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Key Issues in Information Systems Management: 1994-95 SIM Delphi Results¹

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Abstract

Over the past 15 years, the Society for Information Management (SIM) has periodically

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surveyed its members to determine the most critical issues in IS management. Again in 1994-95, SIM institutional and board members were asked to consider what they felt were the most critical issues facing IS executives over the next three to five years. Signaling an evolutionary shift in IS management, this study shows that business relationship issues have declined in importance compared to technology infrastructure issues. For IS executives and general managers, the key issue framework suggests some general directions for emphasis and provides a coarse measure for benchmarking their own concerns against those of their peers. The results of this study also impact educational missions in teaching and research to the extent that they need to be sensitive to the views of practicing IS executives.

Introduction

Over the past 15 years, the Society for Information Management (SIM), in a joint effort with the MIS Research Center (MISRC) at the University of Minnesota and others, has periodically surveyed its members to determine the most critical issues in IS management. These surveys are important because professional societies such as SIM, as well as IS vendors, consultants, educators, and researchers all need to be aware of IS executives' key concerns to serve their markets effectively.

Following the methods developed in earlier studies, this article reports on a three-round Delphi survey of senior IS executives and follow-up interviews. The results highlight what these executives believe are the most important IS management issues over the three- to five-year planning horizon ending in 1999.

The survey and interview methods employed in the research are outlined in the next section. Following this, the results of the survey are presented. Then, some thoughts are offered about managing information systems and the evolving nature of the discipline. Appendices contain additional details about the participants and the results.

Research Methods

One of the noteworthy attributes of this study lies in the strengths obtained by replicating the research methods and subject populations used in previous SIM key issue studies (Ball and Harris, 1982; Brancheau and Wetherbe, 1987; Dickson, et al., 1984; Niederman, et al., 1991). The Delphi method was retained for its value in surfacing new issues and moving study participants toward consensus (Delbecq, et al., 1975). Essentially, the Delphi method employs a series of linked questionnaires. Successive rounds of questionnaires summarize subjects' responses to the preceding questionnaire and ask respondents to re-evaluate their opinions based upon the summarized results. Questionnaire rounds are continued until a reasonable level of consensus is achieved. As in earlier studies, SIM institutional and advisory board members served as our subject population. The timing and nature of the SIM key issue surveys are summarized in Table 1.

Development of methods

A brief summary of the development of the study's issues and the evolution of its methods is presented in this section. Complete details can be found in the article reporting each study. A summary of the methods applied in this study follows.

The first SIM key issues study by Ball and Harris (1982) employed a single round survey of the entire SIM membership. This was the first survey of the SIM membership published

in a major journal. The primary methodological foundation for the present study, however, was laid by Dickson, et al. (1984) when they applied the Delphi method and constrained their sample to the SIM institutional membership. Institutional members represent organizational memberships within SIM. These memberships are usually represented by the highest ranking IT officer within the organization. Utilizing institutional members as a research sample offers the advantage of having one highly placed individual within each organization respond on behalf of the organization and eliminates biases from having multiple people respond from a single organization.

Dickson and his colleagues began with an open-ended survey asking SIM institutional members to identify and briefly describe five to 10 of what they considered to be the major IS management issues over the next five to 10 years. His research team consolidated these qualitative data into a combined list of issues and rationales. The resulting information was sent back to respondents in a second round survey for further ranking and comment. This iteration of ranking and comment was continued for two additional rounds until a reasonable consensus was achieved. The resulting framework was published in the *MIS Quarterly* and became the starting point for the 1986 study.

The 1986 study opened by soliciting revisions to the 1983 issues and rationale in its first survey round. Numerous new issues and rationale were contributed. Existing language was modified as recommended by participating IS executives. Following incorporation of the new qualitative material, two additional rounds of

Table 1. SIM Key Issue Surveys

Data Date	Citation	Participants	Rounds
1980	Ball & Harris, 1982	417 SIM members	1
1983	Dickson, et al., 1984	102 SIM institutional members	4
1986	Brancheau & Wetherbe, 1987	90 SIM institutional members	3
1990	Niederman, et al., 1991	175 SIM institutional members	3
1994-95	(present study)	108 SIM institutional members	3

survey ranking were used to achieve a reasonable consensus on the most important issues facing IS executives. The 1990 study used a similar approach but asked respondents to rate instead of rank the issues. This simplified the complex task of ordinal ranking of 20-25 different issues. To maintain continuity with its predecessors, the 1994-95 study followed a similar approach with minor enhancements.

A strength of this approach is its maintenance of a series of data about a single professional organization spanning 15 years. The continuity of method and issue framework facilitate longitudinal comparison of data. An additional strength is that the issues and their rationale have been created and revised almost exclusively by the respondents themselves. Unfortunately, the approach has weaknesses as well. The two most important are the lack of clarity of some issues and the conceptual overlap of other issues in the framework.

Round one

The 1994-95 study began in March 1994 with a list of the top 21 IS management issues derived from the 1990 study. These issues, along with a brief rationale describing each issue were listed in random order and mailed to 217 SIM institutional and board members. To reduce any bias inherent in a particular randomized sequence, four different randomized versions of the survey were distributed. *Participants 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 1997-99).* They were asked to rate each issue on a 10-point scale, where 10 indicated their highest priority issue(s) and 1 indicated their lowest priority issue(s). Participants were also encouraged to comment on the list of issues and associated rationale as well as write in issues they felt may have emerged since the 1990 study. Of the 217 mailed surveys in round one, useable responses were received from 78 respondents, yielding a response rate of 36 percent.

Round two

In June 1994, all 217 SIM institutional and board members were sent feedback summarizing the results of the first round. Those SIM members that responded to the first round survey were also provided with their personal responses as a baseline for comparison. Issues were listed in rank order of importance from highest to lowest mean rating. Three issues with markedly lower ratings were dropped. These were security and control, disaster recovery, and CASE technology. Based on first-round feedback, five new issues were added. These were business process redesign, collaborative support, outsourcing, object-oriented technologies, and multimedia applications. The new issues were formed by clustering related issues and rationale submitted by first-round respondents in the "open" section of the survey instrument. All write-in issues submitted by four or more respondents were included. Respondents were asked to rate each of the 23 second-round issues on a 10-point scale. This instrument used a closed form with no space provided to write in additional issues. Useable responses were received from 87 respondents, yielding a response rate of 40 percent.

Round three

In September 1994, respondents from the previous two rounds (108 individuals) were sent feedback from the second round survey on the top 20 issues. The three lowest-ranked issues were dropped from the survey. These were decision and executive support systems, object-oriented technologies, and multimedia applications. Respondents were asked to rate the issues one last time. Similar to the second round survey, issues were listed in rank order and *personal* ratings were provided from the last survey that the respondent had returned. Useable responses were received from 83 respondents, yielding a response rate of 76 percent for the final round and 38 percent of the institutional membership.

The three rounds of the survey provided one round for revising issues and rationale and two rounds to increase the level of consensus on the importance of those issues. Overall, 108 of the 217 SIM institutional and board members (50 percent) participated in the study. In the following discussion, data are from the final round of the survey unless otherwise indicated. Appendix A contains the final-round survey instrument.

Interviews

To recap the final survey results for respondents and to facilitate our follow-up interviews, a four-page summary of results was mailed to all participants in February 1995. In March and April, the 10 SIM officers and board members who had participated in the survey were invited to comment on the results and answer questions about the research. Seven individuals made themselves available for telephone interviews. In addition to asking for their general reaction to the results, we asked which forces were driving the top issues, what made the issues so troublesome, and whether they thought the framework had the right balance between management and technology issues. The interviews were recorded, transcribed, and used to help interpret the results of the survey.

Survey participants

The profile of survey participants in the 1994-95 study is consistent with previous SIM surveys. Consequently, one would not expect major shifts in rating due to changes in population demographics across the studies. However, because the individuals responding may be different from one study to the next, one cannot rule out the possibility that rating shifts are attributable to underlying trends among those entering and leaving the field of IS management. Even if this were true, however, such shifts are likely a reflection of changes in the types of people entering and leaving the

field of information systems management at large.

All regions of the United States are represented in the survey, with the majority of participants from the Northeast (40 percent) and Midwest (32 percent); and the minority from the South (13 percent) and West (10 percent). A small number of participants are from Canada (5 percent). This distribution reflects the SIM professional population with its strong membership base in the Northeast and Midwest (Society headquarters are in Chicago). In terms of industry representation, the majority of participants are from the commercial sectors of manufacturing (48 percent) and services (39 percent), with a minority (13 percent) from the non-profit sector. In terms of positions held, the majority of participants (67 percent) are senior IS executives in their respective organizations. Typical job titles include chief information officer, senior vice president, vice president, senior director, or director with their department most commonly named information systems, information services, or information technology. IS department managers (22 percent), IS educators (7 percent), and IS consultants (4 percent) make up the balance of the sample. The high percentage of senior IS executives is a strength of the SIM institutional sample and adds value to the study's findings. A list of the organizations participating in the study is included in Appendix B. Statistical analyses revealed few significant differences in rankings based on position or industry.

Results

The final-round results are shown in Table 2. In presenting the results, we first discuss the top 10 issues and then comment on other substantive changes in the framework.

Top 10 issues

Each of the 10 highest-rated issues are discussed briefly to provide insight into the ratio-

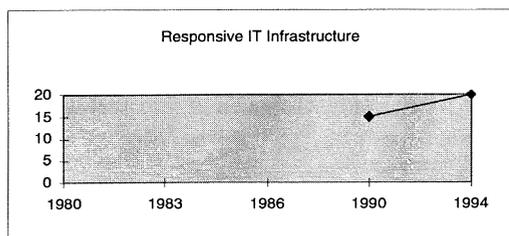
Table 2. 1994-95 Key-Issue Framework

Rank	Key Issue	Mean Rating	Standard Deviation
1	Building a Responsive IT Infrastructure	9.10	.096
2	Facilitating and Managing Business Process Redesign	7.79	1.19
3	Developing and Managing Distributed Systems	7.73	1.38
4	Developing and Implementing an Information Architecture	7.62	1.50
5	Planning and Managing Communication Networks	7.58	1.40
6	Improving the Effectiveness of Software Development	7.50	1.86
7	Making Effective Use of the Data Resource	7.46	1.62
8	Recruiting and Developing IS Human Resources	7.31	1.70
9	Aligning the IS Organization Within the Enterprise	7.11	2.02
10	Improving IS Strategic Planning	6.82	2.02
11A	Implementing and Managing Collaborative Support Systems	6.59	1.91
11B	Measuring IS Effectiveness and Productivity	6.59	2.01
13	Increasing Understanding of IS Role and Contribution	6.53	2.02
14	Facilitating Organizational Learning	6.48	1.87
15	Managing the Existing Portfolio of Legacy Applications	6.31	2.03
16	Facilitating and Managing End-User Computing	6.23	1.88
17	Using Information Systems for Competitive Advantage	6.18	2.12
18	Planning and Integrating MultiVendor Open Systems	6.04	1.86
19	Developing and Managing Electronic Data Interchange	5.91	2.00
20	Outsourcing Selected Information Services	5.40	2.03

Note: All data are from the final round of the Delphi survey (N = 83).

nale behind the issue and its relationship to other issues. The figure for each issue tracks its history in the key-issue framework since 1980. In these figures, ranks are inverted (subtracted from 21) so that higher (more important) rankings are depicted higher on the vertical axis. Issues introduced after the initial study in 1980 show no data for the years they were not included in the key-issue framework.

#1 Building a Responsive IT Infrastructure

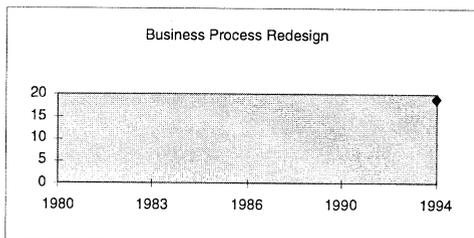


Building a technology infrastructure that supports existing applications while remaining responsive to change is a key to long-term enterprise productivity. This task is made difficult by the continuing rapid changes in infrastructure technology and the increasing breadth and depth of applications needing support. *More than any other, this issue captures an important contemporary thrust of enterprise IS management: providing the processor power, network connectivity, and application framework required to support core business activities and unknown future ventures.* This issue was first introduced in the 1990 study. For 1994-95 it has the lowest standard deviation (s.d. = 0.96) of any issue, indicating strong agreement on its importance. Due to its general nature, it is closely related to several other top issues such as distributed systems (#3), information architecture (#4), and communication networks (#5). In a broad sense, these three issues can be viewed as

relating to three of the components of an IT infrastructure: applications, data, and networks. One of the participating IS executives had this to say:

The number one issue says it all. My number one issue is building and maintaining a reliable and responsive infrastructure. Companies today are built on IT infrastructures—e-mail, LANs, etc. As a result, the infrastructure on which all of this technology depends must be solid. Ten years ago we lived in an easy world—one big box in one place. Today things are very complicated. Therefore, we must be able to depend on the infrastructure.

#2 Facilitating and Managing Business Process Redesign

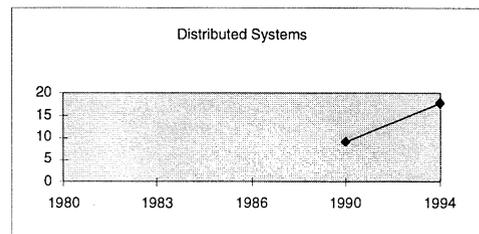


In response to market pressures, many organizations are radically changing the way they do business. IT plays an important role in this change process by enabling the innovative redesign of core business processes. Having been popularized just after the 1990 key issues study (e.g., Hammer 1990), business process redesign (BPR) is new to the key-issue framework in the United States. In related studies worldwide, however, it has been a top issue among IS managers and executives for several years (Watson, et al., 1996). The importance of this issue is attributable to the need for major changes in internal processes to adjust to the ongoing massive changes in the external environment. Interviews with executive participants suggest that this issue is one of the major drivers for infrastructure-related issues such as responsive infrastructure (#1), distributed systems (#3), and communication networks (#5). Without a responsive infrastructure, IS becomes a constraint instead

of an enabler of change. One of the IS executives offered these comments:

I think the reason that you see this trend is that if you look at the last five years, there has been so much downsizing. Okay, let's call it redistribution. And with the miniaturization of technology itself, companies have gone away from mainframes and moved to networks of PCs, super servers, or whatever you want to call them. Clearly we didn't have the infrastructure to do that five years ago. Issues like #1 through #5 all relate to the IS function having to respond to change in the organization.

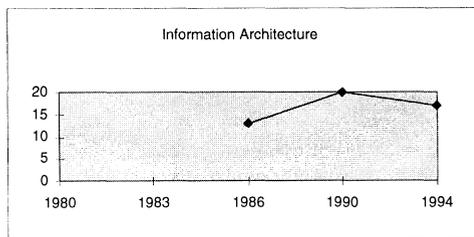
#3 Developing and Managing Distributed Systems



Client-server applications may offer an effective alternative to centralized applications. The demand for graphical user interfaces combined with the economics of making better use of the installed base of desktop computers and local area networks make client server a useful approach for distributing applications across a heterogeneous environment. Unfortunately, they present many challenges including maintaining consistent software versions, maintaining consistent data, controlling joint development projects with users, and administering large-scale distributed applications. First introduced in 1990, the importance of this issue has risen dramatically. This issue is closely related to the other infrastructure issues as well as to software development (#6) and is driven by business issues such as decentralization and BPR. One of the executives offered this thought about the link between decentralization and distributed systems:

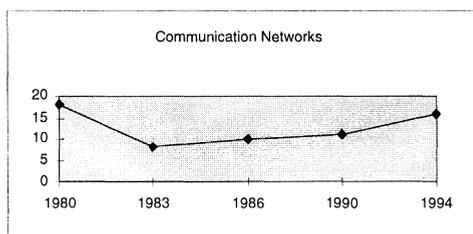
The issue is that companies are distributing themselves. They are putting more people and more management responsibility at the line close to the customer. And these people want access to their own systems and their own data and everything is moving toward that. So managing distributed systems requires very high-capability, client-server systems.

#4 Developing and Implementing an Information Architecture



A corporate/global information architecture is used to identify the major information categories used within an enterprise and their relationships to business processes. It is essential for guiding applications development and facilitating the integration and sharing of data. First introduced in the 1986 study, this issue remains highly ranked. Information architecture is related to the other infrastructure issues as well as software development (#6) and data resource (#7). An infrastructure cannot be responsive if data are scattered throughout the network without a plan. Similarly, software cannot integrate across functions nor distribute across networks without a clear plan for doing so. An information architecture provides a way to coordinate these activities.

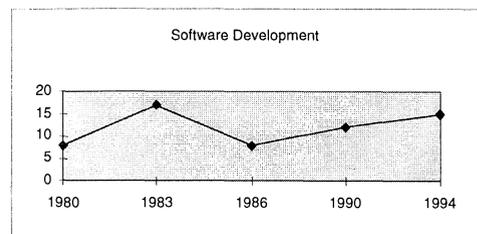
#5 Planning and Managing Communication Networks



Using technology to support organizational information processing depends upon access to appropriate internal and external communication networks. Network access is complicated by rapid advances in underlying technology and ongoing structural changes in the business environment. These forces result in a lack of de facto standards and weakening vendor support. Although not written into the issue rationale on the survey, business use of the Internet surfaced during interviews as an additional factor driving the importance of this issue. This issue has a history dating back to the first SIM survey in 1980. It has long been critical for managing information systems. Communication networks are closely related to the other infrastructure issues as well as to software development (#6) through its impact on network-capable software design. One of the IS executives offered these comments about the lack of network standards and vendor support:

IBM in the past and Microsoft to a certain extent on the PC today are de facto industry standards. So everybody makes components work in accordance with that industry standard. Well, that is all well and good when it comes to the PC world, but when you are in the network world, that doesn't apply anymore. The mainframes and PCs are just pieces on the network. And the big vendors are not as nearly as effective a tool in combating the problems that come about because of all the interface requirements that exist.

#6 Improving the Effectiveness of Software Development

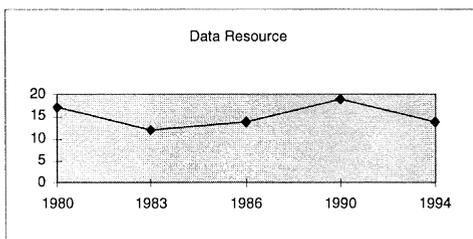


The continuous stream of new technology platforms and strong demand for new soft-

ware keeps application developers on a steep learning curve. Application development backlogs often remain at high levels. Even with CASE tools, development methods can take too long. Centralized implementation platforms may not meet business requirements, yet networked approaches such as client server have not fully matured. Despite these problems, businesses must respond to their markets, and this often means developing new software and integrating diverse systems. As a core issue for managing IS, software development has varied in importance since the first study in 1980, always staying near the top. This issue is closely related to distributed systems (#3), information architecture (#4), communication networks (#5), and human resources (#8). One of the participating executives offered this thought about the difficulties of developing software in a network environment:

For many individuals who are in companies that are not at our stage, they are more in an execution mode and they are faced with a revolution, maybe that's too strong a word, an evolution to client server and a whole new network topology. So as they try to respond to what they know are clearly defined objectives, they are running into all the problems of putting in place the platforms, architecting the network, trying to develop the internal skills to be able to manage the projects.

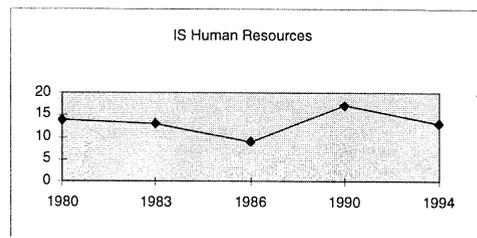
#7 Making Effective Use of the Data Resource



The organization's data resource is growing in size, complexity, and value. Recent research on "data mining" (e.g., Matheus, 1993) has emphasized the notion that organizational data

are still largely unrecognized, inaccessible, and underutilized. IS must develop a *climate* within its department and throughout the organization that values data as a corporate asset. This issue has been in the framework since 1980 and continues to hold an important position. It is closely related to information architecture (#4). While information architecture represents the harder (more quantitative) aspects of strategic data modeling and enterprise database design, this issue represents the softer (more qualitative) aspects of helping the organization develop a discipline for managing data.

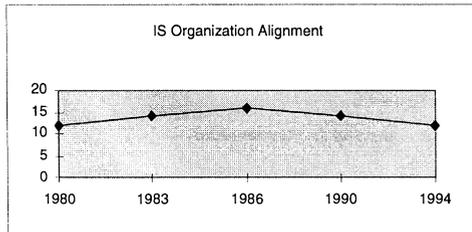
#8 Recruiting and Developing IS Human Resources



Current and future shortages of qualified IS personnel threaten many organizations' ability to make effective use of information technology. Continuing emphasis needs to be put on developing business skills such as teamwork and leadership. Yet IS personnel must also stay current with emerging technologies such as distributed systems, communication networks, object-based development, and multimedia interfaces. The need to stay on top of rapid changes in both business and technology conspire to keep human resources ranked among the top issues as it has been since the first study in 1980. One executive offered this comment:

Organizations have people in them who are mired in the technology of the 80s and early 90s instead of what they now are faced with implementing. So it has become a sudden concern about how do I get the right horses to make this application successful.

#9 Aligning the IS Organization Within the Enterprise

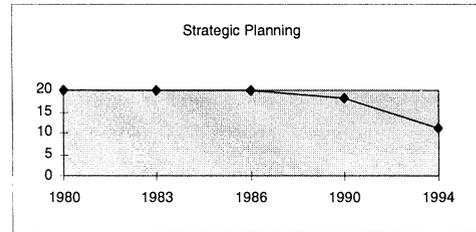


An IS organization's effectiveness in supporting enterprise needs is dependent on its organizational location within the enterprise. Appropriate alignment changes over time and requires a combination of centralized and decentralized structures. Too often the IS organization is not located and structured appropriately, causing this issue to remain important among IS executives. Even after the structural problems are solved with appropriate reporting, cultural and social issues may remain. One of the original issues introduced in 1980, it is closely related to strategic planning (#10) and has consistently remained important over the past 15 years. For 1994-95, this issue tied for the highest standard deviation of any top issue (s.d. = 2.02), indicating some disagreement over its relative importance. The following quote captures the consensus view:

In 1988 we spent a lot of time trying to align the IS organization with the rest of the business. Once our strategic IS plan was accepted by the organization, we turned our efforts from planning to implementation. In addition, we are moving away from a centrally controlled IS organization to one that's more distributed. This again maps to the changes occurring in business; moving away from headquarters control to more autonomous business units.

#10 Improving IS Strategic Planning

The importance of aligning long-range IS plans with strategic business plans has always been high. Rapidly changing business environ-



ments, increased involvement of end users, and accelerated technology change make this difficult. Shorter planning cycles require a great deal of flexibility in any plan. This issue is closely related to organization alignment (#9) and was ranked #1 for many years (1980, 1983, and 1986). Interviews suggest that its drop in rank may be due more to the current focus on implementation and execution rather than to having "solved" the problems relating to this issue. Its relatively high standard deviation (s.d. = 2.02) indicates some disagreement compared to the other top issues. The following quote sums up the majority view:

Our challenge in the 1980s was trying to help the overall organization see where IT fit in the big picture. We had to elevate the priority of IT. Today, I would say that we've been quite successful in doing this, as most companies could not function without IT. For example, I work for the chairman of the Board. My job is to provide the infrastructure so that the organization can run.

Other issues

In addition to the 10 issues above, there are other major changes in the key issue framework. Collaborative support (#11A) is introduced into the framework as an important new application area. Despite a long history of research in academe (e.g., Dennis and Gallupe, 1993), this issue appears for the first time in the framework. The high ranking may reflect the rising popularity of commercial "groupware" products such as Lotus Notes. After declining steadily over the previous four studies, IS effectiveness measurement (#11B) increased in importance by five ranks. This may be due to the long-standing need for IS executives to justify new investment and to be

accountable for their resources. The recent escalation of academic research on the "productivity paradox" appears to be timely (e.g., Brynjolfsson, 1993). The third straight decline in the rank of competitive advantage (#17, down from #8 in 1990) reinforces the belief that achieving competitive advantage is more of an ongoing process that is achieved by focusing on a wide range of issues as opposed to focusing on a single application. Other noteworthy results include the introduction of outsourcing (#20) as a new issue and a large decline in the ranking of organizational learning (#14, down from #5). Appendices C and D provide additional data including results by round and comparisons with 1990 data.

Bonferroni analyses are used to determine whether the mean ratings of the top issues are significantly different from one another. In general, the tests confirm that the top issues as a group are significantly more important than the bottom issues. For example, they indicate that responsive infrastructure (#1) stands alone as being significantly more important to SIM executives than all of the other issues #2 through #20 ($p < 0.05$). They also indicate that business process redesign (#2) and distributed systems (#3) are significantly more important than issues #11 through #20 ($p < 0.05$). For any given issue, the Bonferroni tests show which other issues are significantly different (more or less important) according to the mean importance ratings from the final round of the survey. Appendix E provides details of the analysis.

Observations and Conclusions

It is important to note that this study is *not* intended to capture the *entire* range of perspectives on important issues in information systems. The views expressed here are heavily influenced by the research sample, which, based on SIM's mission, is corporate IS centric in nature. Thus, the study does not necessarily represent emerging roles for IS in other business functions such as marketing, finance, and operations, where using information technolo-

gy to expand markets, to open channels, or to enrich products and services may be of importance. Similarly, the study does not represent the small business or entrepreneurial views of information systems.

Among the corporate IS executives represented by SIM, however, it is clear that the rising importance of technology infrastructure issues noted in the 1990 study (Niederman, et al., 1991) continues as a strong trend. The infrastructure issues (e.g., responsive infrastructure, distributed systems, information architecture, and communication networks) have gained in importance in each of the past two studies. It was apparent from our interviews that building a technology infrastructure to respond to rapid changes in the competitive environment is a major theme for many IS executives as they enter the late 1990s. In ranking technology infrastructure so highly, these executives are trading off the importance of business relationship issues. Many of the business relationship issues (e.g., IS organizational alignment, strategic planning, IS role and contribution, and competitive advantage) have declined in importance over the past two studies. This does not imply that these issues are not important, but only that the executives participating in the study are focused on "implementation and delivery" more than on "planning and alignment."

Turbulent periods of change such as the late 1990s demand both fast response *and* careful positioning for the future. For the first time in its 15-year history, the key issue framework has taken on a technical flavor. Based on our follow-up interviews, this does not mean that IS managers are reverting back to their days as technicians in the 1960s and 1970s. Instead, business requirements for speed, flexibility, and responsiveness are driving the importance of the top issues. The focus on technology infrastructure in this study has important implications for organization structure, human resource development, investment justification, application integration, and the future of electronic commerce. As always, balance in managing the many dimensions of the key-issue framework will prove to be the best course of action.

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Appendix A

Sample Survey Instrument

Key Information Systems Management Issues - Round 3 Survey

The following issues have been listed in descending order from most important to least important based on the average rating received by second round respondents.

For your convenience, your personal ratings from the second-round survey are listed next to each issue. Given the averaged ratings of you and your peers in other organizations, please re-rate these issues by writing your new rating in the space provided. As before, rate each issue on a scale from 1 to 10, where 10 indicates your most important issue(s) and 1 indicates your least important issue(s).

You will notice that many of the average ratings of the issues are relatively close together. Please try to distribute your rating scores across as much of the rating scale as you feel is appropriate. Thank you for your time.

Least Important			Moderately Important				Most Important		
1	2	3	4	5	6	7	8	9	10
<i>(Please fill in your rating in the spaces provided)</i>									

Your Your
 New Avg. Last
 Rating Rating Rating

_____ 8.65 _____ Building a Responsive IT Infrastructure

Building a technology infrastructure that will support existing applications while remaining responsive to change is a key to long-term enterprise productivity. This task is frustrated by the continuing rapid changes in infrastructure technology and the increasing breadth and depth of applications which need to be supported.

_____ 7.94 _____ Facilitating and Managing Business Process Redesign

To remain competitive, many organizations are radically changing the way they do business. IT plays an increasingly important role in this change process by enabling the innovative redesign of core busi-

ness processes. Much has been learned about IT implementation in general which can help facilitate and manage BPR projects.

___ 7.67 ___ Developing and Managing Distributed Systems*

Client-server applications promise to offer a cost-effective alternative to centralized applications. Unfortunately, they present many challenges including: maintaining consistent software versions; maintaining consistent data; controlling joint development projects with users; and administering large-scale distributed applications. (*Edited to recognize client-server technology as a popular implementation of distributed systems today.)

___ 7.62 ___ Developing & Implementing an Information Architecture

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 essential for guiding applications development and facilitating the integration and sharing of data.

___ 7.57 ___ Planning and Managing Communication Networks

Communication is the lifeblood of the organization. Using IS for competitive advantage depends heavily on access to appropriate internal and external communication networks. This task is complicated by rapid advances in underlying technology and major structural changes in the communications industry.

___ 7.43 ___ Improving the Effectiveness of Software Development

The application development backlog remains at unacceptably high levels. Traditional development methods and platforms are no longer satisfactory. New methods and platforms have not yet proven themselves. Sophisticated users are getting impatient. Improved effectiveness will be essential for next-generation applications.

___ 7.32 ___ Making Effective Use of the Data Resource

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 which values the data resource as a corporate asset.

___ 7.26 ___ Aligning the IS Organization within the Enterprise

The IS organization's effectiveness in supporting the enterprise's needs is dependent on its organizational location within the enterprise. Appropriate alignment may require a combination of centralized and decentralized structures. Too often IS is not located and structured appropriately.

___ 7.13 ___ Recruiting and Developing IS Human Resources*

Current and future shortages of qualified IS personnel threaten the organization's ability to make effective use of information technology. More emphasis needs to be put on developing business skills such as teamwork and leadership and staying current with new technology such as object-oriented and multimedia applications. (*Edited to reflect specific business skills and technologies.)

___ 6.99 ___ Managing the Existing Portfolio of Legacy Applications

Most organizations have a large investment in their existing applications portfolio. Some "legacy" applications may need to be retired quickly. Others may need to be leveraged for many years before they

are replaced. Integrating new technologies and migrating to new operating environments can be difficult. Too little is known about managing these problems.

___ 6.96 ___ Improving IS Strategic Planning

It has always been important to align long-range IS plans with strategic business plans. Rapidly changing business environments, increased involvement of end users, and accelerated technological change underscore the need to continue improving strategic planning skills.

___ 6.73 ___ Measuring IS Effectiveness and Productivity

Understanding how IT use impacts the bottom-line is crucial for justifying new investment. In addition, measuring the IS organization's performance is necessary for effective management. Measurement is becoming more important as companies attempt to reduce operating expenses to meet the competition.

___ 6.61 ___ Increasing Understanding of IS Role and Contribution

IS is often viewed as an operational activity with little recognition for its strategic contribution to the organization. This can result in executive management viewing IS strictly as an overhead expense. Funding can be cut resulting in missed opportunities for using IT to solve important business problems.

___ 6.53 ___ Implementing and Managing Collaborative Support Systems

New software is needed to support the reengineered, flat, team-based organization of the future. Appropriate IT support can help teams share information and lead to faster decision making and improved team effectiveness. Such support will become even more important in a distributed ubiquitous computing environment.

___ 6.48 ___ Facilitating Organizational Learning

Organizations that prosper will need to make appropriate use of information technologies across their entire enterprise. 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.

___ 6.43 ___ Using Information Systems for Competitive Advantage

In many businesses, long-term survival is dependent on using information systems to gain competitive advantage. Competitive advantage results from recognition of opportunities through creativity and innovation, followed by rapid implementation. These are historical weaknesses of the IS organization.

___ 6.36 ___ Planning and Integrating MultiVendor Open Systems Technologies*

Many companies are moving away from single-vendor proprietary operating environments to vendor-neutral environments based on industry and de facto standards. Due to large investments in legacy systems, carefully planned migration paths are critical. This task is complicated by a still-maturing technology and unstable standards. (*Edited to reflect the open systems nature of multivendor environments.)

___ 6.34 ___ Facilitating and Managing End-User Computing

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.

___ 5.94 ___ Outsourcing Selected Information Services

The internal information systems organization no longer has a monopoly. Outside contractors may be able to provide some services more effectively. What services should be outsourced? How should contractor relationships be managed? Fair and objective evaluation techniques are needed which assess both costs and benefits as well as potential risks from loss of control.

_____ 5.93 _____ Developing and Managing Electronic Data Interchange

Electronic communication with customers and suppliers may offer competitive advantage to a company or it may be a requirement for staying in business. IS executives must develop (or adapt to) standard transaction formats, keep current on technology developments, and learn to manage interorganizational projects.

Appendix B

Organizations Participating in the Research

A. T. Kearney Inc.	Lomas Information Systems
Actmedia	McCaw Cellular Communications
Aetna Life & Casualty	Medtronic
Agency Rent-a-Car	Michigan State University
Air Products & Chemicals	Milliken & Company
American Management Systems	MIT Sloan School
AmeriData	MTA New York City Transit
Amoco Corporation	N.V. Koninklijke KNP BT
ARCO Chemical Company	Nalco Chemical
Armstrong World Industries	New York Times
Bank of America	Oregon State University
Bose Corporation	Ouellette & Associates Consulting
Canada Mortgage & Housing Corp.	Pacific Bell
Carrier Corporation	PepsiCo
CGI Systems	PHH Corporation
Church of Latter-day Saints	Positive Support Review
Community Mutual Insurance Co.	PPG Industries
Computer Strategies Inc.	Premark International
Conoco Inc.	Procter & Gamble
Corning Incorporated	Rice University
Dept. of Labor and Industries	Rockwell International Corporation
Digital Equipment Corporation	Ryder Systems, Inc.
Donaldson Company	SC Johnson Wax
Dr. Pepper/Seven Up Companies	Simpson Timber Company
Eastman Chemical	Southern New England Telephone
Eastman Kodak Company	Stephen P. Teale Data Center
Elf Atochem North America	Summit Information Systems
G. D. Searle & Company	Sundstrand Aerospace
Gas Research Institute	Tel Aviv University
General Mills	Texas Tech University
GTE Service Corporation	The Coca-Cola Company
Independence Blue Cross	The Prudential Insurance Company
Information Technology Consultants	Towers Perrin
ISP Management Company Inc.	UCLA
ITT Hartford	Unitech Systems, Inc.
J. M. Huber Corporation	University of Miami
James Martin & Company	University of Toronto
Johnson & Johnson	US Committee for UNICEF
Kemper National Insurance Co.	USAIR
KOCH Industries	Washington University
Kraft General Foods	Westinghouse Electric Corporation
Leviton Manufacturing Company	

Appendix C

Results by Delphi Round

Issue	Round One			Round Two			Round Three		
	Rank	Avg. Score	Std. Dev.	Rank	Avg. Score	Std. Dev.	Rank	Avg. Score	Std. Dev.
Responsive IT Infrastructure	1	8.68	1.22	1	8.70	1.31	1	9.10	0.96
Business Process Redesign		new		2	8.00	1.41	2	7.79	1.19
Distributed Systems	5	7.46	2.10	3	7.68	1.49	3	7.73	1.38
Information Architecture	6	7.45	1.84	4	7.62	1.58	4	7.62	1.49
Communication Networks	3	7.64	1.70	5	7.57	1.56	5	7.58	1.40
Software Development	2	7.66	1.63	6	7.42	1.67	6	7.5	1.86
Data Resource	7	7.36	1.93	7	7.36	1.90	7	7.46	1.62
IS Human Resources	9	7.25	1.86	9	7.17	2.00	8	7.31	1.70
IS Organization Alignment	4	7.56	2.36	8	7.28	2.22	9	7.11	2.02
IS Strategic Planning	8	7.35	1.89	10	7.02	1.96	10	6.82	2.02
Collaborative Support		new		14	6.52	2.07	11A	6.59	1.91
IS Effectiveness Measurement	12	6.92	2.00	12	6.79	1.73	11B	6.59	2.01
IS Role & Contribution	10	7.15	2.18	13	6.66	2.24	13	6.53	2.02
Organizational Learning	11	7.01	1.90	15	6.49	1.75	14	6.48	1.87
Legacy Applications	19	5.77	2.04	11	6.99	1.97	15	6.31	2.03
End-User Computing	14	6.69	2.03	17	6.34	1.93	16	6.23	1.88
Competitive Advantage	13	6.76	2.15	16	6.38	2.04	17	6.18	2.12
MultiVendor Systems	16	6.27	1.98	18	6.34	1.67	18	6.04	1.86
Electronic Data Interchange	15	6.50	1.99	19	5.95	1.98	19	5.91	2.00
Outsourcing		new		20	5.94	2.16	20	5.40	2.03
Decision & Executive Support	17	6.20	2.14	21	5.78	1.96		drop	
Object-Oriented Technologies		new		22	5.72	2.09		drop	
Multimedia Applications		new		23	4.56	1.97		drop	
Security & Control	18	5.78	1.9		drop			drop	
Disaster Recovery	20	5.21	2.14		drop			drop	
CASE Technology	21	4.49	1.81		drop			drop	

Appendix D

1990 vs. 1994 Comparison of Key Issues

Key Issue	1994 Rank	1990 Rank	4-Year Change	Issue Classification			
				M/T	P/C	I/E	Group
Responsive IT Infrastructure	1	6	+5	T	C	I	TI
Business Process Redesign	2	—	new	M	C	E	BR
Distributed Systems	3	12	+9	T	C	E	TI
Information Architecture	4	1	-3	T	P	I	TI
Communication Networks	5	10	+5	T	C	E	TI
Software Development	6	9	+3	T	C	I	IE
Data Resource	7	2	-5	M	C	E	BR
IS Human Resources	8	4	-4	M	C	I	IE
IS Organization Alignment	9	7	-2	M	C	E	BR
IS Strategic Planning	10	3	-7	M	P	E	BR
Collaborative Systems	11	—	new	T	C	E	TA
IS Effectiveness Measurement	11	16	+5	M	C	I	IE
IS Role & Contribution	13	11	-2	M	P	E	BR
Organizational Learning	14	5	-9	M	C	E	BR
Legacy Applications	15	15	0	T	C	I	IE
End-User Computing	16	18	+2	M	C	E	TA
Competitive Advantage	17	8	-9	M	P	E	BR
MultiVendor Open Systems	18	12	-7	T	C	I	TI
Electronic Data Interchange	19	12	-7	T	C	E	TI
Outsourcing	20	—	new	M	C	E	IE
CASE Technology	—	12	—	T	C	I	TA
Decision & Executive Support	—	17	—	M	C	E	TA
Security & Control	—	19	—	T	C	I	IE
Disaster Recovery	—	20	—	T	C	I	IE

Notes: M/T indicates management (M) or technology (T); P/C indicates planning (P) or control (C); I/E indicates internal (I) to IS or external (E).

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

Appendix E

Bonferroni Analysis for Statistically Significant Differences

Modified LSD (Bonferroni) test with significance level .05:

		Issue#																				
		s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	
		s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	
		2	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	
Mean		0	9	8	7	6	5	4	3	1	1	0	9	8	7	6	5	4	3	2	1	
Rating	Issue#																					
		B										A										
5.4000	Iss20																					
5.9074	Iss19																					
6.0370	Iss18																					
6.1813	Iss17																					
6.2313	Iss16																					
6.3125	Iss15																					
6.4815	Iss14	*																				
6.5313	Iss13	*																				
6.5926	Iss11B	*																				
6.5938	Iss11A	*																				
6.8250	Iss10	*																				
7.1111	Iss09	*	*	*																		
7.3086	Iss08	*	*	*	*	*																
7.4563	Iss07	*	*	*	*	*	*															
7.5000	Iss06	*	*	*	*	*	*															
7.5813	Iss05	*	*	*	*	*	*	*	*													
7.6250	Iss04	*	*	*	*	*	*	*	*													
7.7313	Iss03	*	*	*	*	*	*	*	*	*	*											
7.7875	Iss02	*	*	*	*	*	*	*	*	*	*	*	*									
9.0988	Iss01	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	

Notes:

The difference between two means is significant if
 $MEAN(J)-MEAN(I) \geq 1.2791 * RANGE * \sqrt{1/N(I) + 1/N(J)}$ where RANGE = 5.17.
 The asterisk "*" denotes that the two issues on the axes are significantly different at p=.05.