of intraorganizational sources. Thus, a classification framework for document-based systems for management planning and control

is suggested in Figure 2. For the three types of planning and control activities, a total of four different types of document-based systems are seen to be of potential importance (excluding those systems designed for transaction processing).

It should be emphasized that the proposed classification framework is provisional, and subject to modification and reformulation on the basis of experience with its application. In particular, caution should be exercised with regard to the assumption that no document-based systems of the extraorganizational source, management or operational control types are likely to exist.

Management Activity	Information Source	
	Intraorganizational	Extraorganizational
Strategic Planning	X	X
Management Control	X	
Operational Control	X	
Transaction Processing	X	X

An "X" indicates that relevant document-based systems should be found to exist in this category.

Figure 2. A Classification Framework for Document-Based Systems For Management Planning and Control

Some Existing Systems

Using the general framework discussed above, a survey of the information science literature, and other related literature, was conducted.³ Illustrative examples of document-based systems within a management planning and control context were identified and classified according to the framework. In this fashion, it was expected that an overall picture of the state-of-the-art in document-based systems for management planning and control would emerge, and, further, that the classification framework would itself be thereby tested.

Twenty-two document-based systems which provide management planning and control information as a primary function were identified from the survey. While this set is clearly not exhaustive of those systems which have been reported in the literature as a whole, and, although many other systems exist which have not been reported, a representative picture does emerge. Interestingly, this picture is *not* one of an even distribution of systems across the four categories of the classification framework. In one category (strategic planning, intraorganizational information) no illustrative systems were identified. And, in the case of six related systems which resisted classification within the original framework, it was judged desirable that a fifth category (office communications) be originated.

A summary of the illustrative systems identified is presented in Figure 3. A profile of each system is presented in the Appendix. The numbering and sequencing of the systems in the Summary and the Appendix are identical.

Systems for strategic planning

Nine document-based systems were identified as useful in accessing extraorganizational

information within a strategic planning context. For the most part, these systems are organized as information utilities. A using organization subscribes to the services provided by the utility, and is charged according to some measure of actual usage. Access may also be obtained by means of brokers who conduct searches on multiple systems for a variety of clients. Most of the nine systems are reference-based systems, *i.e.*, they provide for the identification of certain types of documents, but do not maintain the documents themselves. Most of the systems also access multiple reference data bases, and there are certain overlaps among the systems in the subjects and documents covered. Many of these reference data bases originate in organizations other than those providing the information utility, and, in some cases, data base copies may be obtained directly from the originating organization if desired. Some of the utilities feature a document ordering capability to facilitate access to documents identified. Two of the systems (NAARS and FLITE) are available only to a specified population of users, while the majority permit general public access.

The picture which emerges is that of a rapidly evolving *network* of document-based systems and services, organized to provide various forms of access to the ever-increasing volume of information in the public domain. This information varies widely in subject coverage, and is not restricted to the traditional indexing of publications in the scientific disciplines. From a management perspective, of particular interest are the systems providing business and technology information (see the SDC Search Service, DIALOG™, and the New York Times Information Bank), legal information (see LEXIS, WESTLAW, and FLITE), financial information (see NAARS and DISCLOSURE®), and information on international trade (see INTERFILE).

As mentioned earlier, no document-based systems were identified as used for accessing intraorganizational information within a strategic planning context. One possible explanation is that access to intraorganizational document-based information poses no problem for planners; hence no systems have been needed. However, for the very large organization, this would seem unlikely [34]. A more likely explanation is that the state-of-the-art has not yet progressed to the

³The literature review involved a manual search of ten printed sources covering as a whole the time period 1968-1976:

Computer & Control Abstracts; Quarterly Bibliography of Computers and Data Processing; Journal of the American Society for Information Science; Proceedings of the American Society for Information Science; Information Science Abstracts; Business Periodicals Index; Library Literature; Current Journals in Education; Computing Reviews; and Applied Science & Technology Index.

I. Strategic Planning: Extraorganizational Information	(11) Intelligence Information System
(1) SDC Search Service (ORBIT®)	(12) ACDMS (Automated Control of a Document Management System)
(2) DIALOG™	(13) CDMAN (Computer-Based System for Control and Dissemination)
(3) New York Times Information Bank	IV. Operational Control: Intraorganization Information
(4) INTERFILE	(14) CUBE Registration System
(5) DISCLOSURE®	(15) CADM (Configuration and Data Management)
(6) National Automated Accounting Research System (NAARS)	(16) Engineering Drawing System
(7) WESTLAW	V. Office Communications
(8) LEXIS	(17) DAISY (Decision Aiding Information System)
(9) FLITE	(18) Augmented Knowledge Workshop (AKW)
II. Strategic Planning: Intraorganizational Information	(19) Paperless Office Project
No illustrations	(20) WILTEK
III. Management Control: Intraorganizational Information	(21) Electronic Information Exchange System (EIES)
(10) Construction Project Management System	(22) Management Work Stations (MWS)

Figure 3. Illustrations of Document-Based Systems for Management Planning and Control: A Summary*

*For a profile of each system, see Appendix.

point that organizations have ventured into the development of such systems. Current attention in intraorganizational document-based systems seems concentrated for the most part on the automation of routine office communications, as will be discussed shortly. It may be that this development must precede more sophisticated applications in the same way that the prior development of automated transaction processing systems preceded the current development of management database applications. It is also possible that some document-based systems of the intraorganizational, strategic planning type exist which have not been reported in the literature for reasons of organizational confidentiality.

Management control systems

Four document-based systems were identified for intraorganizational document processing in a management control context. In each case, the system appears custom-tailored to the organizational situation in which it was developed. The techniques employed were those typically associated with the indexing of a document collection in a library. In one case, the system was in fact developed from a library system. In three cases, the management control problem was specifically of the project organization type. Since the control of documentation in large projects is a well recognized problem, the appli-

cation of document-based techniques to this area appears particularly suitable. Notable here is the indexing of project documentation by item due dates, and responsible and originating groups. In these cases, the computer was issued to monitor project progress. Again, further developments in document-based systems for management control should be greatly facilitated by state-of-the-art advances in automated office communications.

Operational control systems

Only three document-based systems were identified for classification in the operational control, intraorganizational information category. In general, this type of document-based system is underrepresented in the literature surveyed. Of the three systems identified, one is used for the operational coordination of a convention, and two are based on the operational use of engineering documents. The usefulness of a document-based approach in the latter two cases is based upon the need to deal with images in the form of engineering drawings; hence the use of microfilm. While no processing of text is implied for such documents, the usual problems of indexing, organization, storage and retrieval are nonetheless present, as with all document-based systems. Thus, it may be that other systems dealing with image, as opposed to word, processing are typical at the operational control level in certain technical fields, e.g., in medicine, and that more systems might have been identified in this category if more specialized literature had been surveyed.

Office communication systems

Six document-based systems were classified as belonging to the special category of office communications. This category was not originally part of the classification framework. In the course of the survey, however, it became apparent that a variety of systems aimed at the automated support of routine office communications are of general interest to management planning and control, in terms of access to intraorganizational information. There was no clear fit within

the Anthony hierarchy, however. Thus, the special category was originated.

Notably, all six systems in the office communications category are experimental in nature and are products of current research and development efforts aimed at the "office of the future." Such systems have their origins in automated text editing systems for document preparation. But documents prepared by means of the computer may also be stored, accessed, transmitted electronically from location to location, and displayed for users of terminals dispersed throughout the organization. The need for paperwork handling may thereby be drastically reduced. This is the vision which has guided "office of the future" research. (For an excellent non-technical summary, see [30]. See also [9, 43, and 44]).

Although the six office communications systems do not appear to be directed primarily toward management planning and control, various management support functions included are noteworthy: computerized conferencing, mail and phone message handling, personal calendar and activity scheduling, and electronic notebooks and blackboards.

Steps toward the "office of the future" would appear to provide organizations with more potential control over their document-based intraorganizational information. This is the significance of the development from a managerial perspective. At the level of the automation of event-driven office procedures, the manager is simply enabled to "keep the ball in someone else's court" [44]. However, computer-distributed office documents may also be classified, indexed, organized, and made accessible for subsequent reference and retrieval throughout the organization. Thus, management may in the future have much improved access to intraorganizational document-based information for planning and control purposes.

Finally, the framework developed for the classification of document-based systems (see Figure 2) suggested that no systems of the extraorganizational source, management or operational control types would be identified. This was in fact the case, lending some support to the viability of the framework.

Conclusion

The use of document-based information systems in management planning and control is an area of emerging importance. Concepts and techniques which have heretofore been associated primarily with library information science must therefore now be considered relevant to designs for management information systems.

Document-based information utilities

Two major lines of development in document-based systems for management planning and control have been identified. The first is the recent growth in document-based information utilities which provide the manager with extensive access to extraorganizational sources of information in the public domain. The second is the development of managerial applications of intraorganizational document-based systems, which should be facilitated, in part, by current technological innovations in general office communications. Each of these lines of development raises some significant issues for the design of management information systems.

In the case of information utilities, the major question is: What steps should the organization take to make best use of these systems by planners and managers? This question is a significant one, for as public domain information continues to grow in volume, effective and efficient access to this information in support of strategic planning may become a competitive necessity.

At present, access to information utilities is likely to be an extension of the organizational library system. Should this continue to be the case? Or should more direct forms of use be encouraged, e.g., should planning groups acquire terminals and subscribe to services independently? Alternatively, should access to information utilities be directed centrally within an Information Services function responsible for other management information systems? How should the costs of using information utilities be accounted for and controlled? Where should the technical expertise in the use of information utilities reside, and how should this expertise be developed?

Effective and efficient use of information utilities in management may depend in large part on answers to these organizational questions, each deserving serious study and research.

Intraorganizational applications

In the case of the development of managerial applications of intraorganizational document-based systems, the major question is twofold: What form should this development take, and how should it be brought about? Again this question is a significant one to the extent that management planning and control can be facilitated by improved access to and control of intraorganizational documentation.

Only a handful of intraorganizational document-based systems now used for management planning and control have been identified. However, a strong impetus for the future development of such systems may be provided by the current widespread efforts in "office of the future" research. The routine computer-based preparation and transmittal of interoffice memoranda and reports suggests that these documents too may be subjected to classification and indexing for storage and subsequent selective retrieval, in support of management planning and control. At the strategic level, improved general access to intraorganizational documents may be of real value to planners seeking to assess organizational capabilities in the light of identified environmental opportunities. It should be noted that in large organizations it is often as difficult to know what is happening within the organization as without [34]. At the management control level, much improved control over project documentation is also foreseen.

Development responsibilities

In bringing this development about, an important organizational issue is: What organizational unit(s) should have primary responsibility for the development of office automation systems? To the extent this responsibility is not that of the organizational unit responsible for other forms of management information systems, development of managerial applications of intraorganizational document-based systems may perhaps be retarded. Much of the recent focus in office

automation has been in increasing the productivity of the secretarial staff, conceived narrowly as a typing pool [30]. More useful to management in the long run is the recognition, shared in part by the developers of the experimental systems identified in this article, that office automation systems are of significant potential as components of the overall management information system.

In conclusion, document-based systems do not by themselves constitute an answer to the long-standing problems of providing good management information. Data-based systems remain

of fundamental importance, as do the discourse methods employed in meeting and other oral interpersonal communications (see Swanson [34] and Back [5]). However, document-based systems do play a potentially important role. In fulfilling this potential, it will be necessary that MIS designers look beyond the usual techniques of data processing, to those associated with document processing, heretofore largely the domain of library information science. The convergence and integration of these techniques in support of management planning and control is thus foreseen.

APPENDIX. Illustrations of Document-Based Systems for Management Planning and Control: Profiles

I. STRATEGIC PLANNING: EXTRAORGANIZATIONAL INFORMATION

- (1) SDC Search Service (ORBIT®)
System Development Corporation
Santa Monica, CA

The SDC Search Service provides online access to indexes to published literature primarily related to business, science, and technology. It is available on a subscription basis. In a majority of organizations, searches are offered through a library or information center. A limited document delivery capability is provided, as the user may place a direct order for certain classes of documents which have been identified in a search. The reference data bases which cover the statistical publications of the U.S. Government (ASI); U.S. legislative activities (CIS INDEX, CRECORD); energy development (ENERGYLINE, P/E NEWS) and the general business literature (ACCOUNTANTS INDEX, MANAGEMENT AND INFORM) would be of particular interest to managers and staff involved in strategic planning (Wanger [40], Canning [11]).

- (2) DIALOG™
Lockheed Missiles & Space Company
Palo Alto, CA

Like ORBIT®, the DIALOG™ system allows domestic and international subscribers to interactively query indexes to published literature primarily related to business, science, and technology. Of particular interest to planners would be the reference data bases which cover international company, product and industry information (PTS F&S INDEXES), market information (PTS MARKET ABSTRACTS), the United States industrial economy (PTS EIS INDUSTRIAL PLANTS), domestic and international business statistics (PTS DOMESTIC STATISTICS, PTS INTERNATIONAL STATISTICS), and the general business literature (ABI/INFORM), (Canning[11]).

- (3) New York Times Information Bank
New York Times Company
New York, NY

Since 1973, the New York Times Company has operated a commercial information utility. Subscribers access the system interactively through a terminal to identify articles from the *New York Times*, as well as seventy other U.S. and foreign newspapers and magazines, including the *Wall Street Journal*, *Barron's*, *London Observer*, and the *Los Angeles Times*. Microfiche copies of the *New York Times* may also be ordered through the service (Canning [11], Blake & Frey [7]).

- (4) INTERFILE
World Trade Information Center
New York, NY

INTERFILE provides subscribers with on-line identification of information related to all phases of international business and trade. Subject coverage includes trade statistics, import and export regulations, and marketing research findings from both published sources and unpublished material contributed by member trade centers throughout the world. Document delivery is facilitated, as each abstract includes all information required to order a copy of the source document directly from its originator (Callahan [10]).

- (5) DISCLOSURE®
Disclosure, Inc.
Silver Spring, MD

DISCLOSURE® indexes reports filed with the Securities and Exchange Commission according to company line of business, legal matters, security transactions, financial reporting, banking matters and other business topics. Users may search the document base by means of a printed index and a monthly announcement bulletin. Once a relevant document has been identified, the subscriber may order a copy, either hardcopy or microfiche, from Disclosure, Inc. (Wall [39]).

- (6) NAARS (National Automated Accounting Research System)
American Institute of Certified Public Accountants
New York, NY

NAARS allows natural language searching of a document-base which includes prospectuses filed with the Securities and Exchange Commission, corporate annual reports, APB Accounting Principles, FASB pronouncements, and other information of interest to accountants. It is available to all AICPA members on a subscription basis. The system utilizes an interactive data base management system developed by Mead Data Central, Inc. (AICPA [1]).

- (7) WESTLAW
West Publishing Company
St. Paul, MN

WESTLAW uses a legal reference data base for the on-line searching of the headnotes for decisions reported in the National Reporter System. Coverage includes selected decisions of all state appellate and supreme courts, U.S. District and Circuit Courts, and all decisions of the U.S. Supreme Court. However, the system includes no statutory law. Full-text searching of decisions is planned for late 1977. The system is available on a subscription basis (Sprowl [33]).

- (8) LEXIS
Mead Data Central, Inc.
Dayton, OH

LEXIS provides natural language searching of the full text of selected Federal statutory law, precedents and administrative decisions, including the current versions of the U.S. Code, SEC

Rules and Regulations and the Internal Revenue Code. Statutory Law and precedents for selected states are also included. Subscribers search the data base interactively (Anderson, *et al.* [2] and Rubin and Woodward [31]).

- (9) FLITE (Federal Legal Information through Electronics)
U.S. Air Force
Lowry Air Force Base, CO

FLITE provides access to the U.S. Code, U.S. Reports, U.S. Court of Claims precedents and military law at no charge to employees in the U.S. Department of Defense, and at a flat rate to all other U.S. government users (U.S. Air Force [37]).

II. STRATEGIC PLANNING: INTRAORGANIZATIONAL INFORMATION

No illustrations

III. MANAGEMENT CONTROL: INTRAORGANIZATIONAL INFORMATION

- (10) Construction project management system
F. Hoffman - La Roche & Co. Ltd.
Basel, Switzerland

This pharmaceutical firm used a Keyword-out-context (KWOC) index to assist in managing a large-scale construction project. The index covered abstracts of all documents, decisions and rules that were relevant to the project. It was cited as being particularly useful in the planning of meetings and for orienting new team members (Balthasar [6]).

- (11) Intelligence information system
U.S. Naval Field Operational Intelligence Office
Fort G.G. Meade, MD

This U.S. Defense agency used a KWOC index to weekly intelligence reports to generate management information related to resource usage. Based on the frequency of entries related to a specific project, ratios were developed to compare personnel utilization on the agency's current projects. This management aspect of the index is no longer operational (Levine [21, 22]).

- (12) ACDMS (Automated Control of a Document Management System)
Johns Hopkins University
Applied Physics Laboratory
Silver Spring, MD

ACDMS was implemented in 1968 to monitor the progress of a project that had been transferred to a subcontractor by the Applied Physics Laboratory. It facilitated access to documentation flowing between the two organizations, and was developed from the Lab's Library SDI system. One function of the system was to monitor due dates that were related to specific pieces of documentation. An enhanced version of the system is currently operational (Komiske and Braunstein [19]).

- (13) CDMAN (Computer-Based System for Control and Dissemination of Routine Management Actions and Notices)
U.S. Air Force Special Weapons Center
Kirtland AFB, NM

CDMAN was designed to generate written communications for assisting an organizational unit in performing its assigned tasks. Action items and meeting notices are documented on a standard form which is subsequently keypunched for use in updating the system. Reports include listings of all action items assigned to an office, listings of all action items by due date, and a listing of scheduled meetings and other items of general interest to the entire staff. The capability to provide statistical data on the performance of various organizational units is planned for the future. The current system has been operational since Spring 1974 (Van Blairicum [38]).

IV. OPERATIONAL CONTROL: INTRAORGANIZATIONAL INFORMATION

- (14) CUBE Registration System
Burroughs Corporation
Detroit, MI

This system helped a computer manufacturer to manage its semi-annual customer meetings. Delegate registration forms were used to create a KWOC index which allowed product managers to identify which of their customers were attending the convention. The data base could also be accessed on-line during the convention. In addition, the data base was used to distribute post-convention materials and the pre-registration materials for the next meeting. Each registration document was assigned an identification number which allowed index entries to be traced back to the original source document (Culnan [12]).

- (15) CADM (Configuration & Data Management)
TRW Systems
TRW, Inc.
Redondo Beach, CA

This organization distributes engineering documents and data to its subscribers on microfilm aperture cards combined with punched cards. The CADM system helped to automate the distribution process, and further, provided document control over the entire collection by preassigning document numbers and by processing inquiries related to the status of documents in the collection (Curry [13]).

- (16) Engineering drawing system
North of Scotland Hydro-Electric Board
Edinburgh, Scotland

This public utility uses an automated system to store and retrieve an index to engineering documents stored on microfilm aperture cards. It will print out lists of documents by document number, structure location, contract number and approval status of the final document (Godfrey [16]).

V. OFFICE COMMUNICATIONS

- (17) DAISY (Decision Aiding Information System)
The Wharton School
University of Pennsylvania
Philadelphia, PA

DAISY was developed as part of a research project on office automation. It attempts to support the day-to-day activities of a manager by replacing paper and blackboards with an interactive terminal. The terminal's screen is partitioned into a number of windows based on user requirements. The terminal may be used concurrently, for example, for scheduling an individual's day, for storing mail and phone messages, and for evaluating outcomes of planning alternatives using a simulation model (Buneman, *et al.* [8] and Morgan [28]).

Document-Based Systems Management

- (18) Augmented Knowledge Workshop (AKW)
SRI International
Menlo Park, CA

The AKW system is part of a package developed at SRI to make workers engaged in the production of knowledge more productive. The AKW is accessed through an interactive terminal, and can be used to create, store, edit and retrieve documents, and to "publish" formatted documents in hardcopy or microform. The system also facilitates communication among individuals with similar interests by means of teleconferencing, and by providing for permanent cataloging and subsequent distribution of any document in the file (Englebart, *et al.* [14], Meyer [27], Norton *et al.* [29], Watson [41]).

- (19) Paperless office project
Information Sciences Institute
University of Southern California
Marina Del Rey, CA

Like the Wharton School, ISI is also conducting research related to office automation. The system developed, which has capabilities for electronic mail, report editing and daily activity scheduling, is connected to the ARPANET, thereby making communication possible outside of the University (Ferreira and Nilles [15]).

- (20) WILTEK
WILTEK, Inc.
Norwalk, CT

WILTEK has developed terminals and software to allow an organization to operate a network for transmitting mail electronically using its own computer system. System capabilities include text editing, message transmission, and the storing of messages for request by the addressees ("When the Interoffice Mail . . ." [42]).

- (21) Electronic Information Exchange System (EIES)
New Jersey Institute of Technology
Newark, NJ

EIES, originally designed to support computerized conferencing, allows groups of remote users usually numbering five to fifty to hold a common discussion on a topic and to maintain a proceedings for later reference. In addition, any individual may send a private message to any other participant. The system also maintains "notebooks" of working documents which may be shared among participants, and "bulletins" which are public reports. All of the documents maintained by the system may be accessed from a terminal on a real-time basis. The system could also be used for maintaining the documentation and facilitating the discussion required to support management decision-making when the participants are dispersed geographically (Turoff and Hiltz [36]).

- (22) Management Work Stations (MWS)
Citibank
New York, NY

Citibank has operationalized the automated office concept by installing terminal-based management work stations for use by a selected group of managers and secretaries. The stations are used to generate and transmit correspondence electronically between member stations and to maintain an individual's electronic in-basket which includes a calendar and a phone message log. Managers may use the MWS to access customer and financial data required for planning, control and daily decision-making (White [43]).

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