A NEW PARADIGM FOR IS
The Educational Implications

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An IS paradigm shift will create problems of adjustment and new opportunities for IS professionals. To function effectively in this new world, current and future IS professionals must acquire new knowledge and skills. This will not be easy to accomplish and will require the joint effort of both industry and academia. However, the payoffs from such human investments will be enormous. The existence of a cadre of capable IS professionals who can intelligently and effectively apply emerging information technologies not only affects the success of individual organizations but improves the competitiveness of our nation.

THE WORLD OF INFORMATION SYSTEMS is changing at an incredible rate. The profession is experiencing a paradigm shift in the nature of information management. The traditional role of IS as the sole proprietor of information is being challenged by users within many organizations.

The pervasiveness and the critical importance of information technologies in business operations, however, are providing opportunities for a vastly expanded role for IS departments. Driven by a combination of enhanced technologies, new operating rules, increasing demands from users, and senior management’s emphasis on the strategic value of information, the IS professional entering the field in this decade will face an environment in which the traditional rules no longer apply.

The widespread restructuring of the IS function and the environment that results from the paradigm shift has an important impact on the skills required of IS professionals. There has been a demonstrated shift in emphasis away from purely technical capabilities and knowledge of traditional systems development techniques toward strong interpersonal skills and broader understanding of business operations.

What will be required of the IS professional for the rest of the 1990s? To address this question, a committee of academicians and practitioners was organized by the executive board of the Boston chapter of the Society for Information Management to examine the key issues concerning the changing needs of the IS profession. The committee conducted a two-year research project that included in-depth focus group discussions as well as a survey involving representatives of the various groups in the field of IS (i.e., IS executives, user managers, IS consultants, university professors, and recent IS graduates). This article describes some of the findings of the study. In addition, the changing needs of the profession in terms of a paradigm shift are examined and the implications of these changes in terms of the responsibilities and skills required of IS professionals and IS educators are discussed.

THE IS PARADIGM SHIFT
Information systems have changed the way business is conducted. For example, a major southern utility company found that entering payments in batch mode (i.e., recording data on a dumb terminal and then feeding that data to a
mainframe at the close of business) was contributing to customer dissatisfaction. It meant that payments received just before the deadline were not reflected in the next billing statement. Customers who paid their bills at the last minute through branch offices were finding their power cut off because of the delay in payment processing.

The company solved this problem by implementing a distributed real-time payment system that allowed payments made at any location and at any time to be immediately credited to the accounts. This operational change not only contributed to customer satisfaction but saved valuable staff and system time in responding to inquiries and updating accounts.

The American Airlines SABRE system is another well-known example of how information systems can be used as a strategic asset to increase competitive position and enhance revenue. Interestingly, as the company's information systems strategy evolves over time, the executives at American Airlines view the future importance of its SABRE system as only a part of its centralized information systems. Their IS strategy is to build a much broader set of information utilities and to encourage their managers and staff to use information technologies effectively in all aspects of their business operations.

Within many organizations, distributed systems and sophisticated workstations are enabling users in areas not traditionally supported by IS to integrate automation into their daily activities. The emergence of sophisticated user systems is changing not only the way individual organizations operate but often the infrastructure of an entire industry.

For example, in the medical field, physicians in different locations can review a digital image of a patient's radiology film and dictate their impressions directly onto the patient's medical record, using voice recognition technology. In a few years, terminals and hand-held devices should become widely available to health care providers in hospitals and clinics so that they can have access to a patient's electronic medical record.

Some hospitals have already created a direct interface with patient monitoring systems for minute-by-minute data capture and analysis. It is estimated that such systems will improve the productivity of health care providers and enhance the quality of medical care while helping to contain health care costs.

These examples and many others demonstrate that, throughout industry, the focus of activity to enhance or even maintain competitive status is shifting toward improving the efficiency of operations and decreasing the time required to conduct business. Although there are success stories, in many cases this driving requirement to become continually more effective has run headlong into the IS bureaucracies that were established during the past three decades.

This unpleasant encounter, which has brought into focus many of the weaknesses in traditional systems architectures (e.g., a lack of integration, flexibility, and compatibility among stored data), has added to a dissatisfaction with those IS departments that appear to be unable to react to the increased information needs of the time-sensitive user of the 1990s. Moreover, as IS technology becomes increasingly available to non-IS personnel, this dissatisfaction will cause more users to develop their own application systems.

Consequently, IS departments that cannot respond effectively to these changes may begin to wither away, and IS staff members unable to adapt to the new requirements of the IS profession will find themselves obsolete. Alternatively, the IS professional and IS department that can effectively deal with the changing complexion of business and technology are assured of not just being a valuable contributor but of also playing a leadership role in setting the future corporate IS strategy. As information strategy is increasingly tied to the way businesses are conducted, IS can play a significant role in reengineering business operations around information technology.

On the basis of the findings of this research study conducted among IS professionals, the effective application of information technology requires a changed paradigm of IS. In addition, this new IS paradigm requires a new breed of IS professionals with different experience and a different type of educational background.

The Old IS World
The paradigm shift implies several different assumptions about the profession in the old and new IS worlds. In the old IS world, it was assumed first that information systems would be developed and directly controlled by IS professionals for the benefit of others in the organization. Second, specialized technical knowledge was needed to develop and use information systems. Third, it was assumed that the IS professionals would possess all the requisite knowledge for designing and implementing effective information systems.

Under the old paradigm, the IS department could be viewed as a creator of products. The
University educators feel they are pressured to emphasize such traditional topics as COBOL because that is what is required to place IS graduates into current jobs.

tasks performed revolved around the development, use, and maintenance of generally large-scale, structured, and usually rigid information systems. The tasks performed by IS staff and consequently the skill set that was needed could be summed up in the phrase systems life cycle. Because applications were generally developed in-house, programming was a primary task of IS professionals and demonstrated ability to program in third-generation languages (mainly COBOL) was a key requirement for employment. Other tasks and related skill sets were associated with user requirements analysis and systems maintenance.

This view of the IS profession also had profound consequences for the career paths of IS professionals. Virtually all data processing professionals (as they were called) moved up the same career ladder. A recent college graduate would be hired as a junior programmer, working with a team on specific aspects of code development. After demonstrating competence in programming, that programmer would move on to systems analysis tasks. Subsequent promotions would lead to positions as programmer, systems analyst, project leader, and ultimately DP manager.

Because the focus of the field was on systems development and maintenance of in-house applications, the educational requirements were primarily technical. During the 1960s and 1970s, a graduate would receive a degree in computer science or engineering. Alternatively (because of the need for programmers), a person with a liberal arts background would receive on-the-job training in programming.

During the late 1970s, in recognition of the value of understanding organizational context for those working with systems, business schools began to offer courses in management information systems (MIS) or computer information systems (CIS). These programs offered courses in aspects of the systems life cycle within the context of a business degree. A typical business degree with a specialization in MIS would offer courses in computer technology, COBOL, systems development, and files and data bases. A capstone course, often called management information systems, would introduce students to the organizational and managerial considerations of information systems.

The New IS World
In the new IS world, the demands on the IS profession will be significantly different. Several fundamental changes are occurring in the business computing environment: first, users are now often in direct control of IS applications. Second, as users become more sophisticated, they also become more demanding of their IS departments and staff. Third, the users' demands are for IS support and services as opposed to IS products.

The paradigm shift reflected in this new world of IS implies a different set of underlying assumptions: first, it is assumed that a large part of information systems development will be done directly by users. Second, the relationship between IS and organizational users will be a far more complex one. The IS department must be more responsive in meeting the users' demand for services. However, the IS department must also be able to take a strong leadership role in mapping out the IS strategy and reengineering business processes around information technologies, as well as establishing standards for effective management of information resources and technologies.

The emerging IS environment has three direct implications on the task requirements of the IS professionals. This new environment is one in which the software component of systems development is deemphasized in the overall task mix. There are two main reasons for this.

First, the emphasis has shifted from make to buy, and buy can occur in several forms. Off-the-shelf software can be purchased directly, applications can be outsourced to development firms, or system shells for spreadsheet, data base, or expert systems applications can be purchased for users to assist in the development of their own systems.

Second, those systems still developed by IS professionals are easier to develop because of the availability of such productivity enhancements as CASE tools. Another feature of this new environment is that IS development and use have become distributed throughout the organization. The IS department is no longer the sole location of IS activities. Functional areas of the organization have sophisticated IS operations. The growing interest in communications reflects the desire to maintain the benefits of centralized IS in a distributed computing environment.

A final feature of this new IS environment is the range of implications for IS management. As the term chief information officer suggests, the senior IS executive needs to do much more than simply manage information systems. The critical need exists for an integrative perspective on corporate computing and the management of corporate information resources.
EXHIBIT 1 IS Critical Tasks: Current Versus Future Importance

<table>
<thead>
<tr>
<th>Current Importance</th>
<th>Future Importance</th>
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<tbody>
<tr>
<td>Support existing portfolio of applications</td>
<td>Analyze IS solutions to business problems</td>
</tr>
<tr>
<td>Develop in-house applications</td>
<td>Analyze business problems</td>
</tr>
<tr>
<td>Manage or plan system development or project implementation</td>
<td>Integrate networks</td>
</tr>
<tr>
<td>Analyze IS solutions to business problems</td>
<td>Integrate existing business applications</td>
</tr>
<tr>
<td>Analyze business problems</td>
<td>Develop data bases</td>
</tr>
<tr>
<td>Integrate new business applications with existing applications</td>
<td>Integrate new business applications with existing applications</td>
</tr>
<tr>
<td>Integrate existing business applications</td>
<td>Implement new or changed, computer-supported business processes</td>
</tr>
<tr>
<td>Develop applications software—</td>
<td>Manage or plan corporate IS strategies</td>
</tr>
<tr>
<td>Purchase and tailor</td>
<td>Support information access and security</td>
</tr>
<tr>
<td>Develop data bases</td>
<td>Manage or plan identification of strategic IS applications</td>
</tr>
<tr>
<td>Implement new or changed computer-supported business processes</td>
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IS PERSONNEL REQUIREMENTS FOR THE NEW PARADIGM

To obtain a clearer view of the changing trend in the critical skills required of IS personnel, input was solicited from a group of 98 IS practitioners, including IS managers, user managers, and IS consultants in the Northeastern US. The IS and user manager respondents in this sample are from both the manufacturing and the service sectors. The majority of these respondents work for medium-sized to large companies and hold senior management positions in their organizations. Among the IS managers, 85% are either corporate or divisional IS executives, whereas among the user managers, 44% are senior executives. The IS consultant respondents have an average of 20.3 years of experience in the IS field.

These practitioners were asked to rate the importance of a list of IS activities. Exhibit 1 compares the list of the most important IS activities, in descending order of importance, for both now and in the near future. Two related critical tasks—analyzing IS solutions to business problems and analyzing business problems—are currently ranked among the top five most important. These become the top two for the future. Clearly then, a most critical role for IS now and in the future is to understand and apply IS solutions to business problems.

The trend away from the traditional IS role is evidenced by the disappearance of the other three top five current activities (supporting an existing portfolio of applications, developing in-house applications, and managing or planning systems development or project implementation) from the top 10 future critical IS tasks. These traditional IS activities are replaced in the future activities list by an increased emphasis on integration, communications (i.e., integrating networks and integrating existing business applications), and data bases. These results suggest that the IS department must play a vital role in integrating the organization’s various functional operations.

In addition to input on critical IS task activities, the respondents were also asked to indicate the relative importance of a set of technical skills for IS personnel both now and in the future. A comparison of the most important IS technical skills is shown in Exhibit 2.

Out of a list of 19 IS technical skills, proficiency in COBOL or another third-generation language is still ranked as the most important for now, although it drops out of the top 10 most important future skills. Communications and network skills, which are ranked as second and third in importance now, move up to become the two most important in the future. Skills in relational data bases, system integration, and fourth-generation languages also increase in importance in the future. However, traditional IS skills that disappear from the future importance list are operating systems, systems analysis, and structured analysis.

From these findings, along with the results from Exhibit 1, a clear trend emerges for the critical IS tasks and required skills. This trend indicates a shift in emphasis away from traditional IS activities and IS skills that support the systems life cycle of the old paradigm. Future IS tasks and skills will be centered on reorientation of IS technologies to solve business problems and the integration of business functions to provide competitive advantages. The implication of these findings is that users will handle more of the traditional IS development tasks themselves, while IS should provide much stronger service in the areas of data communications, networks, data bases, and centralized data management.

Educational Implications

Paralleling this changing pattern of critical IS activities and skills must come accompanying changes in IS undergraduate education for future IS professionals. In this study, the match between what the 98 practitioners rate as important and what a group of 89 educators and re-

Industry and academia must form a solid partnership in order to effectively meet the challenges of the paradigm shift facing the IS profession.
EXHIBIT 2 IS Technical Skills: Current Versus Future
Importance

<table>
<thead>
<tr>
<th>Current Importance</th>
<th>Future Importance</th>
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<tbody>
<tr>
<td>COBOL or other third-generation language</td>
<td>Networks</td>
</tr>
<tr>
<td>Communications</td>
<td>Communications</td>
</tr>
<tr>
<td>Networks</td>
<td>Relational data bases</td>
</tr>
<tr>
<td>Operating systems: mainframes</td>
<td>Fourth-generation languages</td>
</tr>
<tr>
<td>Fourth-generation languages</td>
<td>Systems integration</td>
</tr>
<tr>
<td>Systems integration</td>
<td>Distributed processing</td>
</tr>
<tr>
<td>Operating systems: minicomputers</td>
<td>Data management</td>
</tr>
<tr>
<td>Operating systems: microcomputers</td>
<td>Other technical knowledge*</td>
</tr>
<tr>
<td>Relational data bases</td>
<td>Structured programming, CASE</td>
</tr>
<tr>
<td>Systems analysis or structured analysis; systems life cycle management</td>
<td>methods or tools</td>
</tr>
<tr>
<td>Note:</td>
<td>Decision support systems</td>
</tr>
<tr>
<td>*This included such items as executive information systems, imaging, and end-user computing.</td>
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</tr>
</tbody>
</table>

The IS function must evolve from systems developer and supplier to systems integrator. These roles will require a change in organizational responsibilities to accommodate the dis- | bases are emphasized sufficiently in current college curricula. Telecommunications and fourth-generation languages receive some emphasis in current curricula, although not to the degree necessary as indicated by the practitioners' responses. Networks and systems integration do not appear in the list of 10 skills emphasized most in current curricula.

Overall, the results from Exhibits 3 and 4 reveal significant gaps between the needs of IS professionals in the future and the college curricula that prepare and educate these future professionals. Interestingly, as indicated by comments from several university educators, these gaps do not seem to result from a lack of understanding about what is needed for the future.

University educators often feel that they are pressured to emphasize such traditional topics as COBOL or the systems development life cycle because that is what is required to place IS graduates into current jobs. It seems this constraint of meeting the current job placement needs forces the university IS curricula to be overly oriented toward the old IS paradigm. These findings suggest that there is a definite need to refocus university IS education for the new IS paradigm.

IMPLICATIONS OF PARADIGM SHIFT FOR INDUSTRY AND ACADEMIA
The IS paradigm shift is redefining the information management function within industry. As the business community and its IS departments respond with changes and new initiatives, their actions will have a significant impact on the skills and knowledge that will be required for the future IS professional. Both industry and academia will face challenges as they respond to the new direction for IS.

The Challenge for Industry
There is a growing recognition that the tasks and skill sets associated with the successful IS professional of the past, which centered on technical skills and systems development, will no longer be adequate in the future. The ideal IS professionals of the 1990s will be multifaceted individuals. They will possess a combination of interpersonal, technical, and business skills that will allow them to analyze problems, integrate applications, and implement new business processes built around information technology.

The IS function must evolve from systems developer and supplier to systems integrator. These roles will require a change in organizational responsibilities to accommodate the dis-
Skill requirements for these new positions within the IS profession must be clearly understood within the organization. Moreover, these new requirements must be communicated accurately to potential job applicants, recruiters, and educators.

Unfortunately, the tendency among many IS recruiters today is to place undue emphasis on filling a short-term need in COBOL programming or a specific systems-oriented project. This short-term orientation distracts the recruiter from assessing the broader requirements of the changing IS paradigm. It limits job recruitment success by not considering the broader potential of job applicants. This short-term focus also sends misleading signals to universities about the requirements of the IS field.

**Career Paths for Future IS Professionals**

The new world of IS will demand new IS roles. For these new roles to evolve successfully within an organization, IS managers must develop new career paths for their staff. A model that supports the changing paradigm delineates IS career paths of the future based on specialization in three areas.

First, the technical specialist would be part of the core of the leaner IS department of the future. These people would specialize in the areas of data base development, networks and communications, and systems integration activities. These resources become the backbone for building new IS services and utilities.

The second area of IS specialty will be in software development. These specialists will work for software vendors or large firms that still do substantial in-house programming. As the computing environment moves from proprietary to open, these professionals will increasingly use fourth-generation tools.

The third specialization will be functional, and people working in these areas will work either in liaison roles between IS departments and functional departments or directly for these functional departments. These professionals must have a broad range of interpersonal, business, and technical skills and must be able to select and bring to bear appropriate IS tools to solve business problems.

**Challenges to Academia**

Academia must close the curriculum gap between what IS practitioners expect of IS graduates and the course materials covered in current IS academic programs. The curriculum must
As users become more sophisticated, they also become more demanding of their IS departments and staff. These demands are for support and services as opposed to products.

prepare students for the IS environment and the career paths that have begun to emerge and will continue to evolve within industry.

IS curricula should be modified to emphasize the integration of data, applications, and technology. Networks and data communications are also critical components of this revised curriculum, as are information access and data security, necessitated by the decentralization of IS within most organizations.

Formal systems development life cycle theory must give way to more adaptive approaches toward systems development and to the broader interpretation of systems analysis as an assessment of business problems with respect to technology solutions. Technical courses should emphasize such user-oriented technologies as relational data base management systems, fourth-generation languages, graphical user interfaces, and CASE management tools.

Colleges and universities must also modify their admissions requirements so that they examine potential IS candidates not only on the basis of technical capabilities and potential but on the combination of interpersonal and business abilities that are now required. Moreover, recognizing that technical knowledge alone will not adequately prepare the future IS professionals, the college curricula must be broadened to include more in-depth understanding of business functions (e.g., by requiring students to minor in a business area or in liberal arts). Throughout the college curricula, students should be encouraged or required to participate in field projects, which would provide opportunities to integrate their learning with practical applications and to learn to work effectively with others in a team.

Given the diversity of IS roles in the future, different academic programs could be developed to match the different industrial career tracks. The technical specialist could be the product of a computer science or engineering program or of an MIS program that is based on a conscious decision to emphasize the technical aspects of IS at the expense of other topics. Most MIS curricula, however, should migrate to one of the two following specializations.

Software Development. The software development curriculum is the updated version of the programming curriculum from the old paradigm—that is, programming will remain a significant emphasis but the software and languages used have changed. Traditional COBOL and third-generation languages would give way to fourth-generation languages. Single-applica-

tion oriented systems development life cycle methodologies should be modified to include CASE management tools and rapid prototyping methodologies.

Business Analysis. A track of increasing importance for IS curricula would be the functional IS course of study which would focus on the new relationship between IS and the user. The resulting IS graduates would be positioned to work in the business areas of the organization as the manager of IS support or to work as a liaison between the smaller and more technical IS department and the users. The focus would be away from traditional application development and on business analysis as well as on skills to help users determine their needs and select the most appropriate tools. In addition, this curriculum would place much greater emphasis on communications, networks, and the integration of applications across business areas of the organization.

Cooperation Between Industry and Academia

Industry and academia must form a solid partnership to effectively meet the challenges of the paradigm shift facing the IS profession. Both academia and industry must strengthen the channels of communication so that they can continually refine the skill requirements necessary for success in the future IS profession. This challenge can be met in a variety of ways.

First, academic advisory boards composed of both professors and industry business leaders would offer a broader governance vision. This would provide an effective mechanism for industry to open and maintain a dialogue with academia to ensure that university curricula reflect the needs of the rapidly changing business environment.

Second, an industry-education liaison committee, composed of key academic and business IS leaders, can be organized as a forum to exchange ideas, develop worthwhile educational programs, and formulate projects to further the advancement of mutual understanding of the issues facing the IS field. The Boston chapter of the Society for Information Management formed such a committee to promote closer dialogue among IS practitioners and IS professors from colleges and universities, to address the apparent decline in enrollments in IS degree programs, and to deal with concerns among practitioners about the quality of the educational preparation of IS graduates. Since its formation, this industry-education liaison committee has
sponsored research projects (like the one described in this article) and promotional activities to improve awareness of IS career opportunities among college and secondary school students and teachers.

Third, cooperative programs or partnerships can serve to build a bridge between academia and specific business environments. Cooperative curriculum arrangements that include IS work experience within industry for students will be particularly beneficial for preparing future IS professionals. Similarly, faculty internships in industry can foster a stronger working relationship and improved communication between academia and industry.

Finally, both industry and academia should work together to establish a mechanism by which recent IS graduates or new IS recruits can provide feedback about their professional career progress or difficulties. Their input would be useful not only for improving university curricula but for providing more effective career management of these young IS professionals.

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