THE INFORMATION TECHNOLOGY INTERACTION MODEL: A CORE MODEL FOR THE MBA CORE COURSE

Mark S. Silver
Stern School of Business
New York University

M. Lynne Markus
Information Science
Claremont Graduate School

Cynthia Mathis Beath
Cox School of Business
Southern Methodist University

Working Paper Series
STERN IS-94-5

THE INFORMATION TECHNOLOGY INTERACTION MODEL: A CORE MODEL FOR THE MBA CORE COURSE

Mark S. Silver
Stern School of Business
New York University

M. Lynne Markus
Information Science
Claremont Graduate School

Cynthia Mathis Beath
Cox School of Business
Southern Methodist University

THE INFORMATION TECHNOLOGY INTERACTION MODEL: A CORE MODEL FOR THE MBA CORE COURSE

Abstract

This paper presents a teaching model we have used successfully in the MBA core course in Information Systems at several universities. The model is referred to as the "Information Technology Interaction Model" because it maintains that the consequences of information systems in organizations follow largely from the interaction of the technology with the organization and its environment. The model serves a number of pedagogical purposes: to integrate the various course components, to provide a formal foundation for the course content, to foster practical analytical skills, and to provide a framework for case discussions and student projects. Moreover, the model is intended to acquaint students with the dynamics of information systems in organizations and to help them recognize the benefits, dangers, and limitations of these systems. The paper includes a discussion and examples of how the model can be used for proactive and reactive analyses, and it concludes with an assessment of the model's effectiveness in the core course.

Acknowledgment

The authors are indebted to Burt Swanson for his contributions to the design of the MBA core course that produced the model presented in this paper.

THE INFORMATION TECHNOLOGY INTERACTION MODEL: A CORE MODEL FOR THE MBA CORE COURSE

"The course was not sufficiently analytical." "The course lacked theory." "I didn't learn anything I can use at work." "I understand the pieces but I don't see how they fit together." These concerns are typical of those voiced by MBA students reaching the end of their core course in Information Systems (IS). Indeed, as compared with other core courses they take concurrently (for example, accounting, economics, and marketing), it may be difficult for students to discern the fundamental principles of the IS course that integrate the material, that provide a theoretical foundation, and that foster useful business skills. Toward remedying this deficiency, we propose in this paper a model of information systems in organizations that we have used successfully in teaching the core course in information systems at several universities.

We refer to the model as the "Information Technology (IT) Interaction Model" because it rests on the premise that the consequences of information systems in organizations follow from the interaction of the technology with the organization and its environment. Understanding the nature of this interaction, therefore, is central to leveraging the benefits and avoiding the hazards that information technology presents for organizations. And learning how to leverage the benefits and avoid the hazards is at the core of the core information systems course.

The model addresses the interaction of an information system's design features with five elements of the organization: (1) its external environment, (2) its strategy, (3) its business processes, (4) its structure and culture, and (5) its IT infrastructure. The model

considers the consequences of this interaction for system use, for organizational performance, for the organization's personnel, and for the firm's future flexibility. Moreover, the model relates various aspects of the interaction process to the phases of the development and implementation lifecycles.

By combining these various components, the model integrates the many aspects of the course, including such topics as technology basics, what businesses accomplish with information technology, how IT can change firm and industry structure, how organizations acquire new applications, how firms manage IT standards, and so forth. At the same time, the model serves as a formal foundation for the course. And the model builds practical skills, as well, since it can be used proactively in designing and implementing systems or reactively to evaluate what transpired after the fact. In particular, the model lends itself to use in case discussions and in student projects.

While the model is based upon and consistent with our understanding of the Information Systems research literature, we must emphasize that the model we are presenting in this paper is a teaching model, not a research model. Our aims in this paper are to describe a model that we have found useful for pedagogical purposes in the hope that others will similarly find it worthwhile and to contribute to the current dialogue about teaching innovation and curricular reform. Of necessity, this model, intended for MBA students, reflects a simplification of the full set of relationships that would interest researchers and specialists in the field. We believe, however, that it is flexible enough to serve as a starting point for discussing many specific theories not explicitly modeled in it, while not being so

vague and abstract as to be meaningless.

We begin the paper by stating a premise concerning the core MBA course in Information Systems, after which we present the model. Next we discuss how the model can be used for proactive and reactive analyses, and we then offer an example of each in the context of the core course. After discussing more generally the role of the model in the course, we turn to a number of specific pedagogical issues. We conclude by assessing the model's effectiveness in the course.

THE PREMISE

Core courses in information systems differ both because of programmatic constraints imposed by the institution (for instance, the number of contact hours and the sequencing of the course in the MBA curriculum) and because of content decisions made by the course designers. Among the content choices that vary from school to school and are currently in dispute in the IS community are such issues as which topics to cover, how much hands-on instruction to provide, and if and how to use business cases (Stohr et al., 1990). Although we have strong feelings about a number of these content choices, our aim is not to debate here the objectives or content of the core course but to proceed from a minimalist set of objectives and topics we take as givens. We believe that these givens apply to a large share of core course offerings today and are likely to apply to even more as the decade progresses.

We take as a starting point that as a core course--the only course in information systems many MBA students will take--the course addresses "what every MBA needs to

know about information systems in organizations." While opinions differ as to what constitutes this core of required knowledge, at a minimum the course must acquaint students with the dynamics of information systems in organizations so that they will be able to function and manage effectively in the now IT-laden corporate and industrial worlds. And to function effectively, they must recognize that the consequences of information technology are nondeterministic and not necessarily positive. That is, despite all the excitement surrounding the potential value of IT for business, the benefits of a given system for a given firm may be nonexistent and the effects may even be negative. Indeed, the road to information system success is strewn with information system failures. To succeed, students must understand the range of potential effects, the set of factors that contribute to these outcomes, and the connections between them. Put differently, an objective of the core course is the following: to increase students' knowledge of the potential benefits, dangers, and limitations of information technology and to equip them to leverage the benefits, avoid the dangers, and surmount the limitations. We use the IT Interaction Model to accomplish this objective.

THE MODEL

The IT interaction model is best thought of as a stylized view of the dynamics of information systems in organizations. Based on a large body of research findings (for example, Kling and Scacchi, 1982; Markus, 1984; Markus and Robey, 1988; Orlikowski and Robey, 1991; DeSanctis and Poole, 1994), the model asserts that the effects of an information system for an organization emerge over time as the result of the interaction of the system with the organization. This view leads to a model with four interrelated elements:

(1) the implementation process, (2) the organization and its environment, (3) the information system, and (4) the system's effects.

We present the model to the students in diagrammatic form as shown in Figure 1. The schematic, which captures the main elements of the model and depicts the principal relationships, serves several purposes. It highlights the key components and helps the students see the relationships among them. It also helps the students remember those components and relationships. The figure allows us to focus easily on one portion of the model, without losing sight of how that component fits into the big picture. And it helps the students appreciate the model's dynamics. Figure 2 accompanies the schematic, outlining and exemplifying the model's salient features.

In presenting the model here, we use the terminology that we have found most effective in the classroom. We recognize, however, that in the jargon-rich and rapidly changing field of information systems, some terms have a variety of connotations and, conversely, some concepts go by a variety of names. A given instructor, therefore, might wish to substitute alternative vocabulary for ours to reflect consistency with his or her preferred terminology or with that of the adopted textbook. What matters in the following discussion, therefore, is not the terminology, but the underlying concepts. We shall endeavor to make clear how we use the terms we employ.

What follows is an overview of the essentials of the model. As the term unfolds, we cover a large body of more detailed material that fleshes out the components and relationships more fully.

The Implementation Process

Implementation is one of those terms that has multiple meanings in the context of IS. For example, used narrowly, the term sometimes refers to the coding phase of development and other times to specific tactics and strategies used to introduce a system into an organization. Because we see implementation as an ongoing process throughout the life of an information system, we use the phrase implementation process in its broadest sense to refer to all the management policies and interventions associated with the development, introduction, and use of an information system, from its inception to its retirement (Leonard-Barton, 1988; Markus, 1990).

The model's treatment of the implementation process neither adopts nor depends upon any particular view of the systems development process. It is intended to be compatible with the various versions of the traditional Systems Development Lifecycle (SDLC) as well as with such alternative lifecycles as those associated with prototyping or outsourcing. Consequently, we identify four generic stages in the implementation process: (1) initiation, (2) acquisition (build/buy), (3) introduction, and (4) adaptation. In Figure 1, time proceeds from left to right, but the process is deliberately left "open-ended" to reflect that adaptation of both the organization and the information system is ongoing.

The Organization and Its Environment

The organization and its environment provide the context for an information systems intervention. At the most basic level, it is organizational needs that motivate the design of the system. Nonetheless, organizations are dynamic entities, and once a systems development project is initiated, the process begins to engender changes in the organization in anticipation of the new system. This influence is reflected by the arrow in Figure 1 pointing from "Initiation" to "The Organization."

For the purposes of understanding the dynamics of information systems interventions, we find it useful to distinguish between the organization's external and internal environments and, within the internal environment, to differentiate four components: the firm's strategy, its structure and culture, its business processes, and its IT infrastructure.

The External Environment

Understanding the external business environment is important because the external environment provides the context within which the firm operates. For example, such aspects of the external environment as the competitive position of the firm within the structure of its industry and the firm's relationships with its customers and suppliers will influence its corporate strategy and its use of information technology. Among the relevant dimensions for studying the external environment are the competitive structure of the industry, the relative power of buyers and sellers, the basis of competition, whether the industry is growing, shrinking, or stable, the state of regulation, and the state of technological

deployment (Porter, 1980; McFarlan, 1984).

Firm Strategy

Many information systems projects in organizations today are closely linked to corporate strategy. In some cases, the information system is a key element of implementing a strategy; in other cases, it is at the very essence of the strategy. For many systems, therefore, firm strategy is a critical factor. Among the business strategies that are receiving much attention for their IT implications, for example, are differentiation, low-cost production, a focus on quality and service, globalization, right-sizing, and just-in-time inventory and manufacturing (McFarlan, 1984; Ives and Learmonth, 1984; Porter and Millar, 1985; Boynton, Victor, and Pine, 1993; Treacy and Wiersema, 1993; Lucas, 1994).

Organizational Structure and Culture

A firm's internal design elements--its structure and its culture--may influence system design as well as system success. For example, systems that share data across departmental boundaries raise special design and implementation concerns and are especially vulnerable to user resistance due to loss of flexibility (Goodhue, Wybo, and Kirsch, 1992).

By organizational structure we mean formal aspects of organizational functioning, such as the division of labor, hierarchical authority, and job descriptions. Structure typically includes whether the firm is centralized or decentralized; whether it uses a divisional, functional, or matrix organization; and its reporting relationships. By culture we mean the shared values, basic assumptions, and behaviors of organizational members. Elements of

culture include whether the organization values individuality or teamwork, whether bigger is better, and whether risk taking, such as that commonly associated with IT innovations, is rewarded or reproached.

Business Processes

Information technology, and the procedures associated with it, often represent a major part of a firm's business processes, such as order fulfillment, materials acquisition, and new product development. In the past, many information systems were designed to automate existing business processes. More recently, firms have begun to focus on using IT to reengineer those processes. Although business processes typically cut across the major functional divisions of organizational structure, information systems have often been designed while ignoring that structure. The reengineering movement has helped us realize that, when designing systems, we must consider both business processes and organizational structure simultaneously.

IT Infrastructure

IT infrastructure is another term that appears frequently in the IS literature, but whose meaning varies from source to source. For the purposes of the course, we adopt a broad definition of infrastructure, referring to it as "the capacity of the organization to generate new IT applications" (Weill and Olson, 1989; Markus and Soh, 1993; Weill, 1994). Thus defined, it encompasses a large set of organizational IT resources, including computing hardware, software development tools and programming libraries, databases,

telecommunications networks, training materials and facilities, and the capabilities of IT personnel. And thus defined it also clearly has significant implications for the design and success of an information system.

The Information System

The information system itself is for most students the most familiar element of the model. But our definition of information system, while corresponding with the approach taken in many of the popular IS textbooks, differs from what many of the students entering the course expect. We emphasize that the system is not just the software or even the software and the hardware; the system comprises hardware, software, data, people, and procedures. To portray diagrammatically that the information system is placed into the organizational environment, an arrow points from the "Build/Buy" activity to "The Information System," which is embedded within the organizational rectangle. Examples of information systems for the purposes of the course and the model include such diverse applications as SABRE, ASAP, OTISLINE, Excel, and Lotus Notes.

System Effects

When an information system is introduced into an organization, the system's features will fit well or poorly with the various elements of the organizational environment. *It is this interaction of the system with the organization that we see as the primary determinant of the effects of the system on the organization.* A system that depends on data sharing, for

example, introduced into an organization that inhibits it, may encounter resistance or provoke turf-battles. *We also believe that implementation is a key determinant of system effects.* For instance, how a system is introduced may affect if and how that system is used (Orlikowski, 1992; DeLuca, 1993). In particular, *the implementation process can mediate the effects of the organization-system interaction.* That is, in cases where the new system is in conflict with the existing organization, the way the implementation process is handled may facilitate organizational change and system acceptance or, alternatively, may provoke greater resistance. These effects of implementation are portrayed diagrammatically by the arrow from "Introduction" to "Use."

Although not always thought of as an effect, one of the most fundamental results of introducing an information system into an organization is that the system either is used or is not. This first-order effect must not be neglected, because it is quite common for systems not to be used and such nonuse is a major reason for systems' not achieving their design objectives (Markus and Keil, 1994). And, if the system is used, the question of how the system is used--when, by whom, for what purpose, and so forth--remains a significant issue. Systems are often used in ways other than intended, sometimes with positive consequences, as when a decision support system also serves as a tool for improving customer relations (Keen and Scott Morton, 1978), and sometimes with negative consequences, as when an executive information system is used to intimidate subordinates, stifling creativity. So, understanding if and how a system is used is an essential first step in evaluating system effects.

The second stage of evaluating effects is to assess the consequences of the system for the organization. The model focuses on three classes of outcomes: (1) performance effects, (2) consequences for people (the organization's personnel), and (3) future flexibility. Performance, indicated by a "$" in the figure, includes such bottom-line results as profit, gross revenue, and market share. Consequences for people include such outcomes as shifts in power and influence, job enrichment, and deskilling. Future flexibility (the infinity sign in the figure) refers to the ways that the system may enable or constrain future information systems and strategic initiatives by the organization (Keen, 1991). For example, companies that have invested heavily in mainframe computer architectures and mainframe-related skills are predicted to incur great difficulty and expense converting to object-oriented and client-server architectures (Fichman and Kemerer, 1993).

The consequences of an IS are not necessarily uniform. Some may be desirable while others may not. Performance effects may be at odds with people effects; for example, a system might improve profits at the expense of the quality of worklife for company personnel. Various aspects of performance may clash; increasing long-run market share may conflict with increasing short-run profit. And the consequences for people may differ from one person to another; a system that enriches one person's job may deskill or eliminate another's.

A third-order effect of implementing an information system is that as a result of how the system is used and of its perceived consequences for performance, people, and future flexibility, adaptations will be made over time to the system, the organization, or both. At

Frito-Lay, for example, changes due to the hand-held computer project and the improved IT infrastructure enabled the organization to shift from a one-year planning cycle to a three-times-a-year planning cycle, dramatically improving the rate of organizational learning ("Frito-Lay, Inc.: A Strategic Transition (C)," 1992). Similarly, it has been suggested that, as with any new technology, a period of learning, adjustment, and restructuring may be necessary before the full return on an IT investment is reaped (Brynjolfsson, 1993). The figure depicts these adaptive effects in the form of a feedback loop at the bottom of the diagram.

USING THE IT INTERACTION MODEL: IN THE FIELD AND IN THE CLASSROOM

Before discussing the specific role that the model plays in the core course, we consider more generically how the model can be employed in the field of Information Systems. To do this, we must first consider the "interaction" between system and organization in more depth.

The key concept in understanding the interaction of the system with the organizational environment is the notion of "fit." Intuitively, one might expect that if a system "fits" the organization well, then its effects will be favorable, and that if the system fits the organization poorly, the effects will be unfavorable. But the relationship is not so simple. Since systems have multiple effects, some may be favorable while others are not. Even more importantly, a good "fit" between the new system and the existing organization is not necessarily desirable. Understanding what is desirable requires considering the design

objectives.

Broadly speaking, one can distinguish two design objectives for an information system. These are, in Hammer's (1990) words, "automation" and "obliteration." Put differently, the objective of an information systems project might be to create incremental change, largely by mechanizing or automating the current business processes. Alternatively, the design objective might be radical change, fundamentally reengineering or transforming a firm's processes. For the first case, where changes are incremental, success generally depends on a reasonably good fit with the existing organization, because too great a mismatch between firm and system may engender resistance and other damaging responses. In contrast, where the system is an agent for radical change, success depends on a deliberate clash with the existing organization carefully designed to transform the organization in the desired manner (Markus and Keil, 1994).

So we can understand a system's effects in terms of the interaction between the system and the organization as follows: A good fit is consonant with successful mechanization, while a mismatch offers the potential for transformation. With this observation as a foundation, the IT interaction model can be used in two fundamentally different ways:

- proactively, to analyze the issues involved in designing and implementing an information system and to make appropriate recommendations for action, or
- reactively, to analyze what transpired after the fact in an IS project and to make recommendations for improvement.

When designing an information system, the model can be used proactively in the early stages of development to anticipate consequences and design system features accordingly. One way to do this is by first studying the elements of the existing organizational environment and then contemplating the consequences of the planned system, taking into account both intended effects to be targeted as well as undesirable side-effects to be avoided. Following these analyses, the major design choice between incremental improvement and radical change (transformation) is made. And then throughout the implementation process attention must be given to the various model elements. In the case of incremental improvement, this means ensuring an adequate fit between the existing environment and the system. In the case of transformation, it entails fitting some elements of the environment while deliberately clashing with others (Markus and Keil, 1994; Gersick, 1991; Tushman and Romanelli, 1985). Moreover, in all cases, one must ensure that the implementation process itself is appropriate and effective. In particular, when the information system is transformative, implementation must support and facilitate the organizational transformation.

The interaction model can also be used reactively to analyze the outcome of an information systems project. Such analysis might be useful either for academic purposes or as part of the adaptive process of revising the system. When using the model reactively, a good starting point is to ask whether the design objective was to improve or transform. If the objective was improvement, then the results might best be understood by looking for places where there may be a lack of fit between the system and the organization. If the objective was transformation, the results might depend on understanding where there were fits and where there were clashes. Figure 3 presents a checklist of questions to consider

when performing such an analysis. Note that not every question--every possible interaction--will be important for every situation. The challenge is to determine which are the salient issues for a given project.

These two real-world uses of the model correspond with two uses in the classroom. The reactive approach--ex post analysis of a systems project--lends itself to retrospective analysis of business cases. Students are encouraged to recognize whether the objective was improvement or transformation, to consider whether this objective had merit, to contemplate the full set of consequences (not just the obvious ones of profit or market share), to identify the salient elements of the model that contributed to these outcomes, and to make recommendations concerning what could have been done differently. This approach can also be used for comparative case analyses, to help students examine how different mixes of organizational factors and system features contributed to different outcomes. The model can be used either for written case analyses or as the basis for class discussions.

The proactive approach also has multiple uses in the core MBA course. Many such courses include small systems analysis and design projects, and others include term-long development projects. In some instances these are "textbook cases," where students design systems based on predefined scenarios, while in others they are "living cases," which allow the students to study the environment and interview the people directly. Either way, the interaction model can be used proactively to guide systems analysis and design. The proactive approach may also be appropriate for "action" business cases where students are presented with a business situation and asked what the organization should do next.

EXAMPLES OF PROACTIVE AND REACTIVE ANALYSES

To make the IT Interaction Model and its uses more concrete, we describe two examples of how we use the model in the core course. The first example illustrates the role of proactive analysis in student projects, and the second shows reactive analysis using the OTISLINE business case.

A Living Case: A Proactive Illustration

We have used the model as a foundation for a variety of student projects including systems analysis and design assignments (based on predefined case descriptions) and field-based analysis projects (where the teams found their own sites). One approach we found especially worthwhile for the students was to engage the class in a term-long living case where the teams all served as IT consultants to the same client. For each section of the core course, we selected a different unit in the business school that had expressed a need for IT support. These units included the planning office, placement center, and admissions office. Early in the term we devoted one class session to introducing the interaction model and another to a presentation by the client. The formal charge to the students was to "advise the client about IT-related problems and opportunities," but the client briefings typically focused on a particular issue where the client felt IT could be brought to bear. The students were strongly encouraged to apply the model in making their recommendations. During the term students scheduled follow-up interviews with members of the client organizations and others whose input was desired. Class time was allocated as needed to address issues of importance

to more than one team. At the end of the term, each team submitted a written report and presented an oral summary to the class and the client.

Examining the differences across teams highlights how the students used the model. Some groups took a very technical approach to the task, devoting a good deal of their effort to designing and building prototypes. While their demos were generally slick, other teams that took a broader and more behavioral approach generally made greater use of the model and produced richer analyses. The teams varied in their assessments of whether it was best to automate or obliterate. Some teams made low-tech recommendations, arguing that little new technology was needed but that changes to the unit's processes and procedures were essential. Others argued for incremental improvement, automating existing approaches. Still others argued for more radical reengineering or transformation.

The teams identified an assortment of factors within the organizational environment that constrained the system design or had the potential to affect outcomes. For example, a number of teams expressed concerns about the ability of the existing IT infrastructure to support what they saw as the ideal solution to the problem. Concerns about hardware resources, software compatibility, data availability, and computer skills led some groups to recommend enhancements to the infrastructure and other groups to scale back their proposed solutions. Similarly, internal structure and culture were often seen as additional constraints. Difficulties in sharing data across units, a low-tech atmosphere, and competition among units for central computer resources were all seen as factors requiring attention. Most groups pointed to areas where business processes could be improved, if not transformed. And

although these were units of a nonprofit organization, the external environment also played a role. Units such as the placement center and admissions office were sensitive to the behavior of their counterparts at competitor institutions, and this influenced the project goals and parameters. In their analyses, students were also able to identify sources of potential resistance.

Based on the written reports, oral presentations, follow-up discussions with students, and feedback from clients, we believe that the model helped the students to appreciate the dynamics of information systems in the client organizations and to recognize the opportunities, dangers, and limitations that the client environment posed for the application of information technology. Of course, since the students' term-long participation reflected only the initiation stage of the implementation process, they were not able to experience first-hand the interactions and consequences that would ensue as the projects progressed. For this reason, we recommend coupling the proactive analysis of the project with reactive analyses of a number of business cases.

OTISLINE: A Reactive Illustration

The OTISLINE (1988) case is a popular business case that illustrates how Otis used information technology to enhance its competitive position in the elevator industry. The case is rich with respect to many aspects of the IT Interaction Model.

In brief, the case describes how Otis centralized its dispatching and monitoring of service calls, thereby improving the quality of service and achieving a variety of related

competitive benefits. Our objective in the discussion is to recognize what transpired and to analyze why. The way we open the discussion is usually to ask if OTISLINE was successful.

Students generally conclude that the system was a success by noting that Otis strengthened its number one share of the service market (performance). And they point to a number of second-order competitive benefits that also followed from the system, such as the edges in manufacturing and selling elevators that OTISLINE produced indirectly. Further analysis also reveals that OTISLINE served as the springboard for additional technological innovations that Otis planned down the road. We press the students on this issue of future flexibility versus current performance, asking questions such as the following: How dependent is Otis on OTISLINE? How can Otis insulate itself from the risks of dependence? Is Otis blinding itself to other, better approaches that might be invented in the future?

Next we ask what made OTISLINE a success. It is usually agreed that OTISLINE met the firm's strategic business need and was responsive to the competitive problems Otis faced in the elevator service industry. But we probe further. While the system may have been a good strategic fit, consonant with the demands of the external environment, OTISLINE represented a transformation within the organization. Otis moved from a highly decentralized handling of elevator service, controlled by the field office managers, to a highly centralized approach. Many of the immediate and future benefits of OTISLINE follow from this radical change, which was not just a redesign of the business process of dispatching, but a transformation of managerial control within the firm.

We probe still further. The case notes that Otis was only able to implement OTISLINE so rapidly because a critical database was already in place. So OTISLINE's success was attributable, in part, to having necessary infrastructure already in position to support the new system. We also encourage the students to consider the implementation process; they generally note a number of implementation factors that further contributed to OTISLINE's success.

At this point, the discussion may seem complete to many students, but we have not yet considered the effects on people. These effects varied by position. Centralized dispatching meant replacing local dispatchers with new ones at the central site. For mechanics, the improved dispatching made their lives better in some ways, but it also subjected their performance to greater monitoring. And field office managers found themselves bypassed as service data flowed directly to corporate headquarters, which began to intercede in local service operations. So, the consequences for people in the organization were very mixed. In this, OTISLINE is similar to many systems, we believe, which is why we find it so effective to use this case in conjunction with our model.

We use the IT Interaction Model to present our conclusions. Among the conclusions we reach is that OTISLINE was a good fit with strategic need, but that it was not the technology or the fit alone that produced the successful outcomes. Having an appropriate infrastructure and employing a good implementation process also contributed. And the key ingredient was transforming the organization through centralization. While this transformation had a positive effect on performance, it had a variety of negative effects on

many people's jobs. This conclusion can support a discussion of alternative system design features or alternative implementation strategies that might have produced different results.

THE ROLE OF THE MODEL IN THE COURSE

We can summarize the role of the model in the course as follows. The IT Interaction Model is both a foundation for, and an integration of, virtually all the material we cover during the term. Like many IS core courses, we structure the course around the following main topics:

- the basics of information technology (hardware, software, databases, and telecommunications),
- IS development (the traditional systems development lifecycle, prototyping, outsourcing, and end-user development), and
- IT applications (transaction processing systems, interorganizational systems, decision support systems, groupware, expert systems, and more).

Each of these topics is reflected prominently in the model, yet interwoven with the others as it is in the business world. Consider some examples:

The *basics of technology* come into play in at least three ways in the model. Technology concepts matter for assessing the IT infrastructure, for describing system features, and for examining the relationship between the capabilities of the existing infrastructure and the demands of the proposed system. Indeed, the model helps those students who might otherwise be resistant to the technological component of the course appreciate why they need to learn this material. For example, OTISLINE provides an

excellent illustration of the importance of voice technology (automatic call distribution) complementing computing technology (databases).

The *systems development* portion of the course is reflected by the implementation process time-line that runs across the top of the model. The model portrays an abstracted process comprising four generic phases, but systems development and implementation receive proper and complete attention during the course. In particular, our treatment of these topics pays special attention to the systems analysis and design phases and to implementation tactics and strategies. We point out the importance of process, noting that the implementation process, too, affects system use, consequences, adaptation, and success. The implementation process structures the model visually just as, in the real world, it is the process that carries us from the existing organization to the new system to the effects of their interaction.

Our objective in the *IT applications* section of the course is twofold. One goal is to acquaint students with the range of application types they are likely to encounter in the workplace. The other aim is to familiarize them with the dynamics of these various applications in organizations. We rely on the model heavily to realize this second aim. In the paragraphs that follow we use expert systems, group decision support systems, executive information systems, and interorganizational systems to illustrate briefly this use of the model.

In addition to explaining the routine characteristics of expert systems (Leonard-Barton and Sviokla, 1988)--what rule-based expert systems are, how they work, what tasks they are suited for, and what benefits they offer the organization--we use the interaction model to

provide a more penetrating analysis. What are the consequences of an expert system for people in the organization? Is such a system job enriching or deskilling? Are the consequences the same for the expert and for the novices? How might this system constrain the organization's future flexibility? For instance, might the system lead to deskilling, which in the long run could lead to a loss of knowledge and expertise for the firm?

Similarly, we use the model to probe the features of group decision support systems (GDSS). One GDSS feature that has received much attention is the possibility of sharing ideas anonymously (DeSanctis and Gallupe, 1985; Nunamaker, Applegate, and Konsynski, 1987; Jessup, Connolly, and Galegher, 1990; Valacich, Dennis, and Nunamaker, 1991). Such anonymous communication offers potential advantages as well as potential disadvantages. For example, while anonymity might promote greater participation and more effective brainstorming by reducing inhibitions, it might also suppress participation since individuals are not rewarded for their contributions. Whether anonymity produces good or bad results, therefore, may depend upon whether the organizational culture encourages or stifles open communication and upon whether the organizational reward structure favors individual or group performance. An organization might set anonymity on or off in consonance with its existing structure and culture, or it might do the opposite, using the system, together with a careful implementation process, to transform the structure and culture.

Executive Information Systems (EIS) are rapidly turning into "Everybody Information Systems," proliferating throughout the firm as a means of sharing valuable corporate data

("Trickle-Down Systems," 1990). In some firms, efforts toward corporate-wide information systems may be stymied by inadequate technological infrastructures. In others, the infrastructures may now be robust enough to support such data sharing, but structural and cultural barriers may still block it. A system intended to promote a more informed, data-rich business environment may instead evoke resistance accompanied by the withholding and falsifying of data. Here, again, success may depend upon a well managed transformation of the organization.

Interorganizational Systems (IOS) that electronically link one firm with another (Malone, Yates, and Benjamin, 1989; Cash and Konsynski, 1985) are also growing rapidly in popularity. Whether a given firm will benefit from hooking up with its suppliers and customers electronically, however, and what the most appropriate type of connection will be (for example, an electronic market versus an electronic hierarchy, a proprietary versus a standard EDI protocol, and so forth) depend upon such elements of the external environment as the concentration of sellers in the industry, the relative power of buyers and sellers, and the basis of competition. The Reynolds Aluminum Supply Company case ("RASCO: The EDI Initiative," 1990) illustrates a number of these issues nicely.

In addition to these main topics--technology, development, and applications--two themes that run throughout the course are (1) the strategic use of information technology and (2) business process reengineering. As we have seen, the model captures these themes as well. Strategic use of technology is reflected in the external view of the organizational environment. And reengineering is at the center of both the proactive and reactive uses of

the model.

Given the model as an integrative framework for the course, the students emerge with a better understanding of how the pieces fit together and why each is important for a sound understanding of information systems in business. And by presenting the students with a formal, causal model of information systems in organizations--albeit in the form of a schematic and not a set of equations or propositions--we convey the message that the course and the subject are not a collection of loosely related topics but an integrated whole resting on a well-defined theoretical foundation. It is reassuring to the students to be able to point to the model as the core of the course. If the students grasp the model, they can feel comfortable with their understanding of the theory that underlies IS. And our use of the model also makes the students aware of what we expect them to take from the class.

The way we employ the model in the course fosters a number of important business proficiencies that should serve the students well in the workplace. As "the line takes the leadership" (Rockart, 1988) and the partnership between IT professionals and line managers grows, MBA's are likely to participate in information systems development projects in a number of significant ways: as project sponsors, as members of the design team, as managers of development, as end-user developers, and as project funders. At a minimum, managers should expect to be interviewed during systems analysis and design. Experience with proactive use of the IT interaction model will enable them to serve more competently in these capacities, increasing the likelihood of positive consequences and decreasing the chances of negative ones. Systems will always have unanticipated effects, but the more

people understand about the dynamics of information systems, the better they will be able to minimize these unanticipated effects, to recognize them when they occur, and to cope with them. As citizens of wired organizations, MBAs should expect to encounter first-hand the consequences of their firms' IT undertakings. Experience with reactive use of the model will enable them to comprehend how a given system is affecting them and their organizations and to recommend any necessary corrective actions. This combination of proactive and reactive analytic ability should prepare the students well for the demands of the workplace.

OTHER PEDAGOGICAL ISSUES

In this section, we briefly discuss several additional pedagogical issues that have not already been addressed: at what point in the course the model should be introduced, the independence of the model from the particular sequence of topics, and the relationship between the model and other MBA core courses.

First, we advocate introducing the model early in the core course. Some instructors may wish to present the model at the outset of the term to lay a foundation for what is to come. We find that it is often useful to defer introducing the model until the students have encountered some basic course material and have analyzed at least one business case. This approach serves to motivate the need for a model and to provide a context for appreciating the issues the model raises. OTISLINE is a good choice for such a case. The case can be discussed in class prior to introducing the model, and it can then be used as an illustration while presenting the model.

Second, the IT interaction model does not depend on a particular sequence of topics. Many core courses begin with technology basics, then discuss the development process, and conclude with specific types of applications. Others follow different orders, and still others integrate the topics (for example, by spreading basic technology concepts throughout the discussion of applications or by teaching development approaches in the context of particular classes of applications). Over the years, we have varied the order of presentation, but were still able to employ the model successfully. The model represents an additional level of course structure and can therefore be applied no matter what sequencing of material is used.

Third, although our model uses concepts found in other core MBA courses, such as strategy, structure, and culture, it is not our intention in the core IS course to teach such subjects. Depending on whether these courses are taken by the students previously, concurrently, or in subsequent terms, the level of detail that we employ in presenting the components of the organizational environment vary. For example, in some instances we may make a formal distinction between structure and culture while in others we may not. For those MBA programs focusing on cross-functional integration of the curriculum, the model provides an excellent opportunity for collaborative teaching with the management core course.

ASSESSING THE EFFECTIVENESS OF THE MODEL

Based on our experiences at several universities, we believe that the IT Interaction Model is a useful mechanism for addressing a number of practical teaching concerns as well

as for achieving our main course objectives. With respect to the pedagogical issues, the model unifies what is often perceived as a "topics" course, the model offers a formal foundation for what students sometimes consider a "soft" or "nonrigorous" subject, the model provides a consistent framework for case analyses, discussions, and group projects, and the model fosters critical business competencies. Since introducing the model several years ago, the feedback we have received has shown a marked reduction in student concern about these matters.

With respect to the course objectives, recall that the course goals are to acquaint students with the dynamics of information systems in organizations and, in particular, to increase students' knowledge of the potential benefits, dangers, and limitations of information technology, equipping them to leverage the benefits, avoid the dangers, and surmount the limitations. Based on the way students progress through the term, as evidenced in case discussions, written case analyses, and student projects, we believe that the model accomplishes these objectives. While students tend to enter the course as "technological determinists' (Markus and Robey, 1988), the model shows them that information technology is just one of many important contributors to information systems outcomes and that an assortment of factors interact to produce results. At the beginning of the term, students often focus on technological issues and positive outcomes. Midway through the course, the focus tends to shift in the other direction, such that they are inclined to see only the limitations and the organizational dangers. By the end of the term a balance is achieved.

One concern we have is that some students may be memorizing the model rather than

learning to apply it effectively. Just as in other courses students may memorize equations and invoke them by rote, we have noticed that some students absorb the IT Interaction Model only superficially. These students include all the buzzwords in their written analyses and class participation, but they do not demonstrate an understanding of the concepts. For example, the better analyses and comments focus on the subset of model elements that are salient for the case at hand. The weaker ones, however, list all the components without conveying significant insight. We combat this tendency in a number of ways: through oral and written feedback, by providing a series of written assignments and case discussions so students can develop their analytic skills, and through group projects so the more perspicacious students can share their insights with their peers.

The model is most successful when used for both business cases and student projects. We believe that the model is effective for analyzing most IS cases, but because there is a dearth of IS business cases, and because the existing ones were written independently of the model, finding a complementary set of cases that are rich with respect to the model is difficult. Writing IS cases while keeping the model in mind would therefore be helpful. For example, if the students were provided with rich and thorough description, they could be challenged to identify which model features are the salient factors in the case.

CONCLUSION

We have found the IT Interaction Model to be a valuable tool for teaching the MBA core course in information systems in a number of academic settings. Our hope is that as a

teaching model that encompasses the full range of applicable topics, highlights the critical issues, and focuses on the essential relationships, while remaining independent of particular content choices, the interaction model will prove useful to others as well. We believe the model can also serve as a vehicle for advancing the ongoing dialogue concerning the design of the IS core course.

REFERENCES

Boynton, A.C., Victor, B., and Pine, B.J., II. "New Competitive Strategies: Challenges to Organizations and Information Technology," *IBM Systems Journal*, (32:1), 1993, pp. 40-64.

Brynjolfsson, E. "The Productivity Paradox of Information Technology," *Communications of the ACM*, (36:12), December 1993, pp. 66-77.

Cash, J.I., Jr., and Konsynski, B.R., "IS Redraws Competitive Boundaries," *Harvard Business Review*, (53:2), March-April 1985, pp. 134-142.

DeLuca, J.R. *Overcoming Resistance to Change*, Evergreen Business Group, New York, NY, 1993.

DeSanctis, G. and Gallupe, R.G. "A Foundation for the Study of Group Decision Support Systems," *Management Science*, (33:5), May 1987, pp. 589-609.

DeSanctis, G. and Poole, M.S. "Capturing the Complexity in Advanced Technology Use: Adaptive Structuration Theory," *Organization Science*, (5:2), May 1994, pp. 121-147.

Fichman, R. and Kemerer, C. "Adoption of Software Engineering Process Innovations: The Case of Object Orientation," *Sloan Management Review*, (34:2), Winter 1993, pp. 7-22.

"Frito-Lay, Inc.: A Strategic Transition (C)," Harvard Business School, 9-190-071, revised, March 1992.

Gersick, C.J.G. "Revolutionary Change Theories: A Multilevel Exploration of the Punctuated Equilibrium Paradigm," *Academy of Management Review*, (16:1), 1991, pp. 10-36.

Goodhue, D.L., Wybo, M.D., and Kirsch, L.J. "The Impact of Data Integration on the Costs and Benefits of Information Systems," *MIS Quarterly*, (16:3), September 1992, pp. 293-311.

Hammer, M. "Reengineering Work: Don't Automate, Obliterate," *Harvard Business Review*, (68:4), July-August 1990, pp. 104-112.

Ives, B. and Learmonth, G.P., "The Information Systems as a Competitive Weapon," *Communications of the ACM*, (27:12), December 1984, pp. 1193-1201.

Jessup, L.M., Connolly, T., and Galegher G. "The Effects of Anonymity on GDSS Group Process With an Idea-Generating Task," *MIS Quarterly*, (14:3), September 1990, pp. 313-321.

Keen, P.G.W. *Shaping the Future: Business Design Through Information Technology*, Harvard Business School Press, Boston, MA, 1991.

Keen, P.G.W. and Scott Morton, M.S. *Decision Support Systems: An Organizational Perspective*, Addison-Wesley, Reading, MA, 1978.

Kling, R. and Scacchi, W. "The Web of Computing: Computer Technology as Social Organization," in *Advances in Computers*, (21), Academic Press, New York, NY, 1981.

Leonard-Barton, D. "Implementation as Mutual Adaptation of Technology and Organization," *Research Policy*, (17), 1988, pp. 251-267.

Leonard-Barton, D. and Sviokla, J.J., "Putting Expert Systems to Work," *Harvard Business Review*, (66:2), March-April 1988, pp. 91-98.

Lucas, H.C., Jr. *Information Systems Concepts for Management*, Mitchell McGraw-Hill, San Francisco, CA, fifth edition, 1994.

Malone, T.W., Yates, J., and Benjamin, R.I. "The Logic of Electronic Markets," *Harvard Business Review,* (67:3), May-June 1989, pp. 166-169.

Markus, M.L. *Systems in Organizations: Bugs and Features*, Pitman Publishing, Marshfield, MA, 1984.

Markus, M.L. "Toward A 'Critical Mass' Theory of Interactive Media," in *Organizations and Communication Technology*, J. Fulk and C.W. Steinfield (eds.), Sage Publications, Newbury Park, CA, 1990, pp. 194-218.

Markus, M.L. and Keil, M. "If We Build It They Will Come: Designing Information Systems That Users Want To Use," *Sloan Management Review*, (35:4), Summer 1994 (in press).

Markus, M.L. and Robey, D. Information Technology and Organizational Change: Causal Structure in Theory and Research, *Management Science*, (34:5), May 1988, pp. 583-598.

Markus, M.L. and Soh, C. "Banking on Information Technology: Converting IT Spending Into Firm Performance," in *Perspectives on the Strategic and Economic Value of Information Technology Investment*, R.D. Banker, R.J. Kauffman, and M.A. Mahmood (eds.), Idea Group Publishing, Middletown, PA, 1993, pp. 364-392.

McFarlan, W.F. "Information Technology Changes the Way You Compete," *Harvard Business Review*, (62:3), May-June 1984, pp. 98-103.

Nunamaker, J.F., Jr., Applegate, L.M., and Konsynski, B.R. "Facilitating Group Creativity: Experience with a Group Decision Support System," *Journal of Management Information Systems*, (3:4), Spring 1987, pp. 5-19.

Orlikowski, W.J. "Learning from Notes: Organizational Issues in Groupware Implementation," *Proceedings of the Conference on Computer Supported Cooperative Work*, 1992, pp. 362-269.

Orlikowski, W.J. and Robey, D. "Information Technology and the Structuring of Organizations," *Information Systems Research*, (2:2), June 1991, pp. 143-169.

Porter, M.E. *Competitive Strategy*, The Free Press, New York, NY, 1980.

Porter, M.E. and Millar, V.E. "How Information Gives You Competitive Advantage," *Harvard Business Review*, (63:4), July-August 1985, pp. 149-160.

"OTISLINE," Harvard Business School, 9-186-304, revised, January 1988.

"RASCO: The EDI Initiative," Darden Graduate School of Business Administration, University of Virginia, UVA-IT-001, revised, July 1990.

Rockart, J.F. "The Line Takes the Leadership," *Sloan Management Review*, (29:4), Summer 1988, pp. 57-64.

Stohr, E.A., Jelassi, T., Madnick, S.E., McKenney, J.L., Senn, J.A., and Silver, M.S. "Panel 3: Approaches to the MBA Core Course in Information Systems," in *Proceedings of the Eleventh International Conference on Information Systems*, J.I. DeGross, M. Alavi, and H. Oppelland (eds.), December 16-19, 1990, Copenhagen, Denmark, pp. 308-309.

Treacy, M. and Wiersema, F. "Customer Intimacy and Other Value Disciplines," *Harvard Business Review*, (71:1), January-February 1993, pp. 84-93.

"Trickle-Down Systems," *Information Week*, May 7, 1990.

Tushman, M. and Romanelli, E. "Organizational Evolution: A Metamorphosis Model of Convergence and Reorientation," in *Research in Organizational Behavior*, L.L. Cummings and B.M. Staw (eds.), (7), 1985, pp. 171-222.

Valacich, J.S., Dennis, A.R., and Nunamaker, J.F., Jr. "Group Size and Anonymity Effects on Computer-Mediated Idea Generation," *in Academy of Management Proceedings*, Miami Beach, FL, August 11-14, 1991, p. 447 (abstract).

Weill, P., Broadbent, M., and St. Clair, D. "I/T Value and the Role of I/T Infrastructure Investments," *Strategic Alignment*, Oxford University Press, Oxford, UK, 1994 (in press).

Weill, P. and Olson, M.H. "Managing Investment in Information Technology: Mini Case Examples and Implications, *MIS Quarterly*, (13:1), March 1989, pp. 3-17.

FIGURE 1
THE INFORMATION TECHNOLOGY INTERACTION MODEL

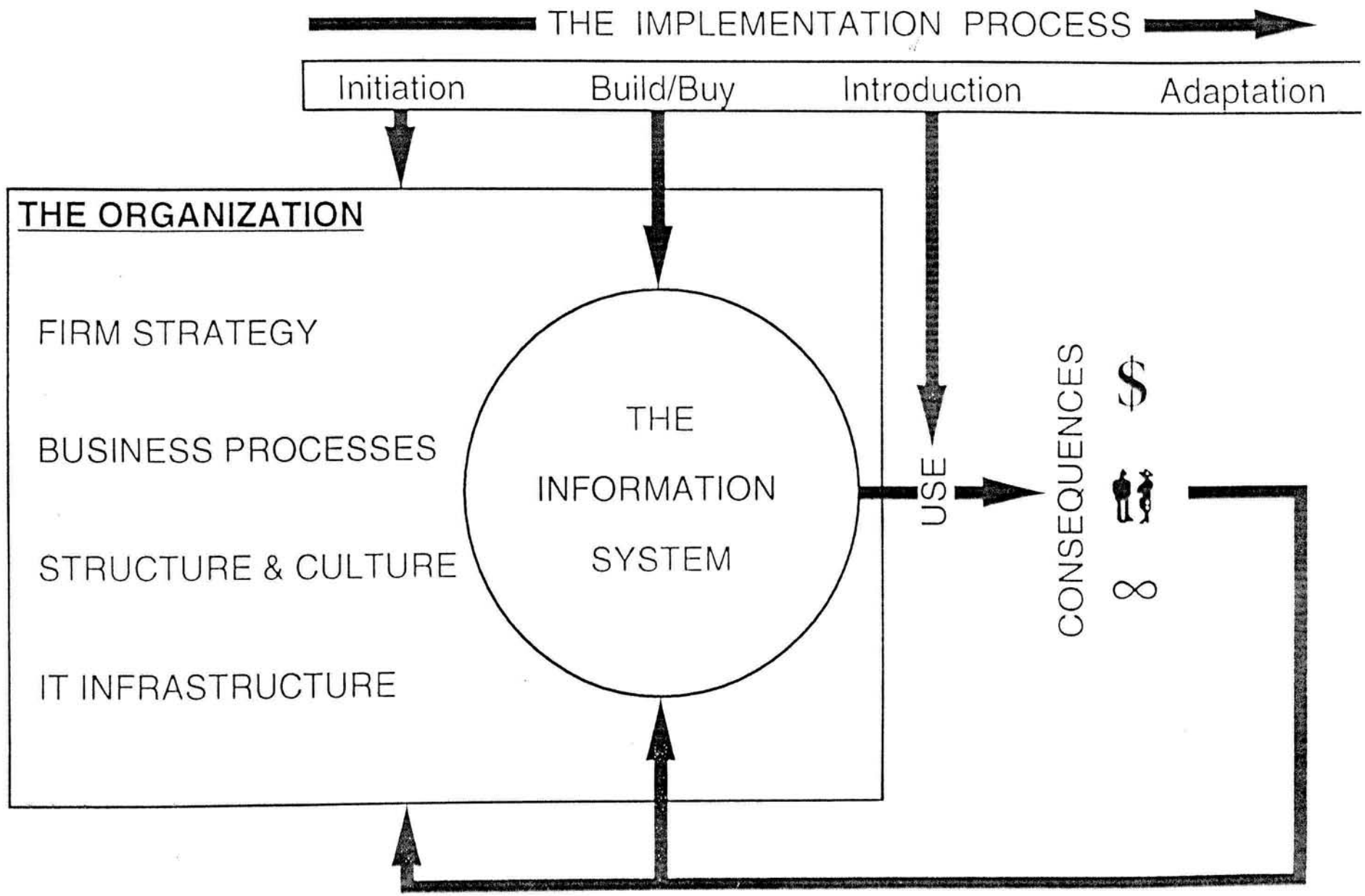

FIGURE 2
COMPONENTS OF THE IT INTERACTION MODEL

ELEMENTS OF THE EXTERNAL ENVIRONMENT:

- Competitive Structure of the Industry
- Relative Power of Buyers and Sellers
- Basis of Competition
- Growing/Shrinking/Stable
- Regulation
- Technological Deployment

EXAMPLES OF FIRM STRATEGIES:

- Differentiation
- Low-Cost Production
- Quality/Service
- Going Global
- Right-Sizing
- Just-In-Time Inventory/Manufacturing

SOME ELEMENTS OF ORGANIZATIONAL STRUCTURE:

- Centralization vs. Decentralization
- Functional, Divisional, or Matrix Organization
- Reporting Relationships

EXAMPLES OF ORGANIZATIONAL CULTURE:

- Individuality (or Teamwork)
- Bigger is Better (or not)
- Risk Aversion (or Risk Taking)

EXAMPLES OF BUSINESS PROCESSES:

- Order Fulfillment
- Materials Acquisition
- New Product Development

IT INFRASTRUCTURE:

- Computing Hardware
- Software Development Tools and Program Libraries
- Databases
- Telecommunications Networks
- Training Materials and Facilities
- Capabilities of IT Personnel

THE INFORMATION SYSTEM:

- Hardware
- Software
- Data
- People
- Procedures

FIGURE 3
REACTIVE ANALYSIS OF AN INFORMATION SYSTEM

- Was the system's design objective to IMPROVE the organization incrementally or to TRANSFORM it?

- What are the system's FEATURES? What does it do?
- How does the system FIT the firm's external BUSINESS ENVIRONMENT?
- How does the system FIT the firm's STRATEGY?
- How does the system FIT the firm's BUSINESS PROCESSES?
- How does the system FIT the organizational STRUCTURE and CULTURE?
- Can the organization's IT INFRASTRUCTURE support the system?
- How and how effectively was the system IMPLEMENTED?
- Who USES the system and how do they USE it? As intended?
- What are the CONSEQUENCES of the system for PERFORMANCE, PEOPLE, and FUTURE FLEXIBILITY? Did the system accomplish its objectives?