moves to develop an extensive network of ATMs and develop interchange links with a major competitor bank.

Developmental work on the 'Integration of customer data' and 'Consolidation of applications' began three years ago after a worldwide search for a replacement banking system, following a merger in the mid-1980s. Bank Five's information systems could not provide the products and services resulting from the merger and the anticipated growth in transaction volume. The variety of separate applications had inadequate flexibility and integration for the Bank to compete effectively in the newly competitive markets. In 1985, a deliberate decision was taken to develop a new core system as a future investment. The system itself could then become an information product available for purchase by other financial systems.

The IS/T manager saw the major problem with this development as the temptation to confuse the sophistication and technical features of the new system with business benefits. The outcomes of IT strategy had to be turned into business benefits. The benefits were not automatic and would have to be earned by the system's integration and use in organizational and business activities.

1.12 Summary

Bank Five was currently an average performer in IBCA, but had made major investments to achieve a leap forward to better the efforts of competitors. The Bank now had a planning process in place which operated on a three year cycle, with a strategic orientation focused on growth in order to provide greater profitability through improved service quality and productivity.

Major information problems were in the customer information and managing information areas. At the same time, senior business managers required greater technology expertise and understanding, and technology-related areas needed to improve their business requirement identification skills.

2. Strategic Planning Analysis

Internal documents indicated that Bank Five's purpose and mission in 1989 was to be a pervasive and cost effective supplier of 'financial (information) services' to Australian and New Zealand markets; and to develop an international presence by exploiting and developing niches based on strengths, with particular emphasis on
developments in the Pacific area. The strengths were in the capital markets and treasury areas.

In the domestic area, strategic business objectives were product diversification building on transaction based links with clients. The Bank was about 'information intermediation' and 'information merchandising' and was a 'system operator' and 'information packager'. In late 1989, management focus was seeking to shift from asset growth to profit.

Documentation from 1989 about the new core system stated that the shift to deregulation and competition in the Australian financial services industry had created an opportunity for the Bank to establish a sustained competitive advantage using information technology. The system was aimed at providing both business and technology support for the Bank's competitive strategy. This strategic system would enable the Bank to gain a competitive advantage in five areas: by offering facilities to differentiate on product and customer service; by more accurately managing the Bank's risk finances; by reducing the cost of new services; consolidating applications into a few product families; and supporting expansion through growth, mergers and acquisitions. The principles on which the system was developed were productivity, flexibility and responsiveness.

Consistently in the Bank's internal documentation was the notion that this investment in technology was aimed at giving the Bank a technology-based competitive advantage.

3. Information Services Infrastructure

In 1989 Bank Five was grouped into seven broad sectors, two of which operate across the other sectors but as GHQ units. Information systems and technology related units function as part of one of these units. The heads of each of the sectors form an Executive Committee.

In 1987 the Retail sector had undergone a restructuring of its state grouping which had removed one level of management. Regional managers were then responsible for their business unit bottom-line performance and the flatter structure meant shorter communication lines. Early in 1990 the Bank put in place a revised structure in which the Bank's core activities reported to the chief operating officer. There was
then a further division into geographic areas, with Australia being subdivided again by both type of banking and geographic area.

The mission statement of the IS/T area early in 1990 was to meet the IT needs of the Bank's business through the timely delivery of quality products and services. The IS/T group were to work with business 'partners to achieve sustained competitive advantage' and to assist business partners to realise the opportunities from the Bank's technological investments. The success of IS/T was achieved through effective implementations in business units.

In Bank Five, business units were seen as clients to whom IS/T aimed to provide a development and operational service at competitive prices.

4. Annual Reports

4.1 Discussion of Strategy

The annual reports for Bank Five showed that greatly increased attention was given to the discussion of strategy and strategic directions from 1985 to 1989. The 1985 report did not refer to the Bank's overall mission or objective and the discussion of strategy was limited. In the Retail area strategy was based on segmentation of markets, improvement in the effectiveness of customer contact, improved access for the more common banking transactions, and attention to cost control and value for the customer. Life cycle needs formed the basis of the design of financial packages for individuals. Developments in customised services for specific industry segments formed part of the report on commercial banking.

The corporate philosophy of Bank Five was listed in the 1986 and subsequent reports. In introductory pages the Bank was referred to as a 'financial intermediary'. The CEO's letter indicated that the Bank's long term strategy was one of growth, centred on three basic and mutually reinforcing 'streams': cost-efficient development of base markets, selective regional expansion and development of a stronger presence in major capital markets. In order to achieve these aims, the Bank had extended and refined its domestic and international markets, expanded the range and depth of its financial services, and worked on improvements in productivity and cost-effectiveness.
From 1987, sections on strategy formed an integral part of each of the annual reports. The key to long term growth in earnings per share in 1987 was seen as a strategy of increasing product diversification, while maintaining leadership in domestic markets and pursuing selected global markets. Bank Five saw itself becoming a 'financial information intermediary', with investment in advanced technology and its application to the financial services industry as establishing a 'competitive advantage'.

In the 1988 report, the Chairman of Bank Five described the Bank as a 'financial services group'. The Bank's 'strategic directions' in the 1988 and 1989 reports occupied three pages. The CEO's 1988 letter referred to the Bank's 'careful strategic planning and positioning' which held the key to the Bank growing sufficiently in size to remain competitive on a global basis. The strategy approaches included extension of domestic product ranges and services, strong technological capabilities and global expansion.

The achievement of the Bank's 1989 objectives was to be pursued through eight strategies. These included the maintenance of the Bank's domestic position, expansion overseas by acquisition, improved productivity, product innovation, enhanced customer service, profitability-oriented management systems and controls, and the integration of business, people and technology to create 'sustainable competitive advantage'.

4.2 Organizational and Structural Changes

There is very little overt reference to organizational and structural concerns and changes in Bank Five's annual reports. The 1985 report refers to selective reorganization of the Retail branch structure into a network of local and district centres. The organizational charts in the annual reports of 1987 to 1988 do reveal an expansion in the number of Business units or groups. However, these annual reports do not indicate concerns about structure during 1985 to 1989, though the organizational charts indicate that there were changes related to the expansion and diversification of business activities.

4.3 Information Technology References

Information technology references in CEO's letters showed a marked increase over the period 1985 to 1989, with IT phrases more than doubling (See Figure Appendix
The dramatic increase from 14 references in 1987 to 51 in 1988 needs to be slightly tempered by acknowledgement of a different form of annual report in 1987, with 11 pages of pictorial highlights and minimal words interposed between the Chairman's and CEO's letters. There were an additional seven IT phrases mentioned in those pages, the content of which is referred to further on.

**Figure Appendix 5.2  IT phrases in Bank Five annual reports**

<table>
<thead>
<tr>
<th>Context and Nature of the Phrase</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>85</td>
</tr>
<tr>
<td><strong>1. Financial Performance</strong></td>
<td></td>
</tr>
<tr>
<td>1.1 Neutrally stated IT expenditure</td>
<td>1</td>
</tr>
<tr>
<td>1.2 Favourably stated IT expenditure</td>
<td></td>
</tr>
<tr>
<td>1.3 Unfavourable stated IT expenditure</td>
<td></td>
</tr>
<tr>
<td><strong>2. Major Event of the Year</strong></td>
<td></td>
</tr>
<tr>
<td>2.1 Investment in IT to offer products</td>
<td>12</td>
</tr>
<tr>
<td>2.2 Investment to change production/prodn econs</td>
<td>7</td>
</tr>
<tr>
<td>2.3 IT executive change</td>
<td></td>
</tr>
<tr>
<td>2.4 IT organization/reorganization</td>
<td>1</td>
</tr>
<tr>
<td>2.5 IT consolidation, incl security</td>
<td></td>
</tr>
<tr>
<td>2.6 IT positioning/repositioning in the firm</td>
<td>1</td>
</tr>
<tr>
<td>2.7 IT repositioning in the industry, alliances</td>
<td>2</td>
</tr>
<tr>
<td>2.8 Education, health and safety considerations</td>
<td>2</td>
</tr>
<tr>
<td><strong>3. Future Outlook</strong></td>
<td></td>
</tr>
<tr>
<td>3.1 Investment in IT to offer products</td>
<td>1</td>
</tr>
<tr>
<td>3.2 Investment to change production/prodn econs</td>
<td>2</td>
</tr>
<tr>
<td>3.3 IT executive change</td>
<td></td>
</tr>
<tr>
<td>3.4 IT organization/reorganization</td>
<td>1</td>
</tr>
<tr>
<td>3.5 IT consolidation, incl security</td>
<td></td>
</tr>
<tr>
<td>3.6 IT positioning/repositioning in the firm</td>
<td></td>
</tr>
<tr>
<td>3.7 IT repositioning in the industry, alliances</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total occurrences by Year</strong></td>
<td>26</td>
</tr>
</tbody>
</table>
The highest number of IT phrases referred to investment in IT to change production or the economics of production (28%), and over 63% of these phrases occurred in the 1988 and 1989 reports. Investment in IT to offer products accounted for 26% of all IT references. The 1987 report signalled major developments in the IT area in the five 'IT consolidation' mentions in the Bank's future outlook. More than 84% of the 'future investment in IT' phrases (categories 3.1 and 3.2) occurred in the 1988 and 1989 reports.

The predominance of technology references in the later reports is confirmed in all indicators listed in Figure Appendix 5.3. Even allowing for the variation in the length of letters, the 1988 and 1989 reports have more IT phrases per paragraph and a greater percentage of paragraphs with IT phrases, with the 1989 report being the highest on both counts.

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Year</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number of IT phrases</td>
<td>85</td>
<td>86</td>
<td>87</td>
<td>88</td>
<td>89</td>
<td>Aver</td>
</tr>
<tr>
<td>2. Length of letter in paragraphs</td>
<td>126</td>
<td>111</td>
<td>74</td>
<td>163</td>
<td>146</td>
<td>124</td>
</tr>
<tr>
<td>3. Phrases per paragraph</td>
<td>0.21</td>
<td>0.16</td>
<td>0.19</td>
<td>0.31</td>
<td>0.37</td>
<td>0.25</td>
</tr>
<tr>
<td>4. Number of paragraphs with IT phrases</td>
<td>12</td>
<td>6</td>
<td>8</td>
<td>22</td>
<td>26</td>
<td>14</td>
</tr>
<tr>
<td>5. Percentage of pars with IT phrases</td>
<td>10</td>
<td>5</td>
<td>11</td>
<td>13</td>
<td>18</td>
<td>11</td>
</tr>
</tbody>
</table>

The quantitative aspect of references to IT is reinforced by a qualitative review of the contents of all parts of the annual reports from 1985 to 1989.

The 1985 Chairman's letter noted that progress towards objectives required the Bank to make full use of the advantages of modern information handling methods. Emphasis in the specific technology mentions was on mechanisms for electronic banking and funds transfer. In 1986, the CEO saw the increased use of electronic processing as a component in Bank Five's efforts to achieve the most efficient and competitive use of resources. The use of computers and management information formed a part of the efforts to improve productivity.
Though the 1987 report does not contain a high number of IT phrases, the content and placement of these references marks the beginning of a different phase in the Bank's IT activities. In the 11 pages of 'highlights', the Bank's ability to harness technology was seen as a major strength: the electronic banking installations and services were described as having the potential to generate substantial competitive advantages in product design and delivery; and 'appropriate technology' assisted the Bank's staff to meet changing customer requirements successfully. The Bank's continuing investment in advanced technology was aimed at establishing a competitive advantage in applying that technology to the financial services industry.

The 1987 report has four paragraphs on the Bank's major investment in redeveloping its software systems into a single integrated system, based on reusable modules. This system was aimed at enabling greater flexibility in the development of new products.

This emphasis on the role of technology was confirmed in the content of Bank Five's 1988 annual report. 'Productivity and technology' was seen as a major strategy 'stream', with investment in the new core systems increasing the speed and flexibility with which financial products could be designed and developed. Successful implementation of technological strategies had 'fundamental implications' for the Bank's productivity and competitiveness. In the 1988 and 1989 reports, acknowledgement was given to the Bank's IT Services component with was providing technology information-based products to the information services industry.

Technology or systems was referred to in three of the eight avenues by which the Bank would achieve its 1989/90 objectives in the 1989 report. Technology investment was linked with improved productivity. The CEO indicated that the Bank's heavy investment in IT developments was giving the Bank a competitive edge which would become more apparent at the decade progressed. In its financial control, the Bank was seeking to gain an advantage from the management of its data and information.

Based on an analysis of the Bank Five's annual reports, there had been a major shift in the role of technology and the management of information and data from 1987 onwards. This is reflected in both the number and nature of IT references in the annual reports, with the later reports emphasising the Bank's technology
investments as being a source of improved productivity at present, and a source of competitive advantage in the future.

4. Bank Five Summary Situation

The IS/T manager in Bank Five did not see the Bank as having achieved any major advances in IBCA to date. However, the Bank had made a major commitment to achieve competitive advantage in the future by its technological capabilities and the development of a new banking system. This decision had been a deliberate one after a worldwide search for suitable software to match the Bank's business needs.

The Bank had undertaken a program of growth by acquisition, and organically with the initiation of new products, services and businesses. This growth was seen as necessary to provide a sufficiently large base from which to provide cost-effective products and services. Cross-selling of products and services, from that base, was an integral part of the organic growth plans of the Bank.

In 1989 Bank Five saw itself in the business of 'information mediation' as a financial institution providing financial information services. The Bank was also in the business of creating, maintaining and marketing technology and information-based products to the information services industry.

The information and information technology orientation of Bank Five appeared to have taken a quantum leap in 1987 with the announcement of major technology investment. That investment was aimed at providing a sustained technology-based competitive advantage for the Bank.
APPENDIX 6

'Information and Information Technology Management'

- Publication from part of the Thesis
INTRODUCTION

The intent of this chapter is to elucidate and to chart the rapidly increasing attention that the field of business administration is giving to information and information technology (IT). As a token of that increased emphasis, one can point to the number of articles in two of the bellwether general management journals—Harvard Business Review and the Sloan Management Review—that in the decade 1977–1986 contained either the phrase "information systems" or "information technology" (or equivalent abbreviations such as MIS (management information systems) or IT) in their titles. Between 1982 and 1986 the increase was fivefold (Figure 1).

This chapter reviews the various strands comprising this increased emphasis, highlighting the key concepts and literature of each strand and relating the strands to each other. It does not purport to be and cannot be a comprehensive review of each strand. Each of these strands could be the subject of a review article (see, e.g., LTILE). It is not surprising to note however that in this rapidly developing area, a review article such as Lytle’s is very much the exception and not the norm. The focus of this chapter is on the developments of the past decade, but since there has been no very closely related previous chapter in ARIST, at least in scope, key articles from earlier years are also discussed. The principal strands of managerial attention to information and information technology that are discussed here are listed below. The outline format suggests a quasi-hierarchical relationship among the strands.

\[ 1 \text{ Present address: Rosary College, River Forest, IL.} \]

Annual Review of Information Science and Technology (ARIST), Volume 23, 1988
Martha E. Williams, Editor
Published for the American Society for Information Science (ASIS)
By Elsevier Science Publishers B.V.
• Strategic uses of information technology
• Competitive advantage
• Information and strategic decisions
• Recognition of the importance of external information
• Evolution of MIS to DSS (decision support systems)
• Decision analysis
• Design of automated information systems
• Data and data flow-driven design
• Information resources management (IRM)
• Information operations management
• Stage hypotheses
• Convergence of the archipelago
• Minimization of unallocated cost
• Information technology and organizational structure
• Information technology and productivity

This list also serves as a table of contents for this chapter.

![Figure 1. Information systems and information technology articles in Harvard Business Review and in Sloan Management Review.](image)

**Background**

Since the early 1970s, the information literature has been elucidating the importance of managing the “data resource” and managing “information technology” in organizations. The progression through “management information systems” and “decision support systems” to “information resources management” and “strategic information systems” is now being matched in the general management literature by identification of information as a
“strategic weapon” and the notion of “information” and “information technology” for “competitive advantage.”

In reviewing the literature of organizational information requirements, YADAV observed that the area spanned “two isolated territories” that were rarely linked. The first was that of “organization and management” while the second belonged to “technicians.” Yadav was correct up to a point, but his analysis did not adequately acknowledge the hybrid territory of “information management” as defined by MARCHAND (1982). The past five years have seen the emergence of expanded vision and interest in the management of information resources by organizations.

This article argues that in some areas the isolated territories are moving toward each other or are at least becoming more aware of each other’s existence. At the same time, related and hybrid territories and concerns have emerged that serve to reinforce the notion of the centrality and importance of the management of information resources by organizations. Converging concerns about the information management practices of organizations are the focus of this article. These concerns are evident in the recent literature about automated information systems, strategic planning, general management, and business and information resources management.

This article charts some of the converging concerns, particularly the increased emphasis on organizational information requirements and strategic information systems by the technicians and increased emphasis on the importance of the information resource management function and on managing information for competitive advantage in the general management literature.

**STRATEGIC USES OF INFORMATION TECHNOLOGY**

Over the past five years, the mainstream management and business literatures have revealed parallel concerns regarding the role of information and information technology but their perspectives, expectations, and approaches have been different. These concerns were not overtly evident previously.

In the early 1980s, GERSTEIN & REISMAN identified the strategic potential of computer technology but expressed puzzlement at the underutilization of data processing as a strategic resource. A major reason for this underutilization was seen in the different orientations of business managers and data processing specialists.

In three much-quoted Harvard Business Review articles, MCKENNEY & MCFARLAN, MCFARLAN ET AL., and MCFARLAN & MCKENNEY used the term “information archipelago” to denote the “islands” that comprise the “archipelago of information” in organizations: office automation, telecommunications, and data processing. These authors saw a need for changes to the organizational structures for information services that should be managed in a coordinated and, in many companies, integrated manner. These articles, aimed at a generalist audience, analyzed some of the issues facing organizations in the management of information and technological “islands” and in the strategic significance of information systems. However, they did not in-
corporate other information centers and records management functions, revealing perhaps a narrower outlook than might at first be apparent.

Competitive Advantage

A continuing emphasis on the importance of information technology and competitive strategy can be seen in informative and thoughtful contributions to both the practice- and research-oriented literature by writers such as BAKOS & TREACY, BENJAMIN ET AL., BURCH, DIEBOLD (1986), IVES & LEARMONTH, MCFARLAN, MILLAR (1986), PARSONS, and WISEMAN & MACMILLAN. Good summaries and comments on this area can be found in works by EARL, EARL & RUNGE, MUNRO & HUFF, and TREACY. In an unpublished bibliography prepared in the first half of 1987, IVES listed over 70 items on the theme of strategic computing published since 1982. Most of the articles came from the general business and management journals.

The work of PORTER (1980) on industry analysis and competitive strategy and that of ROCKART (1979) in identifying techniques to measure critical success factors have been referred to in a considerable number of the works referenced above. IVES included further items to assist in identifying industry and organizational characteristics and purposes. ROCKART & CRESCEZI presented a three-phase process for systems design based on the identification of critical success factors and the use of rapid prototyping. PORTER & MILLAR drew drew on Porter's more recent work (PORTER, 1985)—on the value chain for analyzing the activities of a firm—to illuminate the notion of information intensity and differences in the role and intensity of information among various industries. CLEMONS & MCFARLAN have used the value chain notion to identify the effect telecommunications could have in each area of a firm's activities, while LINDNER & IVES have further developed Porter's notion of information intensity and looked more closely at its implications in organizations.

VITALE appears to be the first to warn about the risks of information systems successes. While acknowledging that the use of information systems for competitive advantage was one of the major business stories of the 1980s, Vitale identified some unintended, and unexpected, negative organizational and competitive consequences of technical successes. One example was that of a major New York bank which found that a consequence of its new integrated customer information system was that customers more frequently shifted funds among accounts to the customers', not the bank's, benefit.

WISEMAN & MACMILLAN state forcefully that strategic information systems were radically different from other applications of computer technology, such as management information systems and management support systems. While acknowledging the contribution of ANTHONY's planning and control paradigm to the field, Wiseman and Macmillan argued that conventional perspectives of planning and control could not take account of strategic information systems opportunities and that a new perspective—the strategic perspective—was needed.
In 1985 WISEMAN (1985) could claim his work Strategy and Computers: Information Systems as Competitive Weapons as the first book devoted solely to the use of information systems as competitive, strategic information systems. Since then works by KEEN (1986), MARCHAND & HORTON, and SYNNOTT have focused on ways to use information and information technology for competitive or strategic advantage, and Pergamon Infotech Ltd. published Information Management State-of-the-Art Report (GRIFFITHS), which included a number of key articles on this theme.

The burgeoning general management literature on strategic uses and implications of information and information technology highlights some of the crossover that has been taking place in both the information systems and management literatures. Since 1982 there appears to have been a considerable upsurge of interest in the more effective utilization of information and information technology as reflected in the mainstream management and business literature. Sloan Management Review, Harvard Business Review, Business Quarterly, Columbia Journal of World Business, Journal of Business Strategy, and Business and Economic Review are publications in which the works cited in this section have appeared. At the same time, journals devoted to information management and systems appear to have widened their focus on strategic business concerns and on aligning information systems strategy with corporate strategy.

INFORMATION AND STRATEGIC DECISIONS

Throughout the 1960s and 1970s, King and Cleland (see, e.g., KING & CLELAND, 1975; 1977; 1978) were significantly ahead of their contemporaries in writing about the interrelationship of various organizational dimensions, including management systems and procedures, information systems and organization structures. In their 1978 work Strategic Planning and Policy, one chapter is devoted to information for strategic planning. They made quite explicit the view that the development of strategic planning MIS should not be taken to refer exclusively to computerized information systems and stressed the importance of external information in initiating the planning process.

KING (1983) questioned the distinctive nature of DSS in the sense propounded by KEEN & STABELL when he drew attention to the fact that much of what was being written about the goals of DSS was similar to what had been espoused as the purposes of MIS a decade previously. KING (1984; 1985) described a circular information planning process for achieving an information-based competitive advantage based on the premise that a company’s business strategy must match its information strategy. He identified a number of examples of how information technology is used for corporate growth and claimed that these indicated fundamental changes to the way some firms will grow and prosper.

Perhaps what had developed since the late 1970s and the mid 1980s was a more sophisticated appreciation of the many different types and levels of
support that might be required within a particular organizational setting. This is at the heart of a recent eloquent exposition of decision support systems as strategic management tools for the 1980s (REIMANN) and is reinforced by the special issue on the strategic management of technology in the April 1986 issue of the journal LONG RANGE PLANNING (p. 21-64).

In 1982 SHUMAN questioned whether strategic planning was an area in which less information might mean better decision making and made valid points regarding the need to link strategic planning information gathering to basic sets of goals and objectives. Shuman argued that strategic planning information systems ought to be automated only with the greatest care. He was critical of information specialists whom he saw as largely accustomed to thinking of information as technical and basically limited to operational applications. In the same year, LUCAS & TURNER used the phrase "strategic information needs of management." These needs could be computer based or manual, formal or informal.

Two years later, MILLAR (1984) used case studies to emphasize that an information structure should be developed according to corporate management's selection and definition of strategic success factors. Millar pointed out that one of the major difficulties in developing an appropriate information structure was that no one person is responsible for information within an organization. He suggested the appointment of a chief information officer to oversee the merger of strategic planning and information processing. These and other measures might go some way toward bridging the gap between information processing and corporate planning.

TOZER drew on his background in planning projects in a variety of industries to propose a four-phase approach to the development of an information systems strategy that would provide adequate support for higher levels of management. Tozer's description of information architecture was not necessarily technology-based, and it focused on the "information view" of an organization.

The area of corporate and competitor intelligence has long been overlooked among the uses of information for strategic management and planning, particularly the uses of external information. PERELMAN saw business intelligence as the industrial equivalent of military intelligence and an essential ingredient of strategic management. Two recent books, Business Competitor Intelligence (SAMMON ET AL.) and Competitor Intelligence: How to Get It, How to Use It (FULD), provide examples of rising interest in sources of external strategic information.

Recognition of the Importance of External Information

A related development—more accurately a subtheme—has been the increasing recognition of the importance of external or exogenous information to strategic decision making. Here exogenous information is defined more broadly than the concern of PERELMAN, SAMMON ET AL., and FULD for competitor intelligence.
In 1985 Rhyne published his empirical study of the relationship between corporate-level planning and information systems. He found strong support, at higher levels of planning, for the importance of external and environmental information. Future-oriented, external, and environmental types of information were found to be strongly correlated with planning sophistication. Rhyne commented, however, on the lack of formal environmental information systems in the field study part of his research.

One of the reasons for the absence of formal environmental information systems could be found in the work of Ghoshal & Kim, which referred to the poor performance of formal units established to monitor and interpret the environment and to provide business intelligence. These authors attributed increased interest in external information and environmental intelligence to trends in global competition, the volatility of the business environment, and the diffusion of managerial capabilities. They claimed that to be effective and useful, intelligence systems need to provide a better balance between the information received, wanted, and needed by a manager.

Both Holmes and Köenig (1986a) argue that the principal reason for the disenchantment with MIS systems in the late 1960s and 1970s was the failure to appreciate the role of external information in managerial decision making; further much of the concern and misgivings about MIS systems (Ackoff; Dearden, 1972), while not incorrect, were not focusing on the most appropriate target, the fact that most MIS systems were limited to data generated from internal operations. Most MIS systems, Holmes and Köenig argue, were processors of only an organization’s own internal data, typically producing various aggregations of transaction data; yet as one goes higher up the ladder of managerial decision making, proportionately less use is made of internal data and more use is made of external data and information as graphically pointed out by Hurtubise. That is, while operational control uses primarily internally generated data, managerial control and strategic decision making use primarily external data.

Although the interest in information for strategic planning and decision making has been a prominent feature of some writers and researchers for some time, even a cursory examination of the literature of strategic planning reveals a heightened awareness of the potential of information systems and services for the strategic concerns of organizations. Increased importance is being placed on harnessing external information as an input to strategic decisions.

Evolution of MIS to DSS

Much of the literature on operational business information systems has focused on the development or transition from MIS (management information systems) to DSS (decision support systems). This change in terminology was to a large extent the result of dissatisfaction with the inadequacies of the
much-touted MIS systems (ACKOFF; DEARDEN, 1972). There have been charges that DSS is simply old wine in a new bottle, simply a response to the basic marketing precept that if one wishes to reintroduce a failed product, one must give it a new name; there is probably some validity to that charge. DSS has not replaced MIS as an operational term and in fact is now becoming less popular. What would have been called decision support systems a few years ago are now being called expert systems or artificial intelligence (AI) or knowledge programming (a blanket term for expert systems and AI).

Nevertheless, the DSS phenomenon did reflect some genuine changes in perspective. One change, as referred to earlier, is the recognition that the more strategic and higher the managerial level that was involved, the greater was the reliance on exogenous rather than endogenous information (HOLMES; HURTUBISE; KOENIG, 1988a; SENN; SYNNOTT & GRUBER). Another was the recognition that managers are not used to being told how to perform. After all, the business culture applauds the principle of giving the manager the goals and letting the manager determine the means, and systems for managers need to reflect that principle. The third point is that systems need to be user friendly, a somewhat belated recognition of Moore’s law. That is, an information system will be used only if it is more trouble not to use it than it is to use it. There has been increasing recognition that MIS systems were simply not being used in the proactive fashion intended by their designers; rather a manager typically uses an MIS system in a defensive way (ALTER).

A major part of the DSS philosophy was to design systems that would be attractive enough so that managers would want to use them.

Decision Analysis

The development of decision analysis by the Rand Corp. (MENKE; MILLIKEN & MORRISON) has also focused attention on the relationship between access to information and strategic planning. In brief, the basic notion of decision analysis is that when strategic alternatives are compared, they are often treated as though the uncertainties involved can be adequately represented as point probabilities whereas in fact, those uncertainties can be much better represented by probability curves. The choice among alternatives is then a “cost lottery” with the choice being made on the basis of stochastic dominance.

Given such a situation, we can then estimate the expected value of perfect information (EVPI) or, alternatively, the expected cost of making a decision based on less-than-perfect information. That is, we can estimate the chance that even though we have selected the statistically correct alternative, that another alternative would have in fact been better. Thus, at any decision point, another alternative is to gather more information and return to the decision point; other factors being equal, that alternative should be pursued if the cost of gathering more information is less than the reduction of the EVPI that will be accomplished. In practice the calculation of an EVPI is seldom straightforward because the uncertainties affecting the alternatives
have a high degree of collinearity and are not statistically independent. Nonetheless, the argument that there is an EVPI, and that an alternative that should always be explicitly examined is to recycle and gather more information, has created a greater awareness not only of the information dependence of strategic decision but of the importance of explicit attention to the information acquisition process.

DESIGN OF AUTOMATED INFORMATION SYSTEMS

In 1967 ACKOFF argued that MIS designers made five assumptions that are often not justified and thus produced systems with major deficiencies. While Ackoff's suggested solutions might be judged as overestimating the potential role of MIS in the decision-making process (particularly in the late 1960s), his criticisms 20 years ago remain concerns of those who seek to provide what EIN-DOR & SEGEV described as individual and organizational "fit" of information systems.

Throughout the 1970s, a number of key writers sought to span YADAV's "isolated territories" by attempting to embed automated information systems firmly into frameworks that more overtly acknowledged the range and nature of organizational requirements. Gorry & Scott Morton drew on Anthony's three-tiered taxonomy of managerial activity (strategic planning, managerial control, and operational control) (Anthony) and Simon's distinctions between programmed and nonprogrammed decisions to develop a matrix that identified three types of decision-making situations: structured, semistructured, and unstructured. Information requirements differed sharply in these three activity areas. Gorry and Scott Morton acknowledged that planning for information systems had resulted in a heavy concentration in operational control.

In 1974, Davis (1974) published the first edition of Management Information Systems: Conceptual Foundations, Structure, and Development. This work sought to provide a conceptual framework for information systems in organizations, and it met some of Ackoff's concern. In the 1985 edition Davis & Olson described a shift in emphasis in organizations from computers and data-based information processing to information as a strategic resource and to an expanded role for information technology. This expanded role was often termed information resources management (IRM) and usually included related activities of data processing, data communication, and office automation.

In viewing information as a process and decisions as the functions within organizational information structures, Tricker (1977) distinguished three levels of systems within organizations (organizational, operational, and technical) and stressed the interdependence among information systems, organizational structures, and management styles. In a later work, Tricker & Boland questioned the applicability of Anthony's hierarchical view of management control and decision processes, now "enshrined in most books on strategy." Tricker and Boland argued that in modern complex organizations
Anthony's neat, militaristic configuration seldom fit reality. They suggested that a more suitable model might be that of a "barrel of resources" controlled under policy guidelines of corporate strategy. Their work was important for stressing the organizational context of information systems and introducing the notion of the strategic significance of information systems.

KEEN & SCOTT MORTON provided a sound organizational perspective to decision support systems in their 1978 text when they acknowledged that decision support requires a detailed understanding of decision making in organizations. They classified the literature into five main schools of thought ranging from the entirely normative to the entirely descriptive. They argued that the fields of management information systems and management science with their analytical and technical approaches had almost entirely ignored descriptive modes of the decision process.

The field of "decision support" was seen by KEEN & STABELL as having evolved from the two areas of organizational decision making and technical work on interactive computer systems. The differences they described between the fields of decision support and management information systems provided considerable overt recognition of the difficulties in providing computer-aided support in the managerial environment of complex and non-programmable activities. KEEN (1981) later stressed the pluralistic nature of organizations when he argued that information systems development was a political as well as a technical process. Keen's work was particularly useful because it articulated many of the reasons for resistance to the implementation of information systems. For example, it had long been recognized that clerical operating systems such as word processing provided good data for evaluation of individual personnel, but Keen was the first to stress that higher-level information systems could be used to evaluate managers and that represented a major source of resistance.

DUMAS made a timely contribution to information systems perspectives by the way in which he sought to link MIS to the information processing model of organizations. Dumas used the work of MASON & MITROFF to emphasize what is basically a contingency approach to the design and operation of MIS. In arguing for a more balanced relationship between MIS users and designers, Dumas recognized that any organizational structure not only imposed requirements on information processing but also possessed inherent capabilities for information processing. At a more pragmatic level, CARROLL drew from the literature of the change agent to explicate the role of the MIS designer and to contrast the cultures of designer vs. user.

Both DAVIS (1982) and PARKER (1982; 1985) attempted to develop frameworks and techniques to help "technicians" identify the kinds of information systems required by organizations. Davis described two levels at which information requirements needed to be established: 1) at the level of the whole organization, and 2) at the level of application requirements. Davis acknowledged the limitations of humans as information processors and proposed a contingency theory for selecting the most appropriate strategy (or combination of strategies) for identifying pertinent information requirements. SULLIVAN (1985) developed a diffusion (extent of use of information tech-
nology) vs. infusion (impact of information technology) array to guide in
the selection of system planning methodologies. CAMILLUS & LEADER
developed a three-dimensional system planning matrix based on: transaction
processing vs. DSS posture, policy stance (strict vs. flexible), and present
hardware configuration. The inclusion of the third factor, while perhaps prag-
matic, leads to some doubt, however, as to the methodology's lack of bias as
a planning tool in that an obsolete or inappropriate hardware configuration
can skew the planning process.

In a series of papers for IBM aimed at helping information system managers
identify organizational information requirements, PARKER (1982; 1985)
outlined the newly named methodology, enterprise-wide information manage-
ment (EwIM). This approach supersedes IBM's business systems planning
(BSP). Parker draws on the work of ANTHONY, GIBSON & NOLAN, and
NOLAN (1979), to highlight the differential requirements in organizations
and the need to provide top management with the means of using computers
to aid in the strategic planning of enterprises. However, the aim she identified
for formal information systems (normalization of the operational procedures
of an enterprise) appears to be a somewhat superficial one that does little to
overcome the communication gap she refers to between top-level manage-
ment and data processing personnel. This concept also seems to invite con-
fusion with use of the term "normalization" in the context of data structur-
ing. Further, as pointed out by SULLIVAN (1985), BSP and its derivatives
are most applicable and most appropriate in the rarely encountered tabula
rasa situation.

Nevertheless, the EwIM concept (also called enterprise information
analysis) and its method of presentation have been very successful in calling
management's attention to the importance of information and information
technology. That presentation is to a substantial degree simply the con-
catenation of Rockart's critical success factors with the BSP methodology
(ROCKART, 1982). The result is that it takes a top-down approach and is
directed, at least initially, to senior management. The first three steps of
enterprise information analysis as defined by IBM, are:

- Determine what your enterprise is;
- Determine what decisions must be made correctly to be success-
  ful in that enterprise; and
- Determine what information is needed to make those decisions
correctly.

The debt to the concept of critical success factors is obvious. Also obvious is
the elegance with which the approach focuses top-level attention on informa-
tion, not merely on information technology, and the elegance with which the
approach takes for granted the fact that concern for the correct information
is a top-level concern.

The language used in articles in the journal Computer Decisions as early as
1983 signaled that at least some of the automated systems literature then
recognized the possible synergy between information and competitive
strategies. KULL's report of a round table on strategic planning was titled "Information's Role in the Battle Plan" and led with the advice that a corporation and its information services groups must share a strategic vision if they are to make effective progress.

Some of the same concerns have been espoused by those who have researched the links between information systems planning and corporate planning (GALLIERS; HANSELL ET AL.). Successive articles in mainstream automated systems journals, such as EDP Analyzer, Communications of the ACM, and MIS Quarterly, have further developed the theme of identifying the strategic requirements and relevance of information systems (see, for example, BAKOS & TREACY; IVES & LEARMOUTH; RACKOFF ET AL.) EARL has made the interesting suggestion that in order properly to align information technology strategy with business strategy, three distinct modes of strategy formulation need to be combined: 1) the infrastructure-led (bottom-up), 2) the business-led (top-down), and 3) the mixed (inside-out).

In reviewing the intellectual development of the MIS field in 1986, CULNAN concluded that despite the centrality of the concept of the organization to widely accepted definitions of MIS, MIS research is not well grounded in organization theory, and MIS research results have not been widely diffused in the organizational literature. She suggested that the concept of organizational effectiveness could be developed as the link between MIS and organizational theory. In a further analysis of the foundation of MIS, CULNAN & SWANSON reinforced the earlier findings of HAMILTON & IVES that MIS is emerging as a distinct field from its bases in computer science, management science, and organizational science.

The need to embed work on automated information systems into stratified systems theory was seen by GOULD as a major requirement if information systems were to serve more than the operational levels of organizations. However, in a study of the information needs of manufacturing companies, WHITE reported that there was no easy correlation between functional role and particular information needs.

GOODYEAR, HURTUBISE, and KOENIG (1986b) have each presented simple and useful diagrams depicting the relationship between levels of organizational decision making and type of information support required. Goodyear's work focused on computer-based information support while Hurtubise and Koenig emphasized the source and scope of information required.

In one of the few articles analyzing the comparative success of the design and implementation of information systems, CERULLO found that the factors characterizing successful MIS implementation were generally in accord with the standard prescriptives, particularly top-management support and user involvement in the planning and design.

The mainstream literature of MIS and DSS specialists (and the many variations on those acronyms) has exhibited increasing concern that the information systems developed be more closely aligned to organizational requirements and that these requirements really need a "federation of information systems" (AHITUV & NEUMANN). Information systems designers have
placed increased importance on the organizational context of information systems, the different levels and types of information requirements in organizations, and on planning for information systems. This is particularly evident in the nature of information support required for decisions of strategic importance.

Data and Data Flow-Driven Design

Driven by concerns for program modularity, reliability, and maintainability, there has been a pronounced shift in software design philosophy and methodology from decomposition of the program functionality to decomposition of the program information flow. BROOKS, in his classic The Mythical Man Month, most clearly articulated the need to modularize the programming task, both so that the task could be accomplished in a timely and effective fashion and equally important, so that it could be maintained and modified effectively (BOEHM, 1976; CONSTANTINE). Collectively the systems design philosophy that arose from those concerns is known as structured programming (DAHL ET AL.; DIJKSTRA; WHITEHOUSE). Much of structured programming focused on the code itself, particularly the internal structure of the code and the avoidance of the GOTO statement, and on adequate documentation (JACKSON). The concern with modularity, however, quickly revealed that the key to defining modules was to determine and define the information to be passed between them. From this realization there quickly developed a methodology referred to as structured analysis or data flow analysis (DEMARCO; WEINBERG).

There are two different conventions for data flow analysis: the Yourdon convention and the Gane and Sarson convention; they are named for their principal proponents (GANE & SARSON; MARTIN & MCCLURE; YOURDON; YOURDON & CONSTANTINE), but they differ only in their method of presentation. The basic philosophy is that the first major step in attacking a system design process is to analyze that data or information flow in a top-down fashion. From this data flow analysis both the system program modules and the required system data stores are derived directly. Classic program logic flow charting is increasingly being seen as secondary to information flow charting (data flow analysis). Logic flow charting occurs after the program or system structure has been shaped by data flow analysis. The above description is somewhat simplistic, of course, since an appropriate data flow analysis must be undertaken with at least a good high-level knowledge of the system function and logic. Nonetheless, it is not too much of an exaggeration to say that structured analysis and program modularity have made logic flow charting subordinate to information flow charting. The consequence of this change has been a heightened awareness of the centrality of the information itself to the process of system design.

The notion of data flow has had its greatest impact at the level of the design of specific systems, but it has also served as the basis for the design of
strategic planning systems. The best known of these is perhaps the "Six -"

system developed by Cornelius H. Sullivan Jr. for AT&T (SULLIVAN, 1987).

INFORMATION RESOURCES MANAGEMENT (IRM)

The previous sections are oriented to what YADAV described as the territ-
tories of the technicians and to those of management and to a particular con-
vergence of orientation across those two territories. As indicated earlier,
Yadav omitted a third category, that of information management as it has
developed from IRM. This territory has been developing in parallel with the
other territories outlined, and there are now signs of considerable con-

fertilization of interests, concerns, and literatures.

In the 1970s and early 1980s, HORTON (1974; 1979; 1981; HORTON &
MARCHAND) shaped the IRM concept and used this terminology to depict
the notion of managing both the information resource (content) and infor-
mation resources (tools) of an enterprise. Horton described the
emergence of a "new function," IRM, which was a response to the "information
and paperwork explosion, and the need for more facts and better organization of and
accessibility to those data, statistics and facts" (HORTON, 1979, p. 34).

The IRM concept was an outcome of the U.S. Commission on Federal
Paperwork, which functioned from 1975 to 1977. As director of the commis-
sion's information management study, Horton articulated the need for
"efficient, effective, and economical management of all of the organiza-
tion's information and information resources." This approach sought to formalize
the treatment of information and deal with data as a "manageable and
must deal with
human, physical, financial, and natural resources." During the 1970s and early
1980s there were some parallel developments in Canada and Australia
(BROADBENT & MCKINTYRE).

The emphasis in these early public-sector activities was very much a content-
driven approach, to use the categories of TAYLOR (1986). There was little
evidence of a real appreciation of the dynamics of other-than-document-based
aspects of information processing and management. This was somewhat
remedied by MARCHAND in a contribution to information management in
public administration co-edited by HORTON & MARCHAND.

In identifying a new resource management function in public administration,
organizationally

Marchand provided a well-developed and useful overview of
oriented information management. The aim of information
management was to promote "organizational effectiveness by enhancing the capacity,
external environment

organization to cope with the demands of its internal and
management in dynamic as well as stable conditions" (HORTON & MARCHAND, p.
61). Information management had two dimensions: manage-

ment of data re-

sources and management of the information process. Management of the organiza-
tion's information processes. Management of the information
process con-
cerned the way in which members of the organization in-

teracted with the
data resources and supporting technology for decision making and analysis. The emphasis in this dimension was on the value of resources that were used in the organization.

In 1980, Diebold had described IRM as a new way of thinking about information by managing information as a resource in much the same way that other corporate resources are managed (reprinted in DIEBOLD, 1984). Developments in information technology were necessitating the development of corporate information policy. A first step in the development of such a policy was to place a value on information in terms of the cost of its acquisition and potential yield.

In a later work, DIEBOLD (1986) outlined what he saw as essential differences between MIS and IRM. The latter was a more "direction-setting concept" at the corporate-policy level with the emphasis on information while MIS was more departmentally and technologically oriented.

In separate series of articles PETERSOHN (1981a; 1981b; 1981c) and OTTEN (1984a; 1984b; 1984c) outlined the basic concepts, principles, and steps involved in the information management process. Each author stressed the importance of a management focus on the value of information and information work as a key factor in IRM. Otten saw IRM as a management approach for a period of transition that "will end as soon as management in general has become information conscious and information resources oriented" (OTTEN, 1984b, p. 10). This is consistent with Marchand’s hypothesis of the step-wise evolutionary development of information management (MARCHAND, 1983; 1985).

CRONIN (1984; 1985), GILLMAN (1985), and VICKERS (1984; 1985) have provided a U.K. perspective on information management as an interdisciplinary area in which organizations benefit from team approaches that are multidisciplinary and organizationally specific. In the preface to a book readings on information management, CRONIN (1985) supported his view that information management was an emergent discipline by referring to new or renamed journals in the area, to the evidence of new job titles and descriptions, and to the growth of new professional associations such as AIM (Associated Information Managers) and AFFIRM (Association For Federal Information Resources Management).

TAYLOR (1986) saw IRM as a "structured way of looking at information processes in an organization [that was built around five questions:] who acquires, organizes, and transmits what information, by what means, at what cost, to whom, and to what effect?" (TAYLOR, 1986, p. 174). Traditionally the last two questions—to whom and to what effect—had not been included in discussions of IRM. The IRM planning process involved some fundamental questions about organizational objectives and direction, investment in expensive information resources, people, and systems, accountability for information resources, access to information, and centralization and autonomy. However, Taylor expressed concern that the IRM function might be going, by default, into the hands of computer literates, many of whom, in his view, had a limited concept of "information problems." Horton might be seen to share some of Taylor’s concerns based on his criticism of many decision support
s that attempt to apply the "mindset of the DP: MIS community" to the information management challenges of the 1980s (HORTON & ARCHAND).

The nature of those information management challenges was investigated by LEVITAN & DINEEN in a study that reported the progress of U.S. federally mandated IRM in 1986. Their findings emphasized the difficulty of implementing such an ambitious approach to the more effective and efficient management of information resources. FARKAS-CONN, though, has suggested that such changes were much more difficult to effect in a government setting than in a private setting.

In a review of the IRM literature from 1981 to 1986, LYTLE observed that the growing popular awareness of information, information technologies, and information issues had had a dramatic impact on IRM. In 1980 the statement that "information is a valuable resource" would have been regarded as odd, but in 1985 it attracted little attention.

INFORMATION OPERATIONS MANAGEMENT

The management of information operations has itself received much attention. We briefly review here some of those concerns that derive especially from the particular nature of information operations and of the nature of information and information technology itself.

Stage Hypotheses

A number of hypotheses relate to perceived predictable stages in the development of information systems and information technology; they might be described as life-cycle hypotheses, and they have been used to develop managerial prescriptive. The best known and certainly the most influential of these is Nolan's stage hypothesis. The Nolan hypothesis was first delineated in terms of four stages (NOLAN, 1973; GIBSON & NOLAN) and was later expanded to six stages (NOLAN, 1979). Those six stages are: initiation, contagion, control, integration, data administration, and maturity. Nolan perceived a commonality of life-cycle development for both systems and technologies. Perhaps the ramification of this hypothesis most commented on is that ideally different stages should be met with different management that is,looser in the initiation and contagion stages and tighter in the strategies, control and integration stages. This point has been expanded on particularly by Lucas (LUCAS, 1986; LUCAS & TURNER) and by McFarlan (MCFARLAN ET AL.) who relabels and returns the Nolan hypothesis to four stages: identification and initial investment, experimentation and learning, control, and widespread technology transfer. Also implicit in the Nolan cycle and its derivatives is a shift in emphasis from management of the technology to management of the data or information conveyed by that technology. Nolan's
Less has been criticized to be sure, particularly as to how generally it has been applied (KING & KRAEMER, 1984; SULLIVAN, 1985), but it has received recognition in the data processing community.

MARCHAND (1985) has postulated a descriptive four-stage development of information management: stage I (1900–1950)―physical control; stage II (1950–mid-1970s)―management of automated technology; stage III (mid-1970s–1980s)―information resources management; and stage IV (1980–1990s)―knowledge management. Marchand's stages proceed from a concern with technology (the carrier) to concern with contents. He later inserted a fifth stage, business-competitor analysis and intelligence, a function which would seem however to be concurrent with stages I, II, or more than a distinct and sequential stage.

Another stage hypothesis has been posited by KOENIG (1986a; 1986b). It derives from the observation that the doubling periods of information technology or trend to become very brief, on the order of a year or two—a phenomenon known as Moore's law (Gordon Moore) (NOYCE)—and that there are three fundamental components of information systems: computation, storage, and communication (SULLIVAN, 1985). An analysis of those components in terms of their growth rates, argues Koenig, leads to three stages: stage I (pre-1971), characterized by exponential Moore's law growth of computation capability and comparative stasis in storage and communication; stage II (1971–1989?), characterized by exponential growth of computation and storage and comparative stasis in communication; and stage III (1989–present), characterized by exponential growth of all three components.

These stages, it is argued, not only have predictive utility but also important ramifications for the robustness of system design, management, and obsolescence. Like Nolan, Koenig has extended his hypothesis, adding a fourth stage derived from Moore's law (Calvin Moores). This fourth stage will be realized in by the achievement of cost-effective continuous speech recognition (KOENIG, 1987b).

Rockart (ROCKART & SCOTT MORTON; IBM CORPORATION) has popularized the terminology of three eras of information processing: the first era—clerical and accounting; the second era—operational; and the third era—managerial. The overlap with and the derivation from ANTHONY'S taxonomy of managerial functions: operational control, managerial control, and strategic planning, are clear.

GIbson & Jackson, admitting their debt to Rockart, derive a similar three-stage cycle of information technology development from a benefit/beneficiary matrix (see Figure 2).

They describe the first domain as the automation of traditional back-office, support operations, yielding benefits to the functional unit, at first greater efficiency and then improved effectiveness. The second domain, which was established with the advent of the minicomputer, resulted in greater efficiency and effectiveness in the domain of end-user computing. Now, they maintain, we are entering the third domain, which will result in greater efficiency and effectiveness for the organization and the transformation of jobs, functions,
and roles at all levels—individual, functional unit, and organizational. What is striking (see Figure 2) is the degree of similarity between the Koenig stages, which are derived entirely from the technology, and the Marchand, Rockart, and Gibson and Jackson stages, which are based primarily on function particularly since all these authors perceive information processing systems as now emerging from the second stage and commencing the third. It is, of course, not unreasonable to expect a degree of fit between the technology and the type of functions that it can support, but the striking similarity among several independently derived categorizations is suggestive.

Convergence of the Archipelago

Another area of concern has been the recognition that as the various information technologies converge, so do the managerial implications and requirements. For example, the observation that there are no longer separate computer and telecommunications industries is obvious. The foremost interpreters of this concern and proponents of integration have been McFarlan and McKenney in their three “archipelago” articles (McFarlan et al.; McFarlan & McKenney; McKenney & McFarlan). Indeed the term “archipelago” has become standard shorthand for the issue.

McFarlan and McKenney raise two principal points. The first derives from the fact that the different islands in the archipelago are typically spread across the organization, with (in a typical organization) data processing reporting to the chief financial officer, telecommunications to the vice president for administration, the libraries (overlooked somehow by McFarlan and McKenney) to the vice president for R&D, and so forth. This dispersion means that a real convergence or coordination is a major managerial task, re-

---

**Figure 2. Benefit/beneficiary matrix (recast from GIBSON & JACKSON).**

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Individual</th>
<th>Functional Unit</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency</td>
<td>Domain II</td>
<td>Domain I</td>
<td>Domain III</td>
</tr>
<tr>
<td>Effectiveness</td>
<td>Domain II</td>
<td>Domain I</td>
<td>Domain III</td>
</tr>
<tr>
<td>Transformation</td>
<td>Domain III</td>
<td>Domain III</td>
<td>Domain III</td>
</tr>
</tbody>
</table>
*We have excluded Marchand's first stage (physical control, 1900-1950) as being beyond the scope of this scheme because it involves the precomputer era; thus, we have renumbered the subsequent three stages.

Figure 3. Comparison of developmental-stage hypotheses for information management.
quiring either a substantial change in the organizational structure or a complex and cumbersome cross-organizational matrix-like arrangement or some combination of both. The second point is that the islands of the information archipelago are almost certainly at different points along the Nolan life cycle and therefore need different managerial approaches; this adds to the difficulty of centralized and coordinated management.

Simultaneous with the concern about integrating these islands has been the emergence of the microcomputer/workstation and the decentralization of "traditional" data processing and the placement of substantial automated information processing power directly in the hands of the end users. The literature on this topic is voluminous, and a thorough analysis of this issue is beyond the scope of this article. The topic is addressed by MCFARLAN & MCKENNEY, by KEENE & WOODMAN, and, in a particularly amusing and insightful fashion, by KRASS & HESH.

Minimization of Unallocated Cost

An emerging management concern that is still relatively unarticulated is what might be called the principle of minimum unallocated cost and its application to information operations within the organization. The parent principle is that the better an organization understands the relationship between its inputs and its outputs—i.e., the more closely an organization can allocate its cost to its outputs—the better will be that organization’s decision making and thus performance. The first corollary of this principle is that insofar as practical an organization should minimize its unallocated costs—i.e., those costs treated as overhead or general and administrative. That corollary is, of course, appropriate across the board, but three factors are focusing particular attention on that corollary’s applicability to information services and systems.

The first factor is simply the increasing proportion of an organization’s resources that are being devoted to information functions. As that proportion increases, an organization can less readily afford to treat those functions as unallocated costs. The increasing proportion of information functions within the economy in general and within organizations in particular has been treated by many authors, perhaps most extensively by PORAT, DEARDEN (1978), KOENIG (1987a), and STRASSMANN (1976) who have all elaborated on that point. Amplifying the first factor is the second, the awareness of the archipelago of information services, which focuses attention on the aggregate extent of what had been perceived as discrete entities, many of which had been treated as unallocated costs. The third factor is the relatively intransigent nature of the economics of information, an infinitely replicable and distributable commodity that handles like no other commodity. The consequence of that intransigence is that the allocation of information service costs presents unusual difficulties that are only beginning to be adequately addressed by economics and accounting.
EFFECT OF INFORMATION TECHNOLOGY ON ORGANIZATIONAL STRUCTURE

There has been considerable interest and speculation about the effect of information technology on organizational structure. The primary focus of the work in this area is Thomas Whisler, who predicted that information technology would flatten hierarchical structures and reduce the number of layers of middle management in professional jobs. Work in this tradition is typically concerned with the specific effects of information technology on the structure of organizations. Straumann makes the same point about information technology, arguing that it facilitates the creation of more horizontal organizational structures and escalated job positions. However, after analyzing a number of cases, argues that the introduction of information technology is not primarily a function of what management intends to accomplish, but rather a secondary function driven by the technology itself, and further that there is no consistent pattern toward flatter structures.

Recent work is concerned with the specific effects of information technology on the specific organizational structure. The consequences of realizing the potential of information technology structure changes in the organization of functions, and even whole departments around the availability of new information processing technology, thus making it possible to place the information technology at the user's fingertips (Keen, 1981). Thus, information technology enables major changes in the structure of an organization, and this change, in turn, conveys major consequences. Demand for the attention of management.

Bryant's work has pointed out that in many cases, especially in the insurance industry, the basic consequence is to increase the proportion of professional to nonprofessional staff, a result opposite that predicted by Whisler and Straumann. The awareness of the organizational impact of information technology is another facet of the awareness that information technology is much more than merely a facilitator of back-room operations, whose management is best left to those who manage those back-room operations, and that many of its ramifications are both subtle and very specific.

INFORMATION TECHNOLOGY AND PRODUCTIVITY

Concern for the influence of information technology on productivity is intense and pervasive. Unfortunately, most of what is written consists essentially of exhortations to work "smarter." The problem is simply that it is extremely difficult to measure the productivity of those functions typically supported by information technology. Also, as one ascend the hierarchy from clerical to operational to managerial to strategic, it becomes yet more difficult. Many obvious functions, such as online airline reservation systems, are responsible for the present levels of stock trading, would be unsupportable without modern information technology, but there is skepticism and a vast dearth of
...the effect that information technology has had on more mundane applications, such as typical office productivity, computerized litigation, and managerial productivity and effectiveness (SCHNEIDER). Some pessimism is well taken, but some seems clearly to be based on faulty analysis of information technology. In the case of BAUMOL & GREENSPAN'S work, that faulty understanding arises from a lack of awareness of the productivity as well as hardware capability is growing rapidly, though clearly not at a Moore's law rate of 100% per year or even the rate of growth of programming or software capability, usually in the range of doubling over periods of 8-12 years (BOEHM, 1981; DURNIAK; MORRISSEY & WU; SOYDAM).

In the whole, the concept that there is a positive relationship between information technology and productivity, and therefore national competitiveness, is often taken for granted. In both the United Kingdom and France, major reforms have occurred because of that perception. In the United Kingdom, the BEESLEY report recommended the demonopolization of communications primarily because of perceived enhanced international competitiveness, and the ALVEY committee recommended increased government support of information technology. In France, the Minitel system, which is having a profound effect on French society (DELACY), is a direct result of the Norge-Minc report (NORA & MINC, 1978; 1980), which recommended increased government support of information technology to preserve France's economic position and cultural identity. Japan has treated information as essential to its continued economic growth. Both Europe and the United States have responded with programs to support information technology. The European Economic Community has launched the Captus program, and in the United States, funding for supercomputers has increased, pressure has been applied to Japan to open her market to U.S. supercomputers, and antitrust laws have been modified to permit increased cooperation in R&D; as a result, a number of R&D consortia both for hardware and software development have been founded.

In short, despite the lack of quantitative evidence about the nature of the relationship, there is a strong belief that the development of information technology is essential for increased productivity and competitiveness, and this belief, coupled with heightened concern for productivity and competitiveness in the world market, has served to focus attention dramatically on information technology and its application.

MERGING CONCERNS AND SUMMARY

This review has charted converging concerns about the centrality and importance of the management of information by organizations. While the particular origins of each area are evident in the different orientations toward managing information, there is at the same time a discernible and overt merging of literatures and concerns.
In the area of automated information systems, IRM was first used to mean data resource management and did not necessarily include the process aspects referred to by MARCHAND (1983). Davis and Olson claimed that there had been a shift in emphasis from “computers and data-based information processing to information as a strategic resource and to an expanded role for information technology” (DAVIS & OLSON, p. 30). The developments in government paperwork were not mentioned as a factor in this change. Rather, these authors attributed the change to advances in the stages of development of the information systems functions combined with generally increasing sophistication in the use of information technologies.

The field of information management as it has evolved from the IRM work of HORTON & MARCHAND owes much to its origin in the public sector with a concern for the management of document-based resources as well as information systems. This partly explains the separate literatures and research that have differentiated it from the work reviewed in the section on automated information systems; in the latter area there has been an overemphasis on the technology at the expense of the value of the information being served. The suggestion of CULNAN, that the concept of organizational effectiveness could be developed as the link between MIS and organizational theory, came four years after MARCHAND (1982) described organizational effectiveness as the aim of information management with both data-resource and process aspects.

The development of the concept of information intensity by LINDNER & IVES, with its emphasis on the amount of intellectual work done in performing a task, is similar in approach to the value-added notion of TAYLOR in 1886. In fact, Taylor's work in this area of information systems evolved from his research on document-based information services and abstracting indexing activities (TAYLOR, 1886).

The focus that has emerged in the general business and management literature is still oriented toward the use of information technology for strategic advantage; there is less emphasis on how information resources generally (including content aspects) can be used for strategic advantage. With their emphasis on the need to identify an organization's information resources and harness these for effective use, Keen's book, Competing in Time: Using Telecommunications for Competitive Advantage (KEEN, 1986), and Synott's volume, The Information Weapon: Winning Customers and Markets with Technology (SYNOTT, 1987), are remarkably similar to the earlier work of HORTON & MARCHAND from the IRM literature, although the latter had very much a public-sector focus at the time.

The 1986 work, Infotrends: Profiting from Your Information Resources, by MARCHAND & HORTON, appears to be aimed at the private-sector practitioners and markets, in the same vein as Keen's and Synott's works (above), which would have been prepared at approximately the same time—i.e., further evidence of convergence. The preface of Infotrends stresses the need for businesses to treat information as a strategic asset, the need to tie information management to strategic business planning, and the need to raise
responsibility for information resources to the top level of the corporate
structure.
Similar concerns are being articulated and discussed in territories that were
once considered isolated, and hybrid territories are emerging. Combinations
of methodologies and approaches are needed to cope with the increasing
sophistication of technology and the increasing volatility and demands of
both private and public environments. Many contributions to the information
management area now suggest that the complexity of organizational environ-
ments is such that the management of information as a resource can be
achieved only with considerable focused effort from multidisciplinary teams
within organizations and sometimes between organizations. At least it appears
as though potential members of such teams might be starting to share a
common language and similar concerns.

BIBLIOGRAPHY

ACKOFF, RUSSELL. 1967. Management Misinformation Systems. Man-
AHITU, NEV; NEUMANN, SVEN. 1986. Principles of Information
ALVEY, J. 1982. A Programme for Advanced Information Technology—
ANTHONY, ROBERT. 1965. Planning and Control Systems: A Frame-
BAKOS, YANNIS J.; TREACY, MICHAEL E. 1986. Information Technol-
1986;10(2): 107-120. ISSN: 0367-7783.
BAUMOL, WILLIAM J.; BLACKMAN, SUE A. B. 1983. Electronics, the
Cost Disease, and the Operation of Libraries. Journal of the American
Society for Information Science. 1983; 34(3): 181-191. ISSN: 0002-
8231.
BEESLEY, MICHAEL E. 1981. Liberalisation of the Use of the British
Telecommunication Network. Report to the Secretary of State. 1981
ISBN: 0-11-3132-49-X.
BENJAMIN, S.; ROCKART, JOHN R.; SCOTT MORTON, MICHAEL S.;
WYMAN, JOHN. 1984. Information Technology: A Strategic Opportu-
nity. Sloan Management Review. 1984; 26(3): 3-10. ISSN: 0019-
845X.


372


REFERENCES


385


