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GUEST EDITORIAL

INFORMATION SYSTEMS AS AN ACADEMIC DISCIPLINE: EXPLAINING THE FUTURE

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Investment in information technology has, in recent years, dominated other capital investments by organizations. Computer applications are broadly diffused in almost all organizations. At the same time that information technology is recognized as vital to business processes and management, some academics have questioned the need for academic study and programs in information technology/ information systems. This article will address the fundamental issue of the future of information systems (or MIS or information management or other academic name) as an academic discipline.

The conclusion from this discussion is that there are compelling reasons for a strong academic discipline in information systems. The challenge for academics in the field is to clearly articulate these reasons. This article is designed to assist in that endeavor.

CHALLENGES AND DEFINING PROPOSITIONS

The nature of the challenges to the academic role of information systems are due in large part to a field in rapid change. This reflects the pace of change in technology and its use in organizations. Information systems as an academic discipline has been in a continuous process of adjusting to these information technology-based transformations in organizations and business processes. The basic intellectual content of the field relative to information processes, systems, and management has been strengthened, but the overall impression to casual observers may be that the field is dominated by descriptions of a changing technology.

Decisions about the academic role of information systems within the business school curriculum are often being made or strongly influenced by deans and colleagues from other disciplines. One of the problems stemming from the period of rapid change is that much of the background and experience of these colleagues may be out of date or very incomplete. For example, they may have learned about computing technology in an age of centralized batch systems and strong, central control of computing resources. They now observe widespread diffusion of information technology within their disciplines. If every functional area can have information resources, what is the value of a separate information systems function? If there are software packages and high level languages, what is the need for a development staff? These are reasonable questions from their standpoint.

Much of the general, introductory instruction about computing at the inception of the study of information systems was designed to explain how computers worked and why they were valuable in data processing and computation. Writing a FORTRAN program was a valuable exercise in achieving these objectives. Now that everyone can use software packages and understands the basics of computers, why should there be any general, required course?

In addressing these questions, it is useful to reason from four proposition that define the foundations for and importance of information systems in the business school curriculum. The first two propositions explain why it is important to understand information systems, the third defines the implications of these propositions for the knowledge a student should obtain, and the fourth describes the basis for a major in the field.

1. Information technology uses in organizations and organizational processes are important, valuable, and pervasive.
2. There are two organizational effects relative to responsibility for information technology systems. There is a diffusion of responsibility for information technology use among business units and functions. At the same time, there is a strong need for a separate information management function to develop and

manage the information infrastructure and to support functions in their use of the technology.

3. Every student graduating from a business school in the information age should be able to:
   - recognize opportunities for use of information technology in business products, services, and processes
   - interact effectively with the information infrastructure of an organization
   - access, organize, and use information resources in his or her work
   - use a basic "toolkit" of software for knowledge work
4. There is a market for an academic specialization in information systems. The positions are with the information management function, in user support within business functions, and with vendors and suppliers of information products and services.

The sections that follow will explain the reasoning behind and implications of each of the propositions.

INFORMATION TECHNOLOGY USES IN ORGANIZATIONS AND ORGANIZATIONAL PROCESSES ARE IMPORTANT, VALUABLE, AND PERVASIVE

Information technology affects the goods and services offered, strategy, competitive behavior, and internal operations of organizations. At a societal level, there have been three outcomes. The first has been new businesses, products, services, and occupations. The second has been new or reengineered business processes. The third, a result of reduction in cost of information processing, has been increased variety and customization of products and services.

Strategic applications of information technology have changed the fundamental nature industries by changing the nature of the products/services, the markets served, and the economics of production. Information systems and information technology innovations interact with strategic planning and strategic decisions in support of basic competitive strategies.

They can also interact with strategic decision making by suggesting new ways of competing and ways to strengthen the organization's competitive position by changing ways of doing business, dealing with customers, and achieving sustainable competitive advantage.

Giving users and departments responsibilities for information processing and for systems affecting their work has significant benefits. ...intellectual understanding of the nature of information systems and information management and also practical knowledge related to system development and use.

Information technology is vital in engineering and reengineering of business processes. Every organization has "mission critical" applications that must work or the firm's operation shuts down. Doing these systems well can provide significant competitive advantages that are difficult for competitors to duplicate. Significant structural changes to business processes typically use information systems and technology.

Changes in organizations to more flexible forms are possible because of information and communication technologies. The emerging organization has been described by Drucker as the information-based organization. At the level of groups, information technology support is changing the dynamics of cooperative work.

Knowledge work by individuals within organizations is heavily supported by personal information technology and by software designed to aid information acquisition, analysis, and decision making.

DUAL EFFECTS OF DIFFUSION OF RESPONSIBILITY FOR INFORMATION TECHNOLOGY USE AND AN INFORMATION MANAGEMENT FUNCTION

The two effects of the diffusion of responsibility for information technology use and the role of a specialized business function are described in this section. The need for expertise in application development is also explained in order to define the need for experts in this process, especially for vital systems.

Diffusion of Responsibility for Information Technology Use

The trend in information technology has been both to an increase in capabilities and improved ease of use. Software packages and high level languages have replaced procedural languages, thereby making it much easier for users to manage their own access to data and their own application development. Client/server architecture makes it possible for users in a department or function to have their own computer with only modest need for technical support for operations.

The diffusion of responsibility for use of information technology is consistent with the trend to increased responsibility at the operational level and empowerment principles. Giving users and departments responsibilities for information processing and for systems affecting their work has significant benefits. It also means that individuals given these responsibilities will benefit from both intellectual understanding of the nature of information systems and information management and also practical knowledge related to system development and use.

Individual and departmental systems achieve the greatest benefit when they fit within the larger fabric of an information and communication infrastructure for the organization. Unless there is a coherent

structure, many small systems will conflict. This leads to the need for a specialized information management function to complement the diffusion of information management responsibility.

Role of a Specialized Information Management Function

The sharing of databases and applications by different locations and functions establishes a need for an information architecture that defines the hardware, software, and databases. The demands for communication and sharing of data means there must be standards, corporate data models, and systems to coordinate activities.

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Some applications are used only by a few locations or a single function. However, the large corporate applications cross functional boundaries and are often integrated with respect to several different functions.

The reasons for an information system function are similar to the reasons for an accounting, marketing, finance, or production function. There are specialized activities that require specialized knowledge. It is more efficient and effective to have a specialized function than to have every person in the organization perform such activities.

There are four broad classes of specialized activities in information management that require specialized knowledge.

1. Management of the information management function
   - Planning the information system infrastructure
   - Planning, budgeting, and scheduling the work of the function
   - Organizing the function and its activities
   - Staff selection, training, assignment, and evaluation
2. Technical support
   - Tracking new technologies and standards
   - Technical innovation experimentation and evaluation
   - Selection of new or replacement computer hardware, software, and communications services
   - Technical training of staff and users
   - Technical support for users of systems and services
3. Development and implementation of applications (described further in the next section)
   - Track developments in software packages and development tools
   - Define, develop, and maintain applications
   - Implement applications
4. Operations
   - Operate computer facilities
   - Perform security, backup, and recovery operations
   - Install and maintain system software
   - Operate and service communications facilities

In a very small organization, these activities may not justify a separate department, but they require those performing them to acquire specialized skills. In larger organizations, these information management activities justify a separate function. Even when some of the activities are decentralized or dispersed to functions, the infrastructure planning, installation, management, and operations are managed by a corporate information management function.

Need for Application Development Expertise for Corporate Systems and Significant Functional Systems

At first glance, using a computer and related information technology in job tasks seems simple. Some data and a few instructions are provided to the computer, the computer follows a program of instructions in retrieving and processing data, and outputs such as instructions, analyses, or reports are provided to users.

To design and implement an application of information technology does not appear complicated. Users provide a set of requirements; developers design and build the programs, screen formats, reports, data files, and data communications to achieve them. For systems of any size or complexity, reality contradicts these simple, uncomplicated views. There are very large differences in results from applying information technology to organizational tasks.

Some organizations achieve competitive advantage from using information technology; others are ineffective. Some departments in an organization are significant users of computers; others have no significant applications. Some work groups enhance their work through information technology; others use it little or poorly. Some individuals improve their performance with information technology; others appear to be less productive. The success rate for new information system applications appears to be less than half.

How can there be such differences in results? The differences arise because information technology applications have technical complexity and they are placed in, support, and interact with complex human systems. The task itself may have some technical complexity.

The information system application is used by individuals who have human capabilities and limitations in providing inputs and using outputs. The way the inputs and outputs are structured and

presented (the interfaces) will affect comprehension, acceptance, error rates, and usage.

The application may fit within the activities of a work group that has communication, interaction, and performance dynamics. The design of the application and its interfaces will affect these dynamics.

The system is used in an organization that has an explicit or implied strategy, an organizational culture, and organizational lines of authority and divisions of responsibility. There is a mixture of shared and individual ideas about how things should be done and how individuals and organizations should behave. The fit between the design of the technical system and these organizational factors affect how it will be used or if it will be used at all.

The system affects the way the organization interacts with its suppliers, customers, suppliers of capital, etc. It affects the types of interaction that are feasible, the information obtained or provided, the speed and accuracy of interactions, the transaction cycle time, and the utilization of feedback.

The expertise requirements for building vital systems within organizations establish a need for system development experts. It also suggests the need for users who develop their own systems to have modest understanding of principles for system design and development and also have access to experts who can assist them with advice and evaluations.

INFORMATION COMPETENCE FOR EVERY STUDENT GRADUATING FROM A BUSINESS SCHOOL IN THE INFORMATION AGE

The basic argument for information competence by every business student is that it adds significant value to individuals who achieve it and they bring that value to the organizations that employ them. This occurs in four activities areas: recognizing opportunities for use of information technology, interacting with the information management function, accessing and using information resources in their work, and selecting and using appropriate knowledge work software packages. The competence encompasses both general knowledge and skills and specialized knowledge and skills associated with a function or industry.

Recognize Opportunities for Use of Information Technology in Business Products, Services, and Processes

A graduate should be able to participate in strategy development for an organization. A critical skill in strategy development is to recognize how information technology may be used in a competitive strategy. This may include new products or services. It may include new or reengineered business processes.

Interact Effectively with the Information Infrastructure of an Organization

An individual in an organization will have a number of opportunities to interact with the information systems function. This includes participation in projects for planning and developing applications and using applications developed by them. The interaction is improved by understanding the mission, organization, and activities of the function.

The ability to interact effectively implies a modest understanding of principles of application design and development. It includes concepts of user interface, quality, error control, appropriate testing and documentation, and use of standards. It also implies an understanding of the expertise that is available and how it applies to problems encountered.

Access and Use Information Resources in His or Her Work

Accessing and using information resources extends beyond the corporate systems. These systems generally provide procedures and instructions. Knowledge workers in all functions are expected to take initiative in locating data, developing and managing small applications related to their work, managing their own databases, defining and employing analytical procedures, and evaluating appropriateness and quality of results.

There are data resources, both externally and internally, that a knowledge worker should know how to access and evaluate. There are general purpose software packages for use in a variety of knowledge work tasks. These are described later as part of the software toolkit.

Knowledge workers in specific functional areas have software for problems that are part of the function. For example, an engineer may use a computer model design (CAD) package, production personnel may use a statistical process control (SPC) application, a master scheduler may use an optimization package, and production and operations management professionals should have a good knowledge of manufacturing resource planning software.

A critical skill in strategy development is to recognize how information technology may be used in a competitive strategy.

Use a Basic "Toolkit" of Software for Knowledge Work

The software toolkit common to most knowledge workers includes eight basic packages and five recommended extensions. In addition, there are software packages that are important to knowledge workers in a given function or industry. These are generic types of software packages that apply to types of problems rather than being brand names. They may be found singly or in combination in commercial software packages.

Information competence with respect to the software toolkit for knowledge work assumes that the knowledge worker understands the domain to which the software is being applied and the underlying techniques being implemented by the software. For example, one of the packages in the knowledge work software toolkit is a statistics

package. This assumes a knowledge of statistics sufficient to formulate the problem and use the features in the software. Given this knowledge base, software packages are often useful in eliciting the knowledge of the user and helping the user make good decisions in problem formulation, choice of procedures, and evaluation of results. Using the statistics example, a statistics package can enhance the statistical knowledge of a user by suggesting alternatives, asking questions, and providing help screens at critical decision points.

There are eight software packages that are generally so valuable that they can be termed the universal toolkit:

1. Word processing
2. Spreadsheet processor
3. Statistical software
4. Presentation graphics software
5. Electronic mail software
6. Numerical database management software
7. Text database software
8. Personal computer management software

There are five additional packages for cooperative work and analysis that are recommended as being valuable in a strategy of individual competence.

1. Cooperative work software
2. Financial modeling software
3. Scheduling and project management software
4. Forecasting software
5. Multicriteria decision making software

The question of how students gain expertise in the toolkit is discussed later in the paper.

THE MARKET FOR AN ACADEMIC SPECIALIZATION IN INFORMATION SYSTEMS

Every business student is expected to understand the basics of accounting, finance, marketing, operations, and so forth. This basic knowledge allows graduates to perform some tasks related to these functions. It also allows them to interact effectively with functional experts. The existence of the functional experts is based on the fact that it is not efficient for every person to be an expert in every function. The same applies to information systems.

The market for graduates in an information systems area of specialization reflects the need for experts in the domain. Some positions that benefit from specialized academic knowledge are the following:

- System analysts and programmers, for positions both within functional areas and within an information management function.
- Technology experts for domains such as database management, data communications, and software development for positions within an information management function or with developers and suppliers of technology and services.
- Expert providers of services such as consultation, outsourced services, software, etc.

Although information technology use may be a part of many functional area courses, the basic topics are more efficiently taught as a single introductory course.

IMPLICATIONS FOR THE FUTURE

There are a number of implications for the future direction of information systems as an academic discipline. Given a very important role for information technology in organizations, the unique roles for the academic function are in providing a solid basic introduction to information management for all business students plus additional electives for them and providing an area of specialization related to the information management function (and related activities). The role includes some instructional modules to help students gain competence in the software toolkit (but not doing it all).

The Mission of Providing a Solid Introduction to All Business Students Plus Electives

The issue of what every business student should know has been defined earlier. This provides objectives for the first course. Although information technology use may be a part of many functional area courses, the basic topics are more efficiently taught as a single introductory course. Functional area courses may then concentrate on unique applications and considerations.

The curricular design needs to allow students to take electives that will enhance the basic knowledge but not require them to be experts. For example, an introductory course may, as one major topic area, explain the process of developing applications and describe important considerations. A follow-on elective course might provide additional expertise in developing small, end-user applications using the development facilities in common software packages. The course could not only teach students how to use the facilities to develop an application but also how to achieve quality in the interfaces, testing, results, etc.

The Mission of an Area of Specialization in Information Systems

The future of the academic discipline of information systems and the business function of information management are deeply intertwined. An academic discipline without a strong connection with a business function will tend to gravitate to a support role and perhaps to sterile, narrow issues. The connection with an information management function keeps the academic discipline within the context of real business needs.

It means that the content of courses, teaching methods, theory, and principles will be related to work that must be performed. There is a vitality in this connection. Similar vitality has been noted

in the strong connection of other disciplines in business administration to business functions.

The area of specialization will continue to draw upon basic knowledge from other academic disciplines such as computer science, cognitive science, and sociology. However, information systems is an applied field and its strength must be in the application of basic theory to the development, implementation, and management of information systems in organizations.

The academic discipline is very broad in its research agenda. This is both good and bad. It is good because it brings a broad range of theory and research to the problems of information management. It has weakness in lack of a single, well-defined body of theory. On balance, however, the future for research is also tied to the continued existence of a strong information systems function that provides a core practice domain for research.

Figure 1: EXAMPLES OF SOFTWARE MODULE ALTERNATIVES

Word processing	Remedial, if taught Not part of any management course
Spreadsheet processor	Module along with accounting or finance
Statistical software	Module along with statistics course
Electronic mail software	Module in connection with a first course or orientation module
Numerical database management software	Module in connection with information management course that teaches simple data modeling and database concepts

Teaching the Software Toolkit

It is important to separate information literacy from the issue of the toolkit. Information literacy rests on underlying concepts, principles, process, and procedures. It builds intellectual background in information management, information system building, and information use. These are proper content for a solid course in information management.

Learning the toolkit involves exposure to the processes and procedures for applying an example of each type of software. Such toolkit activities tend to drive out intellectual content when combined with a principles course. Therefore, as far as possible, information literacy for management students should be a separate concept-based course.

The next learning and pedagogical issue is how a knowledge worker obtains the operational skill to use the software toolkit. There are many scheduling constraints, but an ideal solution is to teach each part of the software toolkit at the same time as the student needs the software for solving coursework problems. It is desirable to have the software taught in connection with a course but separable from the course. This may involve separate software modules (using either instructors or self-teaching computer courses).

The emphasis in all cases should be on the use of the software functions in problem solving and not on learning the detailed procedures for the specific software. Since the software package is viewed as an example of a type of software, the experience of using it is more important than learning its detailed procedures.

If this approach is followed, software modules might be organized in a variety of ways. Five examples, shown above in Figure 1, illustrate alternatives such as remedial, orientation, along-with, and within-course modules.

SUMMARY

There are compelling reasons for the view that information management is a vital part of business management. It affects strategy, products and services, organization, business processes, and analytical and decision procedures. These effects support the need for every business school graduate to be well grounded in information management. They help to define what a every student graduating from a business school in the information age should be able to do: recognize opportunities for use of information technology in business products, services, and processes; interact effectively with the information infrastructure of an organization; access, organize, and use information resources in his or her work; and use a basic "toolkit" of software for knowledge work

There is an area of specialization based on domain expertise in information management. Because the expertise is associated with functional specialization within organizations, the future of the academic discipline of information management will depend, to a great extent, on the vitality of the information management function in organizations. The signs point to an information function that will shrink in size but increase in importance, impact, and focus.

There are two main ongoing tasks for the information management academic discipline. The first is to provide academic leadership in identifying and explaining the curricular significance of changes in information management. The second is to generalize industry practice and expertise in an ongoing revision of a body of teachable information management concepts, principles, and methods.

AUTHOR'S BIOGRAPHY

Gordon B. Davis has made significant contributions to the field of Information Systems as an educator, author, leader, and role model. His accomplishments have been recently recognized by EDSIG and the DPMA Education Foundation through awarding the 1992 Distinguished Educational Services Award to Dr. Davis.

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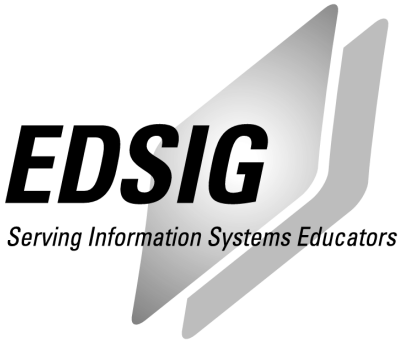

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