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Source: *MIS Quarterly*, Vol. 15, No. 4 (Dec., 1991), pp. 475-500

Published by: [Management Information Systems Research Center, University of Minnesota](#)

Stable URL: <http://www.jstor.org/stable/249452>

Accessed: 14/12/2013 15:31

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# Information Systems Management Issues for the 1990s

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## Abstract

*This three-round delphi survey of senior IS executives is the third in a series designed to determine the most critical issues in IS management. Analysis focuses on respondents' assessments of specific issues as well as emerging trends. Key findings include: (1) Continued concern for traditional issues such as strategic planning and organizational alignment; (2) only six of the top issues from 1986 remained in the top 10; (3) one new issue, technology infrastructure, made the top 10; (4) three issues from previous studies re-joined the top 10—IS human resources, software development, and telecommunication systems; and (5) data-related issues now occupy the top two slots. This study reveals two important trends as the field enters the 1990s. First is the rising importance of technology infrastructure issues. Technology infrastructure issues now occupy three of the top 10 slots including the highest position. Second, it appears that internal effectiveness issues have made a strong comeback*

*after being virtually ignored in 1986. IS human resources, software development, and the applications portfolio—issues that make up the core of the IS function—all increased in importance.*

**Keywords:** Information systems management, IS executives, key issues, management priorities

**ACM Categories:** A.2, H.0, K.6.0

## Introduction

During the past 30 years the overall business environment and the information technology embedded within it have undergone tremendous changes (Huber, 1984b). Information technology has grown by orders of magnitude in computing capacity and speed (Athey and Zmud, 1988). The increasing speed and capacity of hardware technologies provide a platform for broader application of software in the areas of database management, distributed data processing, expert systems, and electronic communication. Personal productivity tools are now accessible throughout most organizations. New technologies on the horizon promise to improve the human-computer interface, enhance the richness of electronic communication, and automate the development of even more systems (Straub and Wetherbe, 1989).

This burgeoning capability of information technology coincides with growing changes in the business environment exemplified by familiar business themes of the 1980s, including mergers, leveraged buyouts, downsizing, strategic alliances, just-in-time scheduling, flexible manufacturing, globalization, and total quality commitment. These environmental changes present demands on IS departments to provide timely, high-quality information and to support innovation in products, production techniques, and organizational designs. IS executives are particularly challenged because they operate at the intersection between information technology (IT) and their organization. In the face of rapid change, IS executives must be able to interpret trends in information technology and assess current and future impacts on their organization, while also managing day-to-day operations.

In 1986, the Society for Information Management (SIM), in a joint effort with the MIS Research Center (MISRC) at the University of Minnesota,

conducted a delphi survey of its members to determine the importance of the most critical issues in IS management. To keep the "key issues" framework current, SIM and MISRC conducted a study in 1989-90 to reassess this framework. The primary purpose of the study was to determine:

- Which IS management issues are expected to be most important over the next three to five years and thus most deserving of time and resource investment.
- How much consensus exists about the relative importance of specific issues.
- Why some issues deserve more attention than others.

IS vendors, professional societies, consultants, educators, and researchers need to be aware of IS executives' key concerns to serve their markets effectively. Vendors can use this information to develop and market products and services. Professional societies can use this information to plan conferences and seminars as well as disseminate knowledge through their publications. Consultants can use this information to help accelerate the transfer of technology and management skills among their clients. Educators can use this information to develop programs and place their graduates. Finally, researchers can use this information to guide their inquiry and improve understanding of critical managerial issues. Thus, the entire IS community needs to be aware of the issues that are judged to be of critical concern by its leading practitioners.

A three-round delphi survey of senior IS executives, combined with an historical analysis of prior research, was used to answer the questions posed. The methods employed in the research, are outlined in the next section. Following this, the findings of the survey are presented. Next, findings are discussed in terms of historical trends. Finally, conclusions are drawn about managing information systems and the evolving nature of the IS executive's job.

## Methods

For this study, research methods were selected to facilitate comparison with previous SIM/MISRC studies (Dickson, et al., 1984; Brancheau and

Wetherbe, 1987). The delphi method was retained for its value in surfacing new issues and moving participants toward consensus. Essentially, delphi is a series of linked questionnaires. Starting with a base-line questionnaire, succeeding questionnaires summarize group responses to the preceding questionnaire and ask participants to re-evaluate their opinions based upon the new evidence. The delphi process stops when a reasonable level of consensus is achieved (for details, see Delbecq, et al., 1975).

## Research method

The 1989-90 study began with a list of 20 issues in IS management and their supporting rationale derived from the 1986 study. Following Watson's (1989) Australian study, two modifications were made to previous methods. Participants were asked to rate, rather than rank, each issue. Rating is less taxing mentally because issues can be evaluated one at a time rather than requiring simultaneous consideration of all issues. Rating allows respondents to show indifference among issues (by giving them the same rating) and also allows them to show relative strength of judgment (by using a wide or narrow range of ranking assignments). Rating also provides valuable interval-level data for follow-up analyses. The other modification involved feeding back the results from each delphi round to non-respondents in an effort to improve response rate. Data were collected in three rounds of surveys as follows:

### Round One

In June 1989, SIM institutional and board members were asked to review the key issues framework generated in 1983 and revised in 1986. Via mail questionnaire, members were asked to consider what they felt were the most critical issues facing IS executives over the next three to five years (i.e., through 1994). The 20 issues from the 1986 study were presented in random sequence along with a brief rationale describing the issue. Members were asked to indicate their views by rating each issue on a 10-point scale, where 10 indicated their highest priority issue(s) and 1 indicated their lowest priority issue(s). They were also encouraged to write in new issues and update existing issue rationale. In round one, surveys were mailed to 241 SIM institutional and

board members. Useable responses were received from 114 respondents, yielding a response rate of 47 percent.

### Round Two

In September 1989, all 241 institutional and board members were sent feedback showing the results of round one. First-round respondents were also provided with their individual responses as a base line for comparison. Issues were listed in rank order of importance from highest to lowest mean rating. Four issues with markedly low ratings were dropped (leaving 16 remaining issues). Nine new issues were added to the survey (resulting in a total of 25 issues). These were formed by clustering related issues and rationale submitted by round one respondents. All issues submitted by two or more respondents were included. Respondents were again asked to rate these issues on a 10-point scale (see Appendix A for an adaptation of the survey instrument). In round two, useable responses were received from 126 respondents, yielding a response rate of 52 percent.

### Round Three

In January 1990, respondents from all previous rounds (175 respondents) were sent feedback from round two on all 25 issues. They were asked to rate the issues one last time. Again, issues were listed in rank order and personal ratings were provided when available. Useable responses were received from 104 respondents, yielding a response rate of 59 percent.

The three rounds of the survey provided one round for revising and generating issues and two rounds to increase the level of consensus on the importance of those issues. Overall, 175 of the 241 SIM institutional and board members participated in the study. This represents 73 percent of the membership. In the following discussion, data are from the final round of the survey unless otherwise indicated.

### *The participants*

A profile of survey participants by geographic location, industry, and position is provided in Figure 1. Despite the larger sample size (104 versus 68), the 1989 participant profile is remarkably

consistent with the 1986 study. As a result we would not expect major shifts in rating due to changes in population demographics between studies. However, because the individuals responding may be different, we cannot rule out the possibility that rating shifts might be attributable to underlying trends among those entering and leaving the field of IS management. As shown in Figure 1, all regions of the United States were represented in the survey, with the majority of the participants coming from the Northeast (40 percent) and Midwest (29 percent) and the minority from the South (16 percent) and West (15 percent). In terms of industry representation, the majority of participants came from the primary commercial sectors of manufacturing (43 percent) and services (43 percent), with a minority (14 percent) from the non-profit sector. In terms of positions held, the vast majority of participants (79 percent) were the most senior IS executive in their respective organizations. The high percentage of senior IS executives is a major strength of the SIM institutional sample and adds value to the study's findings. IS department managers (9 percent), IS educators (7 percent), and IS consultants (5 percent) made up the remainder of the sample. Although these respondents are not dominated by any particular region or industry, caution should be exercised in generalizing from this sample. Any systematic differences between SIM members and the greater population of IS executives in the United States may have biased the findings reported here.

## Findings

While traditional issues such as strategic planning and organizational alignment remain crucial, the research results revealed a number of surprises. One new issue, technology infrastructure, made the top 10. Three issues from previous studies rejoined the top 10—IS human resources, software development, and telecommunication systems.

### *Top 10 issues*

The most critical issues IS executives expect to face over the 1992-94 timeframe are listed in Table 1. Each of the top 10 issues are discussed briefly below. A few general references are provided for each issue to provide interested readers with a source for more information.

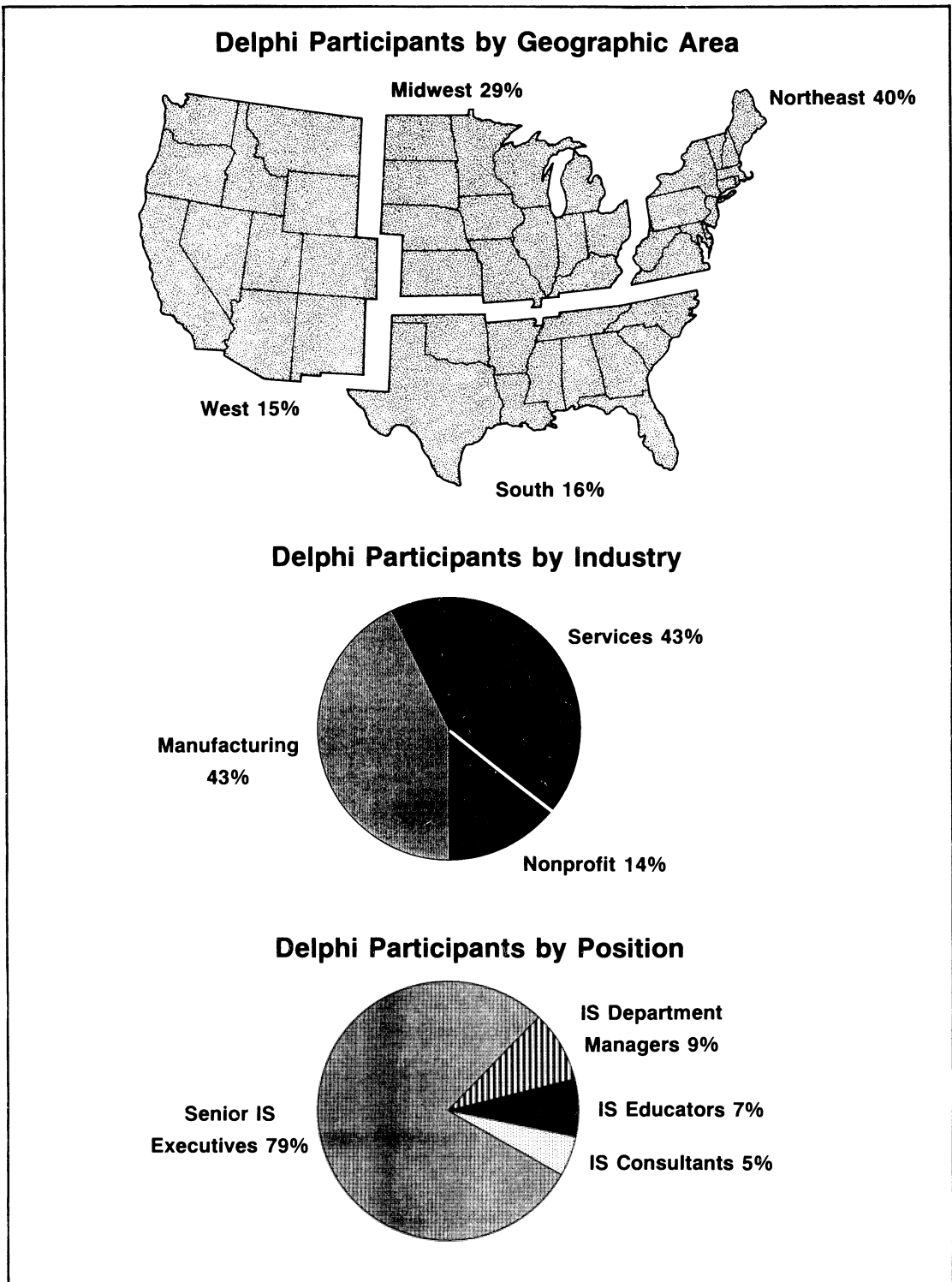


Figure 1. Delphi Participants by Region, Industry, and Position

## 1. Information Architecture

Developing an information architecture is ranked first in importance. A newcomer to the key issue framework in 1986, information architecture is the first issue to supplant strategic planning as #1 since the initial SIM survey in 1980. An information architecture is a high-level map of the information requirements of an organization. It shows how major classes of information are related to major functions of the organization. In its pure form, the information mapping is independent of personnel staffing, organization structures, and technology platforms (Brancheau, et al., 1989a). It is used to guide applications development and facilitate the integration and sharing of data. Sometimes referred to as an enterprise model, many experts now agree that an information architecture offers the potential to serve as a basis for building a coordinated, responsive, long-lasting set of business applications (see, for example, Scheer, 1989; Martin, 1989b). Such an architecture also provides a view of the business-oriented uses of information from which an ef-

fective IT infrastructure can be derived (see issue #6). While the potential benefits of such an architecture have been articulated, the information architecture is difficult to capture, use, and maintain, due to both the breadth of information requirements and the changing nature of the business environment. For more information, see Hackathorn and Karimi (1988), Hull and King (1987), and Inmon (1989).

## 2. Data Resource

Making effective use of the data resource is ranked second in importance. This issue has steadily gained importance over the years. Given its ability to leverage both labor and capital, information is now viewed as an essential factor of production. As information technology continues to penetrate the value chain, firms are reducing the levels of inventory they carry and are relying on timely information for managing production and distribution processes (Keen, 1988). Moreover, many firms are gathering in-

**Table 1. Key Issues in Information Systems Management**

Rank	Rating	Description of Issue
# 1	8.32	Developing an Information Architecture
# 2	8.31	Making Effective Use of the Data Resource
# 3	8.06	Improving IS Strategic Planning
# 4	7.74	Specifying, Recruiting, and Developing IS Human Resources
# 5	7.54	Facilitating Organizational Learning and Use of IS Technologies
# 6	7.44	Building a Responsive IT Infrastructure
# 7	7.39	Aligning the IS Organization With That of the Enterprise
# 8	7.34	Using Information Systems for Competitive Advantage
# 9	7.22	Improving the Quality of Software Development
#10	6.92	Planning and Implementing a Telecommunications System
#11	6.85	Increasing Understanding of Role and Contribution of IS
#12	6.63	Enabling Multi-Vendor Data Interchange and Integration
#12	6.63	Developing and Managing Distributed Systems
#12	6.63	Planning and Using CASE Technology
#15	6.37	Planning and Managing the Applications Portfolio
#16	6.20	Measuring IS Effectiveness and Productivity
#17	6.02	Facilitating and Managing Decision and Executive Support Systems
#18	5.93	Facilitating and Managing End-User Computing
#19	5.82	Improving Information Security and Control
#20	5.69	Establishing Effective Disaster Recovery Capabilities

Notes: Final results based on third round of delphi survey; Rating based on 10-point scale, 10 = most important and 1 = least important.

creasing volumes of information from customers, suppliers, financial partners, and the economic environment (Frenzel, 1991). Intelligently combining these disparate streams of information for purposes of making better decisions, gaining insight into potentially useful innovations, and streamlining operations without being overwhelmed by information overload remains both a major challenge and opportunity. Given the volume of data that firms handle, firms also need a strategy for archiving and later retrieving information of limited current value but of potential importance down the road. Both the concern for management of data resources and information architecture (#1) indicate that IS executives are shifting toward an increasingly data-oriented view and are looking for ways to leverage that view into increased IS effectiveness. For more information, see Goodhue, et al. (1988), March and Kim (1989), and Martin (1989a).

### 3. Strategic Planning

Improving IS strategic planning is ranked third in importance. For the first time in a decade, this issue was not ranked #1. Nevertheless, its relatively high mean rating (over 8 on the 10-point scale) underscores its continuing importance. With more businesses dependent on information technology as both a sustaining force and competitive weapon, IS strategic planning requires close alignment with business plans (Certo and Peter, 1988). IS executives face the challenges of using their knowledge of leading-edge technology to contribute to the firm's products and strategies as well as to enhance their organization's strategic planning process. At the same time, they must temper enthusiastic commitment to new technology with realistic cost and risk assessments (Frenzel, 1991). They also assume responsibility for implementing these changes in light of technological uncertainty and (sometimes unanticipated) organizational change. Given the current rate of organizational and technological change, long-range planning is still extremely difficult. Because of these problems, many executives argue that the key issue is not the IS strategic plan itself but the learning that results from the planning process. Effective planning depends heavily on appropriate IS organization alignment (#7) and provides direction for information architecture (#1), technology infrastructure (#6), and software development (#9).

For more information see Marrus (1984), and Ohmae (1988).

### 4. IS Human Resources

Specifying, recruiting, and developing IS human resources is ranked fourth in importance. This issue is back in the top 10 after an absence in 1986. While shortages of IS talent may not be as acute as they were during the first half of the 1980s, they have not gone away. For one thing, downsizing has forced some IS executives to do more projects with fewer people, thus forcing a broadening of skills. At the same time, IS executives are often faced with an increasing number of projects covering an increasing breadth of technologies calling for greater and more specialized skills. And because of changing demographics, acute shortages of IS talent are forecast by the year 2000 (U.S. Department of Labor, 1989). For now, many executives underscore the word *developing* when considering IS human resources. What is needed is a flexible and productive work force with continuous development via multi-functional career paths (Dreyfuss, 1990). As evidenced by this issue's highest ranking of the decade, solving the IS human resources problem is a moving target. IS professionals in the 1990s need a new set of technical skills and improved business skills in order to serve their clients effectively (Couger, 1988). They must also have a high tolerance for ambiguity. IS executives should reward extraordinary effort, not just longevity. One problem looms on the horizon: if computer-aided software engineering (CASE) successfully penetrates the market as many experts predict, IS executives will need to decide what to do with the half-million traditional analysts and COBOL programmers holding current IS positions (U.S. Department of Labor, 1989). Should they be retrained or replaced? This aspect of the issue is closely related to software development (#9), CASE technology (#12), and the applications portfolio (#15) (where the bulk of IS professionals are employed). For more information, see Dreyfuss (1990) and Ferratt and Short (1988).

### 5. Organizational Learning

Facilitating organizational learning and use of IS technologies is ranked fifth in importance. Based on responses to this survey, IS executives

continue to believe that organizations that prosper will be those making appropriate use of new information technologies. Over time, this will require continuous learning about ways to better utilize the information resource and integrate new technologies into the organization. For IS executives, facilitating organizational learning is difficult in part because the introduction of each new technology signals the start of a new learning curve (Bouldin, 1989). For example, McClure (1989) predicts a long learning curve for CASE technology (#12). As recently commented by Emery (1990), aspects of this issue are closely related to all the other top issues, particularly to using IS for competitive advantage (#8) and increasing understanding of IS's role and contribution (#11). But the organizational learning problem extends far beyond the IS arena (Strata, 1989). In addition to rotations through other functional areas, promising high-potential professionals should be exposed to the IS function so that as senior managers they will be better able to integrate IS into the overall strategies of the firm. IS can become a hub for encouraging learning by helping one department learn from the next. For more information, see Argyris (1982), Botkin, et al. (1979), and Morgan (1989).

## 6. Technology Infrastructure

Building a responsive IT infrastructure is ranked sixth in importance. While strategic planning (#3) clarifies the business need and information architecture (#1) identifies the data required, this issue is concerned with the implementation of the organization's diverse computers, operating systems, networks, core databases, and mission-critical applications. This is the only new issue to rate among the top 10 in this study. As discussed later, this appears to reflect a new thrust in IS management (Dixon and John, 1989). The technology infrastructure problem is exacerbated by a combination of evolving technology platforms, integration of custom-engineered and packaged application software, and rigidity of existing applications (Zachman, 1987). The emphasis is on networking and open systems to facilitate timely response to changing business conditions. Building an infrastructure that will support existing business applications while remaining responsive to change is a key to long-term enterprise productivity. But creating this infrastructure from scratch is not an option for most

firms. Architectural plans need to start with existing "point" solutions and move forward. For more information, see Martin, J., Chapman, K.K., and Leben, J. (1990), Hammer and Mangurian (1987), and Inmon (1990).

## 7. IS Organization Alignment

Aligning the IS organization with the enterprise is ranked seventh in importance. The effectiveness with which IS can support the enterprise is dependent on the IS function's position within the enterprise. Inappropriate alignment can seriously impede effective IS strategic planning (#3). Organizations now have available technology to implement either centralized or decentralized relationships; too often, however, IS reporting relationships do not reflect needed communication channels through the organization. IS needs to find a way to provide a mix of line and staff functions while staying in tune with company strategy, organizational direction, and business cycles (Dixon and John, 1989). Decentralization to the business unit level must be balanced with the need for centralized planning of information architecture (#1) and technology infrastructure (#6). Among SIM institutional members, 45 percent are decentralizing their IS function, while another 28 percent are centralizing (Society for Information Management, 1990). Obviously, appropriate alignment will be different for each organization and for each phase of the organization's growth. These problems interact to make appropriate alignment a difficult issue. For more information, see Cash, et al. (1988), King (1983), and Vincent (1990).

## 8. Competitive Advantage

Using information systems for competitive advantage is ranked eighth in importance. Although it remains among the top 10 issues, this represents a significant decline from 1986. This decline may result from the realization that gaining competitive advantage is based more often on effectively developing and extending basic technologies than on building information systems specifically for strategic advantage (Emery, 1990). Nevertheless, in a highly competitive environment, senior executives can be expected to look at all possible avenues for strengthening their firm in the marketplace. In-



formation technology can play a role in the information content of products by streamlining internal business processes, forging electronic links to suppliers and customers, and shaping the design of the organization. Gaining competitive advantage almost always requires integration of business activities (Stalk, 1988). This can be within a business area, across business areas, vertically through senior management, and externally through customers and suppliers. This in turn requires an intimate understanding of the business (#3, #7), well-planned data resources (#1, #2), and a responsive technology infrastructure (#6). This issue is closely related to and provides the rationale for all of the other top issues. For more information, see Porter (1980), Porter and Millar (1985), and Wiseman (1985). Additionally, *MIS Quarterly* (1991) has devoted an entire issue to the topic of using IS for competitive advantage.

### 9. Software Development

Improving the quality of software development is ranked ninth in importance. This issue is back in the top 10 after being ranked #13 in 1986. This may be surprising given that some progress has been made toward improved software development. With the rise of end-user computing, business professionals have better access to data and are increasingly developing their own software. In some environments, packaged software presents a reasonable alternative to in-house development. Prototyping has been demonstrated as a viable approach for some applications, notably decision support systems (Alavi and Henderson, 1981). As evidenced by IS executive's high ranking of this issue, much work remains to be done. There is no clear evidence that organizations are effectively migrating away from their large investment in aging software, as described by Buss (1981). New and innovative projects often include requirements for integration of previously single-objective systems (Yourdon, 1989). This puts new pressure on the software development organization. In addition, new technologies, such as CASE (#12), must be evaluated and, where introduced into the organization, integrated into standard software development procedures (McClure, 1989). Next generation software projects may require even greater business and political skills (e.g., to negotiate data definitions across depart-

ments) as well as broader technical skills (e.g., to work in an object-oriented development environment), thus putting additional stress on IS human resources (#4). For more information, see Martin and McClure (1988) and Pressman (1987).

### 10. Telecommunications Systems

Planning and implementing a telecommunications system is ranked tenth in importance. After gaining in importance in each of the previous SIM/MISRC delphi studies, telecommunications systems has finally joined the top 10. Human communication remains the lifeblood of organizations. Electronic communication paths can be used to reduce limits on organizational relationships created by time and distance (Keen, 1988). Implementing effective telecommunication systems can be difficult due to required large financial investments in the face of changing technologies and limited industry standards. Building a responsive IT infrastructure (#6) and using IS for competitive advantage (#8) also depend heavily on telecommunications (Clemons and McFarlan, 1986). For more information, see Cobbin, et al. (1989), Hammer and Mangurian (1987), and Sumner (1989).

### *Movement toward consensus*

One of the objectives of the study was to achieve a degree of consensus on the importance of specific issues. Examination of issue ratings by delphi round shows that standard deviation (a measure of the spread of opinion) consistently decreased over the three rounds of the study (see Appendix B). This suggests that the delphi method did improve the level of consensus. For highly rated (top 10) issues, the mean rating consistently increased round by round. For lower-rated issues, the mean rating consistently decreased round-by-round. These general movements differentiated the relative importance of specific issues. One of the reasons 100 percent consensus was not achieved (and cannot be expected) is that the importance of specific issues to an IS executive depends on many factors. Three factors examined in this study include region, industry, and position. Among the top 10 issues, there were no significant differences by region. Differences by industry and position are discussed next.

### Analysis by industry

Analysis by industry follows the lines drawn earlier: manufacturing, services, and non-profit. Table 2 lists the top 10 issues for each industry sector. As noted below, there are considerable differences across the three sectors.<sup>1</sup> For example, IS executives in non-profit organizations tended to take a different view from their counterparts in the commercial sector. These executives were primarily vice presidents at major universities. Their views were characterized by low ratings for competitive advantage ( $p < 0.05$ ), systems development (ns), applications portfolio (ns), and security and control (ns); and high ratings for end-user computing ( $p < 0.05$ ) and the issues related to technology applications in general ( $p < 0.05$ ). This difference may be due to relatively small IS staff sizes (vis-a-vis the commercial sector) and reliance on outside services and applications. Alternatively, it could reflect differing organizational environments where the non-profit sector is driven less by market forces and competition with other firms and more by pressures to demonstrate efficient uses of and justification for specific technologies.

IS executives in manufacturing and services also hold differing views from one another. Most differences involved less highly ranked issues. For example, IS executives in services tended to give higher ratings to the management of their applications portfolio (#15) than their counterparts in manufacturing ( $p < 0.10$ ). One possible explanation follows McFarlan, et al.'s (1983) reasoning that industries can be classified into different strategic quadrants and that firms in those industries take different levels of strategic orientation toward both their existing and planned application portfolios. Information-intensive service industries, such as banking and insurance, exemplify the "factory" or "strategic" quadrants in McFarlan's grid. This may explain why senior executives in service firms attach more importance to their applications portfolio. The strategic importance of existing and planned systems may also be related to their high ratings of effec-

<sup>1</sup> Differences discussed in the next sections were identified through analysis of variance procedures (fixed effects model) combined with SCHEFFE multiple comparison tests at the 0.05 and 0.10 significance levels. Because of the conservative nature of the analysis, some near-significant differences are also discussed (i.e., 0.10 is  $< p < 0.20$ ). These are noted in the text as "ns."

tiveness measurement (ns) and security and control (ns). In addition, the information intensity of most service firms' environment and operations leads these IS executives to be significantly more concerned about the application of image technology (#24) than their counterparts in manufacturing ( $p < 0.05$ ). In general, IS executives in service companies rated issues concerning their

**Table 2. Top 10 Issues by Industry**

Manufacturing Companies (N = 43)		
Rank	Mean	Issue
1	8.39	Information Architecture
2	8.02	Data Resource
2	8.02	Strategic Planning
4	7.60	Technology Infrastructure
5	7.51	Organizational Learning
6	7.50	IS Human Resources
7	7.23	Competitive Advantage
8	7.14	IS Organizational Alignment
9	6.98	Software Development
9	6.98	IS Role and Contribution
Service Companies (N = 37)		
Rank	Mean	Issue
1	8.59	Data Resource
2	8.54	Information Architecture
3	7.95	Strategic Planning
4	7.87	Competitive Advantage
5	7.85	IS Human Resources
6	7.59	Software Development
7	7.54	Technology Infrastructure
7	7.54	IS Organizational Alignment
9	7.44	Organizational Learning
10	7.23	Telecommunication Systems
Non-Profit Organizations (N = 8)		
Rank	Mean	Issue
1	8.63	Data Resource
2	8.25	Information Architecture
2	8.25	Organizational Learning
4	8.00	IS Organizational Alignment
5	7.88	Strategic Planning
6	7.63	End-User Computing
7	7.25	IS Human Resources
8	7.13	Telecommunication Systems
9	7.00	Technology Infrastructure
10	6.88	CASE Technology

Note: Excludes IS educators and consultants.

internal effectiveness as more important than did their counterparts in manufacturing ( $p < 0.05$ ).

### Analysis by position

Analysis by position revealed no significant differences between the ratings of senior IS executives and department managers participating in this study. The primary differences were between IS practitioners (senior executives and department managers) and IS observers (consultants and educators). Table 3 shows that observers generally agree with practitioners on the top 10 issues but disagree over the order of importance of specific issues. For example, the issues dealing with technology infrastructure (information architecture, hardware architecture, telecommunications, etc.) tended to be ranked lower by industry observers than by practitioners (ns). The IS observers participating in the study also attached significantly less importance to security and control, disaster recovery, and the issues relating to technology applications in general (all significant at  $p < 0.05$ ). This makes sense given that IS observers do not need to deal with the realities of day-to-day operations.

## Discussion

Only six of the top issues from 1986 remained in the top 10. In addition, the ordering within the top 10 has changed substantially. Table 4 provides a summary of changes in the key issue framework since 1986. The top 10 issues have been discussed in some depth. In the next section, discussion turns to three new issues of particular importance and to four issues that dropped out of the top 10 since 1986 (each falling by seven or more ranks).

### Important new issues

#### Distributed Systems

Developing and managing distributed systems was ranked highly (tied for #12) and was generated during the first round of the delphi study. It appears to reflect the increasing focus on managing the organization's technology infrastructure (#6) and the new economics of distributed computing via the client/server architecture. This architecture involves a "client"

(usually an intelligent desktop system) capable of executing business applications in cooperation with a "server" (usually a more powerful special or general-purpose computer). Distributed systems present a variety of challenges including: determining the preferred ways to allocate data to support business functions; establishing and maintaining consistent data and procedures; logically connecting computers linked by various networks; responding to increased demands for joint development projects with users; controlling wasteful duplication of effort; and establishing guidelines for providing data resources to multiple users.

#### CASE Technology

Planning and using CASE technology was highly ranked (tied for #12) and was also generated

Table 3. Top 10 Issues by Position

IS Practitioners (N = 92)		
Rank	Mean	Issue
1	8.43	Information Architecture
2	8.33	Data Resource
3	7.98	Strategic Planning
4	7.65	IS Human Resources
5	7.55	Organizational Learning
6	7.52	Technology Infrastructure
7	7.34	IS Organizational Alignment
8	7.33	Competitive Advantage
9	7.24	Software Development
10	7.01	Telecommunications
IS Observers (N = 13)		
Rank	Mean	Issue
1	8.67	Strategic Planning
2	8.42	IS Human Resources
3	8.17	Data Resource
4	7.83	IS Organizational Alignment
5	7.50	Organizational Learning
6	7.42	Information Architecture
6	7.42	Competitive Advantage
8	7.08	Software Development
9	6.92	IS Role and Contribution
10	6.83	Technology Infrastructure

Note: "IS practitioners" includes senior IS executives and IS department managers; "IS observers" includes IS educators and consultants.

during the first round of the delphi study. It reflects the industry-wide move toward developing IT products to improve lagging software productivity. While progress has been made automating many business functions, the rate of automation has been limited by manual processes used for developing new systems. The rate of change itself may be accelerated if the processes by which business functions are automated are enhanced with more sophisticated tools. In principle, software systems can provide repository-based support for building informa-

tion architectures, for integrating the efforts of analysis and design teams, for standardizing representation methods, for generating code, and for maintaining code once in production. Software can also provide support for the "reverse engineering" of existing business applications by extracting key design elements from existing code. But even after this technology matures, providing automated support for systems development will be extraordinarily complex and will require major changes within the IS function.

**Table 4. Comparison of Key Issues in 1989 and 1986**

1989 Rank	1986 Rank	3-Year Change	Issue Name	Issue Classification			
				M/T	P/C	I/E	Group
1	8	+7	Information Architecture	T	P	I	TI
2	7	+5	Data Resource	M	C	E	BR
3	1	-2	Strategic Planning	M	P	E	BR
4	12	+8	IS Human Resources	M	C	I	IE
5	3	-2	Organizational Learning	M	C	E	BR
6	NR	new	Technology Infrastructure	T	C	I	TI
7	5	-2	IS Organization Alignment	M	C	E	BR
8	2	-6	Competitive Advantage	M	P	E	BR
9	13	+4	Software Development	T	C	I	IE
10	11	+1	Telecommunication Systems	T	C	E	TI
11	4	-7	IS Role and Contribution	M	P	E	BR
12	14	+2	Electronic Data Interchange	T	C	E	TI
12	NR	new	Distributed Systems	T	C	E	TI
12	NR	new	CASE Technology	T	C	I	TA
15	16	+1	Applications Portfolio	T	C	I	IE
16	9	-7	IS Effectiveness Measurement	M	C	I	IE
17	NR	new	Executive/Decision Support	M	C	E	TA
18	6	-12	End-User Computing	M	C	E	TA
19	18	-1	Security and Control	T	C	I	IE
20	NR	new	Disaster Recovery	T	C	I	IE
21	NR	new	Organizational Structure	M	C	E	BR
22	10	-12	Technology Islands	T	C	E	TI
22	NR	new	Global Systems	M	P	E	TI
24	NR	new	Image Technology	T	C	E	TA
25	NR	new	IS Asset Accounting	M	C	E	BR

Notes: "NR" indicates that an issue was not ranked.

Issues were classified as follows:

"M/T" indicates management (M) or technology (T);

"P/C" indicates planning (P) or control (C);

"I/E" indicates internal (I) to IS organization or external (E);

"Group" indicates business relationship (BR), technology infrastructure (TI), internal effectiveness (IE), or technology application (TA).

### **Executive/Decision Support**

Facilitating and managing decision and executive support systems (#17) rejoins the key issue framework after dropping out of the survey in 1986. It is essentially the same issue that in 1980 and 1983 was ranked in the top 10, with an increased emphasis now on application of DSS in the executive suite. Since 1986, commercial executive support system shells, such as Comshare's Commander EIS and Pilot's Executive Systems Command Center, have begun to penetrate the market. Over the past few years, these systems have gained increased acceptance by CEOs. They enhance management's access to current "what-is" data and facilitate experimentation with "what-if" decision possibilities. Decision support tools are increasingly viewed as a welcome opportunity for introducing IS to senior executives.

### *Issues dropped from top 10*

#### **IS Role and Contribution**

Concern for defining IS role and contribution to the organization, although still highly ranked (#11), dropped seven places from fourth to 11th since 1986. In the past, IS was often viewed as an overhead expense with little appreciation of its contributions to the organization. But it is possible that the highly publicized accounts of IS adding strategic value (e.g., American Airlines, American Hospital Supply, Otis Elevator, Mrs. Fields, etc.) have raised awareness of the potential role IS can play. Elevated reporting levels and a back-to-the-basics attitude among IS executives may have also contributed to the devaluation of this issue.

#### **IS Effectiveness Measurement**

Concern for the measurement of IS effectiveness and productivity (#16) has steadily declined in importance since the SIM surveys were initiated in 1980. Down seven places since 1986, this is the first year it has fallen from the top 10. Its relatively low ranking among IS executives is somewhat surprising. Effectiveness continues to evade all attempts to define and measure it (Dixon and John, 1989). The role of information technology in business performance is subtle and difficult to untangle from other factors. In some companies,

weak "surrogate" measures have obscured the path toward establishing value. Effectiveness measures need to be linked to business performance. They need to be reliable and ongoing. As Dixon and John (1989) point out, a key question in the future will be to determine how to measure the impacts of IT investment on the organizational bottom line.

#### **End-User Computing**

The low ranking of end-user computing (#18) may provide a good example of organizational learning. After ranking #2 in 1983 and #6 in 1986, the issue dropped 12 ranks in this study. While the problem has not gone away (it is still ranked #6 among non-profit organizations), end-user computing has penetrated so broadly into most organizations that it can no longer be effectively managed solely through the IS function (Reed, 1989). By 1986, most organizations that needed information centers had implemented them to provide end-user training, consulting, and technical support. In some organizations, where these services duplicated existing services, information centers have been dissolved. Needed services have been redistributed back to appropriate subunits (Robey and Zmud, 1990). In the process, much of the planning has returned to IS, while much of the control has been distributed to the line organization (see, for example, Brancheau, et al., 1989b).

#### **Technology Islands**

The technology islands issue (#22) appears to provide additional evidence of successful organizational learning. A decade ago, researchers pointed out the need to merge the "islands of automation" (data processing, telecommunications, and office automation) into a single function (McFarlan and McKenney, 1982; McFarlan, et al., 1983). They identified the difficulties organizations would face unless these technologies could be managed together. After ranking #3 in 1983 and #10 in 1986, this issue dropped twelve ranks in this study. Over the decade, many companies have made substantial progress toward merging the management of related information technologies. Recent studies support the view that both IS and telecom executives have begun to work together more closely (Kuehn, 1990).

### *Issues not mentioned*

Some readers may be surprised at the absence of certain important issues from the key issues framework. For example, artificial intelligence and expert systems do not appear in the final issues list. Object-oriented systems and reverse engineering are also missing. In addressing the first point, an issue labeled "Managing the Impact of Artificial Intelligence" was carried over from the 1986 study into the first round of the 1989-90 study. This issue was dropped after the first round (along with issues about packaged software, factory automation, and IS funding level) after receiving markedly low ratings from respondents.

As for other issues not listed in the framework, the topic of object-oriented systems was mentioned in the first-round cover letter but was not written in as a distinct issue by any respondent. Because object-oriented systems provide one means of improving the quality of software development (#9), respondents may have factored object-oriented systems into their ratings for software development. It also seems likely that senior IS executives are more concerned about the general problem of improving software quality and less concerned with the specific means employed to solve that problem. Additionally, IS executives might have subsumed some narrowly defined issues under related but more broadly defined issues (e.g., reverse engineering subsumed under CASE). Other important issues may be delegated to subordinates or be viewed as outside their control and, thus, not of immediate concern. In interpreting the key issues framework, the purpose and scope of the study need to be kept in mind. This study's focus on senior IS executives captures a perspective likely to focus on broad management questions and commercially viable information technologies.

### *Classification of issues*

To facilitate further analysis and discussion, the issues are classified along three dimensions and categorized into four groups. The classification scheme is presented as part of Table 3. Where possible, issues were classified along the lines suggested in previous studies. The "M/T" classification is adapted from work by Brancheau and Wetherbe (1987). It denotes whether an issue is predominantly concerned with management (M) or technology (T) factors. Management issues

tend to deal with organizational factors, such as policy, strategy, structure, accountability, and human resources. Technology issues tend to deal with the specification, acquisition, development, use, and protection of information technologies. The "P/C" classification is adapted from work by Watson (1989). It indicates whether an issue is predominantly concerned with factors related to planning (P) or control (C). Planning issues tend to take a long-range strategic view of a problem, while control issues tend to take a mid-range tactical view. The "I/E" classification is adopted from work by Hirschheim, et al. (1988). It indicates whether an issue is predominantly concerned with factors internal (I) or external (E) to the IS organization. Internal matters are concerned with management of the IS organization and related technologies, while external matters are concerned with management of the business as a whole. Despite the reliance on past work, some issues resisted classification. In the end, a good deal of subjective judgment was involved. The classification scheme in Table 3 is not presented as a rigid formula but as a guide for discussion and understanding.

### *Long-term trends*

Based on the dimensions discussed above, the issues examined in this study are organized into four groups reflecting major thrusts in IS management. As listed in Table 3, the four groups are business relationship (BR), technology infrastructure (TI), internal effectiveness (IE), and technology application (TA). The business relationship group includes data resource, strategic planning, organizational learning, IS organization alignment, and competitive advantage (among others). These issues deal with concerns external to IS departments. They focus on managing the relationship between IS and the business. The technology infrastructure group includes information architecture, technology infrastructure, telecommunications systems, distributed systems, and electronic data interchange. These issues deal with technology concerns. They focus on the integration of technology components to support basic business needs. The internal effectiveness group includes IS human resources, software development, applications portfolio, and IS effectiveness measurement. All these issues focus internally on the IS function. They are concerned with those essential activities comprising

the bulk of the IS function's work. Finally, the technology application group includes CASE technology, executive/decision support, end-user computing, and image technology (e.g., facsimile machines, data input scanners, and large-scale document imaging systems). These issues focus on the business application of specific information technologies.

Figures 2a through 2d trace the importance of the four groups of issues over time (see Appendix C for details). As shown in Figure 2a, business relationship issues have dominated the top 10 throughout the 1980s. In this study, five of the top 10 issues are concerned with managing the relationship between IS and the business. This is not surprising considering IT's increasing range of application and importance in most firms (Owen, 1986). A great deal of material on the IS leader's transition from technologist to manager to executive can be found in the literature. Thus, a key thrust through the 1980s has been increasing focus on external managerial activities (Benjamin, et al., 1985; Brancheau and Wetherbe, 1987; Dickson, et al., 1984; Radding, 1987; Rockart, et al., 1982). However, the drive toward responsiveness to business issues may have increased the pressure for new and more sophisticated technology.

This study reveals two important trends as the field enters the 1990s. First, and most important, is the rising importance of technology infrastructure issues. An examination of Figure 2b reveals strong and upward trends in the importance of five different infrastructure issues. The overall trend may date back to 1986 but has become readily apparent in this study. Technology infrastructure issues now occupy three of the top 10 slots, including the highest position. Second, it appears that internal effectiveness issues (Figure 2c) have made a strong comeback after being virtually ignored in 1986. IS human resources, software development, and the applications portfolio—issues that make up the core of the IS function—all increased in importance. As discussed earlier, the one declining issue in this group—effectiveness measurement—may be declining in part because it has defied solution.

Also deserving attention are the relatively narrow technology application issues shown in Figure 2d. These issues have lagged behind pressing concerns about business relationships and inter-

nal effectiveness. Technology application issues that have gained importance typically have not stayed important over the long run. The optimistic view holds that these issues are largely solvable. As technologies mature and experience accumulates, management practices can be refined to the point where specific applications can be delegated to lower levels in the organization. The pessimistic view holds that technology application issues are not so much solvable as they are ephemeral. New technologies are often commercialized with a great deal of hype. Some applications fail to meet true business needs; others support only a narrow or specialized range of applications. For unsuccessful applications, marketing efforts are abandoned only to be repeated with the next wave of technology. Given the rapid pace of technological change, technology application issues cannot be ignored. The application of new information technologies should continue to be critical in certain situations and for certain periods of time.

### Limitations

Some caution is warranted in interpreting the key issues framework. This study focused on U.S.-based IS executives who were members of the Society for Information Management. While members of this organization are often noted for their leading-edge views, the study may not reflect the views of IS executives in all types of organizations. For example, firms with revenues less than \$250 million, government agencies, and defense contractors are not well-represented in the SIM membership (Society for Information Management, 1990). In general, the small sample from the non-profit sector and small number of IS educators and consultants is limiting with respect to their views. Also, as Watson and Brancheau (1991) have shown, it cannot be assumed that key IS management issues in the United States are the same as key issues in other technologically developed countries. Furthermore, what is important to an IS executive at any point in time is not determined by statistical averages but depends on the complex interaction of business need, technological development, and resource availability. The premise is that the key issues framework can serve as a yardstick for marking major changes in IS management and a guidepost for comparing specific situations with general trends.

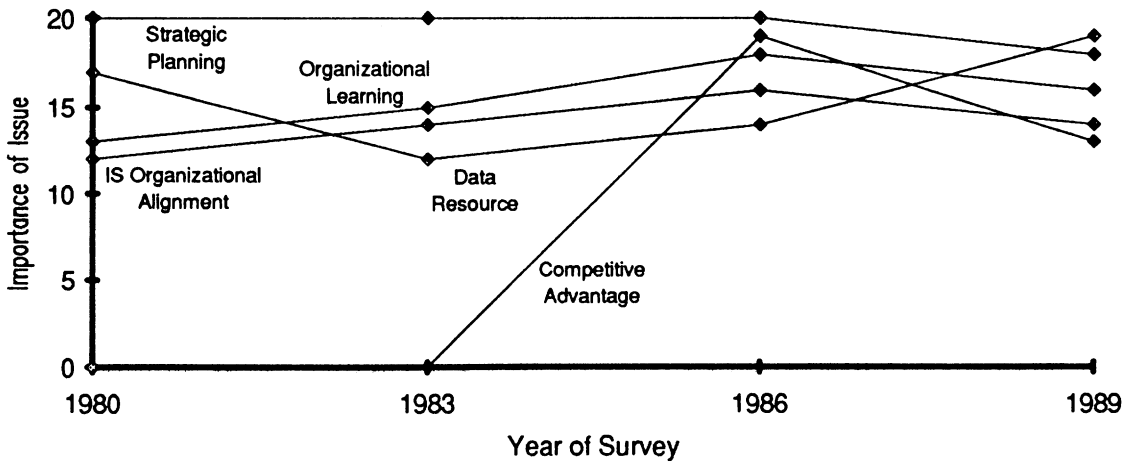


Figure 2a. Long-Term Trends in Issue Importance: "Business Relationship" Issues

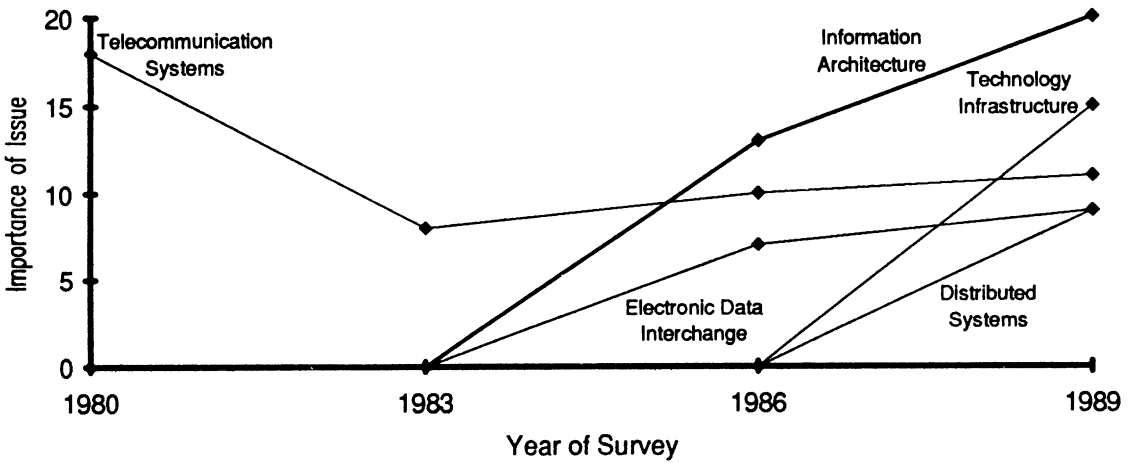


Figure 2b. Long-Term Trends in Issue Importance: "Technology Infrastructure" Issues



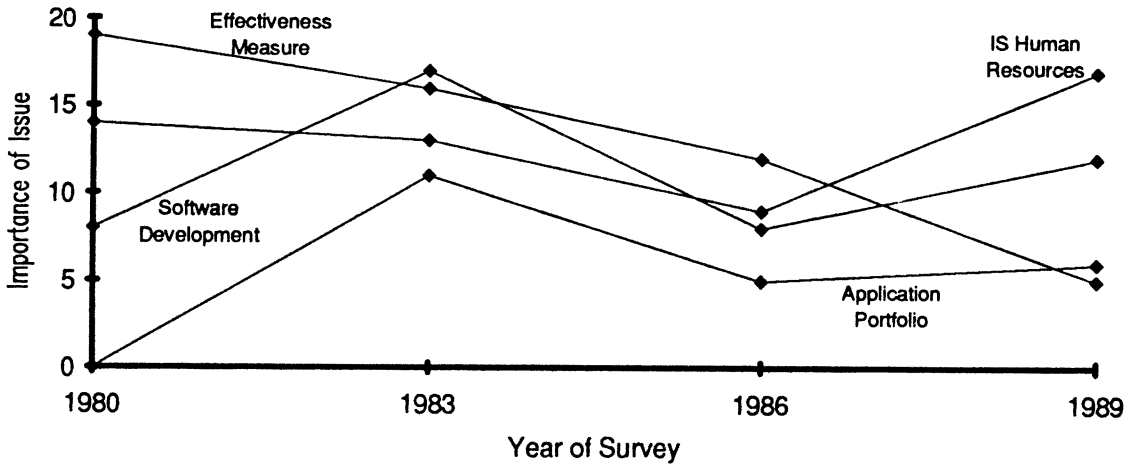


Figure 2c. Long-Term Trends in Issue Importance: "Internal Effectiveness" Issues

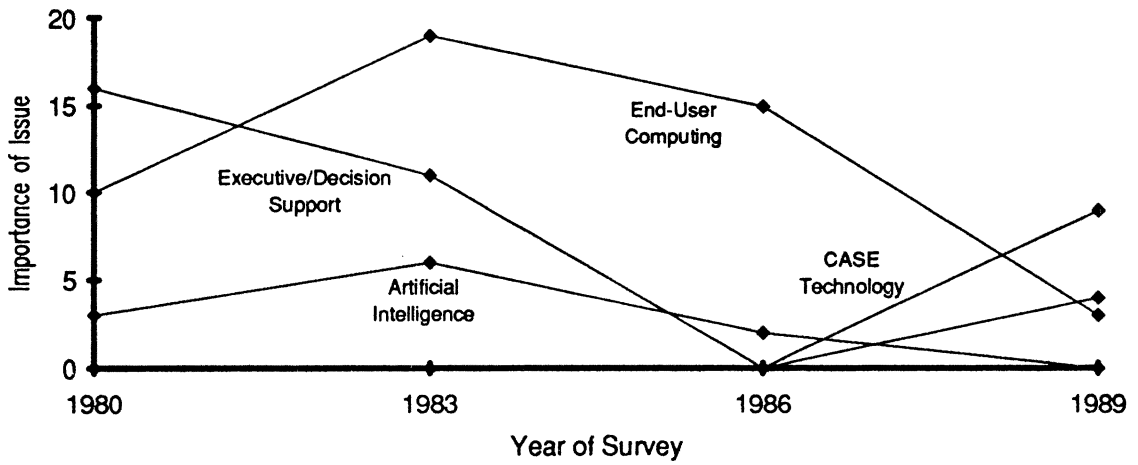


Figure 2d. Long-Term Trends in Issue Importance: "Technology Application" Issues

## Implications for Researchers

This study addresses how IS executives prioritize key IS issues. By developing useful insights and deeper understanding of these issues, researchers offer potential benefit to practitioners. One method for leveraging this study would be to continue developing knowledge regarding highly rated issues. Rigorous examination of information architecture (issue #1), for example, can (1) categorize and describe techniques for creating firm-wide information architectures; (2) clarify organizational circumstances in which an information architecture is of greatest value; and (3) link initiation, development, and evaluation of information architecture to technology infrastructure requirements and to theoretical bases for predicting successful enterprise-wide application of IT. Similar research efforts might be directed at solving problems related to strategic planning and organizational alignment.

Another approach for researchers would be to examine some of the less highly ranked issues that appear to be crucial to the future of IS. For example, the ranking of IS effectiveness measurement dropped considerably from prior years. Yet, few would argue against the importance of valid and reliable measures for managing the IS function. Rigorous examination of IS measurement can (1) identify and prioritize the several dimensions of the measurement problem; (2) develop implementable measurement techniques; (3) test the techniques in the field to identify validity issues and obstacles to acceptance; and (4) refine the techniques and package them with more effective implementation strategies. Similar research efforts might be directed toward solving problems related to global systems, collaborative support, and artificial intelligence. In-depth, long-term, multi-method studies of these and other important issues will strengthen the critical link between information systems research and practice.

## Comments About the Future

What might the planned replication of this study in 1992-93 find? While no one can predict the future, examination of current trends provides some useful clues. While the 1980s may have ushered in solutions for managing end-user computing and integrating the islands of technology, less progress was made on improving strategic planning, aligning the IS organization, and

facilitating organizational learning. As business and technology change, solutions to these problems must be constantly invented by IS executives, consultants, researchers, and vendors. These issues will remain important for the foreseeable future.

If the current rate of change in the business environment continues, organizations in the future will need to respond effectively to turbulence and complexity (Huber, 1984b). This suggests increased reliance on computers and communications as technologies to support new organizational designs (Huber, 1984a; Kiechel, 1990). In this environment, teamwork systems may eventually come into their own. Group decision and collaborative support systems aim to facilitate concurrent processing of ideas and rapid response to changing market conditions (Applegate, et al., 1986; DeSanctis, et al., 1989). The continuing improvement of laptop computers and eventual commercialization of tablet interfaces will facilitate still broader organizational use of IT (*Business Week*, 1991). Additionally, the 1990s will bring increased support via new IT products integrating voice, image, and text (Straub and Wetherbe, 1989). These technologies can be used to manipulate and transport compound documents and to facilitate collaborative work. Improved teamwork technologies may accelerate the acceptance of CASE and improve support for critical aspects of systems development.

Demographic trends point to a serious reduction of talented entry-level professionals in the United States by the end of the 1990s (Couger, 1988; Dreyfuss, 1990). Thus, IS human resources will remain an important issue. While demographics affect the entire firm, solving this problem will be particularly difficult for IS executives due to their heavy reliance on technical staff. Because of the apparent insatiable demand for software, increased automation of systems development will only partially mitigate this problem. In some industries, the human resource problem may initiate a move toward outsourcing of systems development similar to the trend toward facilities management in the 1970s. For many companies, however, IS in the 1990s will probably be too critical to their primary mission and too integral to their corporate strategy to be managed by outsiders.

The outsourcing of systems development has already begun to take on global dimensions

(Press, 1991). In the future, the gap in supply and demand for skilled labor may force IS executives to reach outside the United States to find skilled employees (Johnson, 1991). As Europe's EC 1992 is implemented and its markets extend their reach into Eastern Europe, national boundaries will present fewer barriers to commerce. In addition to tracking global markets for manufacturing and capital, information systems will be increasingly important for tracking market demand, product development, and human resource availability on a worldwide basis (Ives and Jarvenpaa, 1991). Global systems will take on greater importance in many companies.

Because of the magnitude of IT investments, the infrastructure issue will remain important in the years ahead. IS executives will continue seeking ways to deliver services efficiently while providing tools to respond to rapidly changing business requirements. They will continue to upgrade the quality of the IT infrastructure by evaluating emerging technologies and integrating promising new technologies into their operations. UNIX operating systems, open systems interconnect, client/server architectures, and enhanced systems development capabilities point to continued vendor support for building an IT infrastructure that provides efficient service while allowing for innovation.

Previous SIM/MISRC studies have marked the transition of IS leaders from managers of technology to managers of the enterprise. Echoing Taggart and Sibley's (1979) warning a decade ago, this study underscores the need for IT executives to keep these perspectives in balance. As noted by Dixon and John (1989), IS executives must focus on sharing knowledge and contributing to others' strategic initiatives. They must act as consultants, as directors of research and development, and as planners and managers of complex infrastructures. They must expand their view of the enterprise, champion new initiatives, and develop staff skilled in business processes, teamwork, consulting, and communications. This diversity of roles and demands appears to be reflected in the broad range of issues identified by the IS executives in this study.

### Acknowledgments

We wish to acknowledge the Society for Information Management and the MIS Research Center

for their support of the research. We also thank Chris Pickering, Carroll Frenzel, and the anonymous associate editor and reviewers for help in improving the manuscript.

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## Appendix A

### Sample Survey Instrument (Round 2)

### Key Information Systems Management Issues

What do you consider to be the most critical issues facing IS executives over the next three to five years? Please indicate your views by rating each issue on a scale of 1 to 10, where 10 indicates your highest priority issue(s) and 1 indicates your lowest priority issue(s). The more important the issue, the higher the rating. Use the space below to assign your ratings. Space is also provided at the end of the form to write in additional issues.

**RATING SCALE:**

Indifferent							Moderately Important							Critically Important
1	2	3	4	5	6	7	8	9	10					

Your Current Rating:

Key Issues and Their Rationale:

- \_\_\_ 1. **Developing an Information Architecture**  
Rationale: A corporate/global information architecture is needed to identify the major information categories used within an enterprise and their relationships to business processes. It is a necessity to guide applications development and facilitate the integration and sharing of data.
  
- \_\_\_ 2. **Improving IS Strategic Planning**  
Rationale: It is increasingly critical to an organization's success that it align its long-range IS plan with its strategic business plan. Rapidly changing business environments, increased involvement of end users, and accelerated technological change underscore the need to continue improving strategic planning skills.
  
- \_\_\_ 3. **Making Effective Use of the Data Resource**  
Rationale: The organization's data resource is growing in size, complexity, and value. Despite this, it remains largely unrecognized, inaccessible, and underutilized. IS must develop a climate within its department and throughout the organization that values the data resource as a corporate asset.
  
- \_\_\_ 4. **Specifying, Recruiting, and Developing Human Resources for IS**  
Rationale: Current and future shortages of qualified information systems personnel threaten the IS department's ability to keep up with the information needs of its parent organization. Career paths need to be clarified. More emphasis needs to be put on developing business skills.
  
- \_\_\_ 5. **Using Information Systems for Competitive Advantage**  
Rationale: In many businesses, long-term survival is dependent on using information systems to gain competitive advantage. The business can be lost without it. Competitive advantage results from recognition of opportunities through creativity and innovation, followed by rapid implementation. These are historical weaknesses of IS
  
- \_\_\_ 6. **Aligning the IS Organization With That of the Enterprise**  
Rationale: The effectiveness with which IS can support the enterprise's information needs is dependent on the IS department's position within the enterprise. Too often IS is not located appropriately within the organization.

- \_\_\_ 7. **Facilitating Organizational Learning and Use of IS Technologies**  
Rationale: Organizations that prosper will be those that make use of appropriate new IS technologies in their entire operation. Business practices and organizational structures will need to be modified in many cases. IS also must demonstrate its own ability to learn and use new technology.
- \_\_\_ 8. **Increasing Understanding of the Role and Contribution of IS**  
Rationale: IS is sometimes viewed as an overhead expense with little appreciation of its contributions to the organization. This can lead executive management to make infeasible demands and cut funding, resulting in missed opportunities for the organization.
- \_\_\_ 9. **Planning and Implementing a Telecommunications System**  
Rationale: Communication is the lifeblood of the organization. Using IS for competitive advantage often depends heavily on telecommunications. Rapid and major changes in the industry complicate this task.
- \_\_\_ 10. **Improving the Quality of Software Development**  
Rationale: The application development backlog remains at unacceptably high levels. Users are getting impatient. Add to this the increasing costs of human resources, and the need for improved effectiveness in systems development becomes clear.
- \_\_\_ 11. **Enabling Electronic Data Interchange and Multi-Vendor Integration**  
Rationale: Electronic communications with vendors and customers may offer tremendous competitive advantage to a company. IS executives must push for basic industry standards. Standards would enable electronic data interchange and cost-effective multi-vendor environments without major conversion costs or loss of functionality.
- \_\_\_ 12. **Planning and Management of the Applications Portfolio**  
Rationale: The applications portfolio is rapidly increasing in size, complexity, and maintenance cost. Despite the longevity of the maintenance problem, too little is known about managing it effectively.
- \_\_\_ 13. **Measuring IS Effectiveness and Productivity**  
Rationale: The measurement of IS performance is crucial to its effective management. This is becoming more important as organizations invest more and more money in information systems.
- \_\_\_ 14. **Integrating Data Processing, Office Automation, Telecommunication, and Factory Automation**  
Rationale: The capability now exists to integrate systems that are based on these diverse technologies. As organizations try to integrate their technologies, organizations and managerial problems will need to be solved.
- \_\_\_ 15. **Improving Information Security and Control**  
Rationale: As organizations increase their dependence on information systems, there is a greater risk from destruction and alteration of data, disclosure to outside sources, and disruption of information services. Tight security controls and fault-tolerant information delivery are becoming a necessity.
- \_\_\_ 16. **Facilitating and Managing End-User Computing**  
Rationale: The proliferation of end-user computing through personal computers offers the promise of improved productivity but also the dangers of inadequate management control. Information systems management must balance control against the need for slack. Clarification of IS and end-user roles is a necessity.



- \_\_\_ 17. **Developing and Managing Distributed Systems**  
Rationale: Distributed systems present a variety of challenges including: establishing and maintaining consistent data; physically connecting computers linked by various networks with seamless gateways; responding to increased demands for joint development projects with users; controlling wasteful duplication of efforts; and establishing guidelines for providing data resources to multiple versus local users.
- \_\_\_ 18. **Planning and Using CASE Technology**  
Rationale: Significant progress has been made automating business functions within organizations; however, a vast productivity gain is possible if the automation process itself is automated. In principle, software systems can provide support for integrating the design efforts of project teams, standardizing representation methods, and generating code. While this technology is still being refined, providing support for systems development is extraordinarily complex and will require major changes within the IS function.
- \_\_\_ 19. **Building a Responsive IT Infrastructure**  
Rationale: The combination of maintenance problems, evolving corporate architecture, package integration, user-developed systems, and quality of the application portfolio will require extensive automation of the IT processes required to coordinate action and manage the business. Building an integrated technology platform is the key to enterprise and industry productivity.
- \_\_\_ 20. **Using IS to Influence Organizational Structure**  
Rationale: It is commonly accepted that new information technologies offer the potential to flatten organizational structure, thereby creating a more responsive, flexible, innovative firm. Information systems may also enable new, dynamic organizational forms, further improving the firm's responsiveness to react to new opportunities.
- \_\_\_ 21. **Facilitating/Managing Decision and Executive Support Systems**  
Rationale: Increasing the ability to exploit situations for competitive advantage depends on enhancing the ability of management to "experiment" with decision possibilities. Many other issues also depend on this capability. Decision support tools have long been viewed as a method for introducing modelling tools to executives to improve their decision making. However, these efforts have met with mixed success.
- \_\_\_ 22. **Establishing Effective Disaster Recovery Capabilities**  
Rationale: Down-side risks are increasing daily from the potential loss of business due to a disaster. Effective recovery plans must be in place and tested regularly to ensure losses are minimized. As organizational applications grow and become more integrated, the greater the risk becomes.
- \_\_\_ 23. **Planning and Using Image Technology**  
Rationale: The utilization of image technology, such as facsimile machines and data input through scanners, is growing in firms. There is an increasing need to integrate these into the IS arena and consider their impact on technology planning and acquisition, hardware and software architecture, and user policies.
- \_\_\_ 24. **Moving Toward Global Systems**  
Rationale: With increasingly global orientation of markets, suppliers, customers, etc., business will require global information planning, designs, and implementations to permit effective and efficient operations. This will challenge current systems of data transfer, time concepts, cooperative work, and language utilization.
- \_\_\_ 25. **Accounting for the Asset Value of Information and Software**  
Rationale: Currently, most internally developed software and information databases are expensed, not amortized. Effective long-term management requires an acceptable method of accounting for the asset value of software and databases.

## Appendix B

### Survey Data by Delphi Round

Issue Name	Round One			Round Two			Round Three		
	Ordinal Rank	Mean Rating	Std Dev	Ordinal Rank	Mean Rating	Std Dev	Ordinal Rank	Mean Rating	Std Dev
Information Architecture	2	7.78	1.90	1	8.15	1.72	1	8.32	1.49
Data Resource	3	7.70	1.79	2	8.13	1.64	2	8.31	1.42
Strategic Planning	1	7.80	1.86	3	7.97	1.75	3	8.06	1.53
IS Human Resources	4	7.55	2.00	4	7.44	1.89	4	7.74	1.76
Organizational Learning	3	7.22	1.75	6	7.26	1.58	5	7.54	1.51
Technology Infrastructure		-new issue-		8	7.09	1.84	6	7.44	1.80
IS Organization Alignment	6	7.38	2.45	7	7.21	2.29	7	7.39	2.18
Competitive Advantage	5	7.49	2.09	5	7.29	2.05	8	7.34	2.10
Software Development	10	6.84	1.88	9	7.11	1.85	9	7.22	1.76
Telecommunication Systems	9	7.10	1.85	10	7.02	1.89	10	6.92	1.84
IS Role and Contribution	8	7.13	2.15	11	6.90	2.05	11	6.85	1.97
Electronic Data Interchange	10	6.84	1.72	12	6.82	1.83	12	6.63	1.83
Distributed Systems		-new issue-		13	6.69	1.75	12	6.63	1.92
CASE Technology		-new issue-		14	6.61	1.62	12	6.63	1.61
Applications Portfolio	12	6.46	1.75	16	6.36	1.61	15	6.37	1.41
IS Effectiveness Measurement	13	6.33	1.96	15	6.44	1.94	16	6.20	1.93
Executive/Decision Support		-new issue-		18	6.02	1.73	17	6.02	1.83
End-User Computing	16	6.31	2.02	21	5.83	1.98	18	5.93	2.02
Security and Control	15	6.32	2.02	17	6.07	2.01	19	5.82	2.09
Disaster Recovery		-new issue-		22	5.83	2.16	20	5.69	2.00
Organizational Structure		-new issue-		19	5.98	2.33	21	5.67	2.31
Technology Islands	13	6.33	2.12	20	5.94	1.97	22	5.65	2.12
Global Systems		-new issue-		23	5.69	2.41	22	5.65	2.48
Image Technology		-new issue-		24	5.36	1.95	24	5.53	1.69
IS Asset Accounting		-new issue-		25	4.91	2.22	25	4.53	2.36
IS Funding Level	17	6.12	2.11		dropped-			dropped-	
Packaged Software	18	5.84	1.96		dropped-			dropped-	
Artificial Intelligence	19	5.01	2.16		dropped-			dropped-	
Factory Automation	20	4.99	2.63		dropped-			dropped-	

Notes: NR indicates item was not ranked as a key issue;

N = 114 for round one; N = 126 for round two; N = 104 for round three.

## Appendix C

### Ranking of Key Issues Over Time

Issue Name	Issue Rank by Year of Survey			
	1980	1983	1986	1989
Information Architecture	NR	NR	8	1
Data Resource	4	9	7	2
Strategic Planning	1	1	1	3
IS Human Resources	7	8	12	4
Organizational Learning	8	6	3	5
Technology Infrastructure	NR	NR	NR	6
IS Organization Alignment	9	7	5	7
Competitive Advantage	NR	NR	2	8
Software Development	13	4	13	9
Telecommunication Systems	3	13	11	10
IS Role and Contribution	NR	15	4	11
Electronic Data Interchange	NR	NR	14	12
Distributed Systems	NR	NR	NR	12
CASE Technology	NR	NR	NR	12
Applications Portfolio	NR	10	16	15
IS Effectiveness Measurement	2	5	9	16
Executive/Decision Support	5	10	NR	17
End-User Computing	11	2	6	18
Security and Control	12	14	18	19
Disaster Recovery	NR	NR	NR	20
Organizational Structure	18	NR	NR	21
Technology Islands	NR	3	10	22
Global Systems	NR	NR	NR	22
Image Technology	NR	NR	NR	24
IS Asset Accounting	NR	NR	NR	25

Notes: 1980 data adapted from Ball and Harris (1982) (see Brancheau and Wetherbe, 1987, for detailed mapping; 1983 data from Dickson, et al. (1984); 1986 data from Brancheau and Wetherbe (1987); NR indicates item was not ranked as a key issue.