Focus on **People and Organization Issues**

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Review ■

Antecedents of the People and Organizational Aspects of Medical Informatics: Review of the Literature

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A b s t r a c t   People and organizational issues are critical in both implementing medical informatics systems and in dealing with the altered organizations that new systems often create. The people and organizational issues area—like medical informatics itself—is a blend of many disciplines. The academic disciplines of psychology, sociology, social psychology, social anthropology, organizational behavior and organizational development, management, and cognitive sciences are rich with research with significant potential to ease the introduction and on-going use of information technology in today's complex health systems. These academic areas contribute research data and core information for better understanding of such issues as the importance of and processes for creating future direction; managing a complex change process; effective strategies for involving individuals and groups in the informatics effort; and effectively managing the altered organization. This article reviews the behavioral and business referent disciplines that can potentially contribute to improved implementations and on-going management of change in the medical informatics arena.

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In the first stages of the information revolution in health care, technical hardware and software issues understandably received far more attention than people and organizational issues. Many of the early implementations were in the "business" areas of health care, which are characterized by hierarchical manage-

ment structures that are similar to other businesses. When early clinical implementations did occur, they were often of limited scope, affected relatively few people, and had strong local champions.

Today's informatics implementations often involve far larger systems with wide-ranging effects and requiring the cooperation of many people. These systems are also being introduced into organizations that are more complex and that are often traumatized by other changes, such as downsizing or mergers. While some implementation failures do make it into print,[1,2] others are only discussed in private at conferences. The complexity of the environment in which the technology operates does make failure analysis difficult and controversial.[3] Today's informatics implementations—and especially the larger scale ones—are becoming increasingly dependent upon how well the people and organizational issues are managed.

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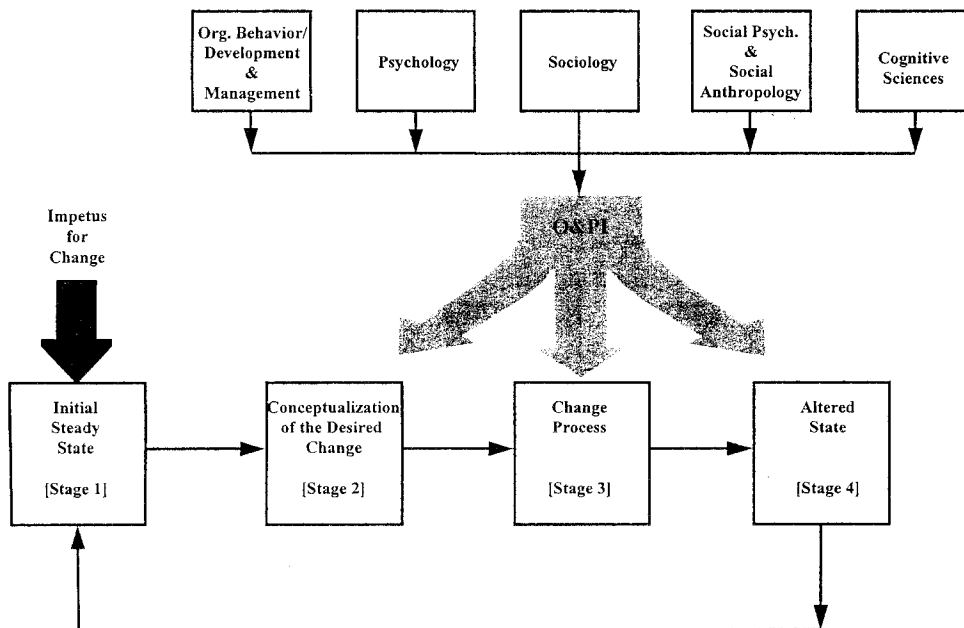
Link Between Medical Informatics and Change

The relationship between technological change and organizational change is always an interesting one in a classic chicken-or-egg sense.[4] Do the technological advances drive the change, as in the case of developments in medical imaging? Or does the technology merely enable changes that are largely driven by non-technical forces, as in the case of information systems developed to support cost reductions forced by economic pressures?

People can easily be overwhelmed by change, especially within large organizations where they may perceive they have little or no voice in or control over the changes they believe are descending upon them.[5-8] The typical response is fight or flight, not co-operation. Managers often interpret such human resistance to change as "stubbornness" or as "not being on the team." This reaction solves nothing in terms of reducing resistance to change or gaining acceptance of it. Many managers do not accept that they are regarded as imposing "life-threatening" changes and establishing "no-win" adversary relationships between management and those below in the organization. Sometime managers try to disguise the impending change with what they consider innocuous names, (e.g., organizational effectiveness) or they adopt a metaphor (e.g., architecture for the future). In this case, we are referring to the parent organization, but the same analogy applies to the medical informatics area as well. The end result of people feeling disen-

franchised is inevitable, as the following examples from around the world attest.

■ In 1988, the University of Virginia Medical Center began implementing a medical information system based on mandatory physician order entry. The implementation process was much more difficult than expected. The program experienced considerable delays and cost much more than was originally estimated. Although there were some legitimate questions concerning the user-friendliness of the new technology, these were less significant than the cultural and individual behavioral problems encountered. The new system challenged basic institutional assumptions; it disturbed traditional patterns of conduct; and it forced people to modify established practice routines. Real progress toward the integration of the system into the center's operational culture occurred only after a senior management team representing important sectors of the hospital staff and administration began meeting regularly to address the institution-wide issues that had been raised.[9]

■ In 1990, at Calgary's Foothills Hospital, a war began between the users of the new information system called OSCAR and the people responsible for delivering the system. At the heart of the problem was the perception that OSCAR was prohibiting the medical staff at the hospital from performing their functions. The medical staff perceived that management was attempting to impose its will over them, restricting and redefining their work roles and pat-

terns. The medical staff consequently refused to work with OSCAR.[1]

- In 1992, the Computer Aided Dispatch system for the London Ambulance Service failed, primarily because the information system supported the values and norms of senior management, not the values and norms of the ambulance crews and the command and control staff.[2]

Each implementation was made with the best intentions and in response to the perceived changes needed to function in today's health care environment. However, it appears that the implementors did not consider an organizational change model or the people and organizational issues associated with these implementations.

Figure 1 shows a basic four-stage model of organizational change that applies at the general level as well as for the implementation of change through informatics systems. The initial steady state (1) is affected by some impetus for change—whether technical or non-technical. This impetus might be a quite visionary perception or it might be a rather tardy reaction to environmental change. The organization then conceptualizes the desired outcome (2) and implements the change (3). If the change is not trivial, the organization is itself altered in various ways by the change (4). Over time, the altered organization adjusts and becomes the "new" initial state for the next change. In a complex organization functioning in a volatile environment, various portions of the organization are passing through various stages of the process at varying rates. There is a continuous cycle of change that organizations are constantly managing.

The people and organizational issues area—like medical informatics itself—is a blend of many disciplines. These referent disciplines include psychology, sociology, social psychology, social anthropology, organizational behavior and organizational development, management, and cognitive sciences. They are displayed as flowing through the arrow toward Stages 2–4 in Figure 1. The research from these disciplines focuses on individuals, groups, and organizations and contributes to understanding and designing effective strategies for the non-technological side of change, including informatics changes. Each of the disciplines contains knowledge and skills that can contribute to more effective passage through all the latter three change stages.

Those not educated in these areas have widely varying reactions to social science knowledge. Some regard it as "just common sense." To others, it represents a mysterious "black box" that they may

Table 1 ∎

A Listing of Some of the Topics Researched In the Referent Disciplines According to Individual, Group, and/or Organization Area of Focus

Research Topics	Focus		
	I	G	O
User cordial information system design.[10,11,12,58,81,151,152]	X		
Empowering end users.[118]	X	X	
Behaviors lead to system success/failure.[13,14]	X	X	
Role of professional **values/cultures**.[26,50,51]	X	X	
Why and how people accept or resist **change**.[15]	X	X	
User **involvement and participation**.[83,84,123 – 125,129,133,140]	X	X	
User **satisfaction/acceptance and attitudes**.[82,85,86,102,103,126,128,131,135,138,141,145,146]	X	X	
Strategies for **managing complex change**.[16,17,46,95,104]			X
Organizational structures.[18,33,34,35,40,41]			X
Role of information in organizations.[57,77,78,89,96]			X
Total **quality** management in the organization.[36 – 38]			X
How ideas/technology are **diffused** through an organization.[19,80]			X
Organizational **political process**.[25,91]			X
Types of **Organizations**.[24,32,59]			X
Transforming **health care**.[52,55,111,149]			X
Reengineering.[47,48,63,150]		X	X
The role of social **control** systems.[3]		X	X
Organizational **culture**.[43,44,51,62,66,116]	X	X	X
Strategies to **motivate** people.[59,60]	X	X	X
Effective **leadership** strategies.[20,56,72,73,74,75,76,87]	X	X	X
Decision making.[30]	X	X	X
Implementation strategies.[92,93,97,108,122]	X	X	X

appreciate but do not pretend to understand. In reality, there has been much research and knowledge accumulated within the black box that is available to increase the quality of the change outcomes. Some of the more relevant topics researched are outlined in Table 1. To illustrate the breadth of the research, the topics are listed and then categorized according to their area of focus: e.g., individuals (I), Groups (G), and Organizations (O). Some of the topics listed have research that involves all of the broad areas of focus. Experts in the various areas might argue that an "X" could be placed in each box. However, we have elected to focus on a portion of the research that we believe affects medical informatics the most.

While these topical areas may not seem difficult or challenging to the informatics change leader, failing to address them well usually leads more to the failure of a systems effort than hardware or software deficiencies do.[21]

Knowledge from the Core Referent Disciplines

The antecedents for learning about and understanding the processes that might have led to greater success are known and have been known for some time. We will briefly review the extensive research that pertains to medical informatics according to (1) business and organizational issues; (2) individuals and groups; and (3) management of information issues.

Business and Organizational Issues

It has always been difficult to develop a clear and concise concept of what an organization is and how it behaves. The classic concepts developed early this century were dominated by the somewhat mechanistic models of scientific management and bureaucracy. These models emphasized formal regulations, clear lines of accountability, and compliance with authority. In the middle of the century, there was a move to more "organic" concepts to take better account of the more human characteristics of organizations.[22] As understanding matured, a wider range of perspectives developed.[23] Some of the more important of these are:

- **Ecology:** The organization is seen as a discrete entity that has a primary objective of surviving in its environment. Issues of financial viability, strategic goals, market niches, and competition are paramount.

- **Structure:** The organization is seen as a set of control and accountability systems that must be attuned to the particular needs of that organization. Structure may be formal and hierarchical or quite loose and informal.[24]

- **Politics:** The organization is composed of and affected by a wide range of often conflicting interest groups that make demands on it. It is the interaction among these various forces that determines the organization's behavior.[25]

- **Culture:** There are common factors such as symbols, customs, values, and assumptions that characterize and influence the way people in an organization think and act. This "culture" is an important determinant of the way that the organization functions.[26]

- **Psychology:** Organizations have sets of behaviors that mimic those of human behaviors.[27]

- **Human Resource:** Staff are seen as the organization's principal asset, and the most important task is the development of staff skills, commitment, and initiative.[28]

- **Functional:** The nature of the organization arises from its function, the technology and systems that it uses, and the skills that it requires.

- **Intelligence:** The core assets of many organizations are "soft" and lie in a combination of data, programs, procedures, skills, knowledge, culture, and values that make the organization function.[29]

- **Decision Making:** This is seen as the basis of the organization.[30]

This diverse set of perspectives illustrates the complexity involved in developing a coherent concept of an organization. Each perspective deals with very different sets of characteristics and demands quite different ways of thinking. Yet they are intimately related and must be integrated to provide a comprehensive view of the organization. However, there is no consensus of how this integration is to be done.[31]

Organizational Types

Not only are there many ways of looking at organizations, but their basic structures can change dramatically. Mintzberg identified five basic types of organization:[59]

- **Simple.** Typically, this organization was started by one person and is still dominated by that person. Its style is idiosyncratic, and a person's position and power are very much dependent on his or her relationship to the leader.

- **Machine Bureaucracy.** This organization is controlled from the top by formal processes. There are strong reporting and accountability lines emanating from the chief executive, and a high degree of compliance is required. This type of structure can manage large organizations, but it is not effective in managing the unpredictable or in enabling staff to take initiative.

- **Professional Bureaucracy.** This organization is built around professional activities. Because of the complexity of professional work, it cannot be formally directed. The organization is primarily a supportive framework in which professionals can operate largely autonomously. They are controlled more by professional values and culture than by formal means.

- **Adhocracy.** This is a very adaptive organization set up around a specific project. The demands of the task dictate the structure, which may change quite frequently. It is driven very much by the skills and the commitment of the people involved.

- **Divisionalized.** When large organizations take on diverse activities, they may become divisionalized. Each division is a semi-autonomous unit with over-

sight from the center that provides a base for effective management in each division.

Two other types of organization can be added to Mintzberg's five:

■ **Federal.** These are large, fairly homogeneous organizations that may be broken down into regional units for effective management (e.g., some of today's health care enterprise systems). These sub-units may be put into competition with each other, or they may work together to enhance their performance.

■ **Networked.** These organizations are "non" organizations in many respects. They are independent individuals or sub-organizations that link opportunistically to address a particular task. These occur typically in primary health care; a general practitioner may refer a patient to a surgeon, who then engages a hospital in which to do the surgery and subsequently refers the patient to a physiotherapist for rehabilitation.[32]

While these are archetypal organizations, any complex organization may be a combination of types. A large hospital system may have a federal structure, with management having largely a machine bureaucracy form, yet its autonomous medical staff could give it a substantial professional bureaucratic nature. However, some sections may be run by a strong autocrat, similar to the primitive form. In its wider function, the system may be part of a network operation, and many of its internal functions may be driven by network relationships. The types of organizational structures will have an impact on the implementation of an information system.

Evolution of Organizational Concepts

While organizations, large and small, have been managed in many different ways for centuries, the formal understanding of how this is done is relatively recent. The formalization began early in this century, dominated by Fayol, Weber, and Taylor. While there were many aspects to their theories, their overall emphasis was on a formal organizational structure, a line of command, and specialization of function.[33–35] The critical information involved was the command and control structure—providing instructions and ensuring compliance—and the knowledge of optimum production techniques, which was the province of the industrial engineer. The worker's role was to comply with instructions. These principles were modified to some extent by the human-relations movement. Western industrial development in this century was based on these principles up to and into the sixties.

In the 1970s, however, the Japanese economic recov-

ery started to threaten many Western industries. The principles on which many Japanese industries were based seemed dramatically different from those in the West—principles such as singular commitment to the company, life-time employment, and collective decision making. However, perhaps the most dramatic difference was that of "Total Quality Management" (TQM), a principle that had been developed in the United States by Deming but adopted in Japan. Instead of limiting production staff to observing set procedures, TQM gave production staff the tools and authority to monitor the quality and efficiency of their work and to find better ways of working. The focus of activity moved from the individual worker to the team. The critical information in this environment was what the production workers chose to collect to assist them in addressing the important problems at each stage. Although attempts were made to transfer the statistical tools of TQM to the service environment, it was clear that they required considerable modification.[36] While TQM is now well recognized, there are concerns that there still remain basic conflicts with management theory.[37,38]

Into the nineties, the increasing importance of the knowledge industry became evident from the rapidly advancing capabilities of information technology and the complexities of the services that were being provided. In 1996, it was recognized that the element that had been largely ignored in these organizational concepts was the role of the professional. According to Quinn, this was most surprising because "the professional intellect creates most of the value in the new economy."[39] This, in turn, requires rather special forms of organization.[40]

Thus, there is a tremendous dynamism in the understanding and restructuring of organizations.[41,42] National culture can also have an important impact on the style of management and the nature of organizations.[43] There is considerable confusion and a proliferation of different theories and techniques that are often marketed as the solution to a particular organization's problems.[44] Such terms as "excellence," Management by Objectives, Management By Walking Around, Continuous Quality Improvement, Strategic Planning, Business Process Reengineering, downsizing, right-sizing, and restructuring have all had their advocates and detractors.[45] Many organizations have gone through such repetitive changes that they have lost their organizational memory and hence any resistance to such abuses.[46,47]

Overall, organizations are extraordinarily complex entities, and our understanding of them and their management is still in a state of considerable flux and con-

fusion. This applies particularly to the management and exploitation of information.[48,49]

Health Service Organizations

Health service organizations are particularly complex for a number of reasons.

- Health services are provided by a wide range of institutions, ranging from major specialty hospitals to a complex of community hospitals, small clinics, and individual professionals. These components work in conjunction with each other, forming network organizations that are much larger than each component.

- Public, not-for-profit, and volunteer organizations are often dominant in the health services arena. There are typically strong humanitarian values that may override commercial or financial objectives.[50,51]

- Professionals dominate in both the definition and the execution of the task. In some organizations, they also dominate in the management and the governance of the organization.

- The definition of the task and its objectives are in many cases very difficult to establish in advance. Often the task is related to such fundamental human questions as: What is life? What we can expect of life? How should we die?[52–54]

- The health system is undergoing fundamental structural change in most places in the world, with many countries following quite different principles.

The ever-advancing technology has prompted dreams of being able to quantify health service performance and outcomes, thereby enabling managers to manage clinical operations more effectively and enabling consumers to choose the best provider—a step toward a genuine health services market.[55] Previous research about organizational issues provide the antecedent to help us identify the relationship between visions and reality to manage this process.[56,57]

Individuals and Groups

The coffee machine and the computer have influenced twentieth-century organizational development because both mediate social relationships.[58] While there are many social relationships that we could include, we have selected three—motivation, culture, and leadership.

Motivation

Two theories—Field and Reinforcement—are relevant to understanding individuals and groups within organizations. Field Theory was established by Kurt Lewin, who focused much of his attention on motivation.[59] Field theory is primarily concerned with the purposes that underlie behavior and the goals toward or away from which behavior is directed. Lewin researched a wide variety of topics, including motivation of individuals, decision making both by individuals and in groups, group leadership, resumption of interrupted activities, level of aspiration, and how people interact with each other. Field theory establishes the need for active involvement of individuals within any change process. If people are actively involved, they will be motivated toward making the end effort a success. If people are not involved in the change process, they can and will resist because they might see the changes as detrimental to them personally.

Reinforcement theorists are from the discipline of psychology and focused their efforts on the motivation and conditioning. B. F. Skinner, a major reinforcement theorist, said that behavior can be reinforced either positively or negatively.[60] Some medical informatics implementations have used positive reinforcement techniques. One example is the design of training programs to meet physicians' needs. Training aids for physicians are prepared on 3×5 cards because most physicians are accustomed to keeping pertinent information in this manner. Another reinforcer is to have a clinically knowledgeable person (e.g., nurse, pharmacists, physician) to explain the system. Both of these steps help create positive reinforcers to meet physician needs. The positive training reinforcement will lead to a greater awareness of the system capabilities and acceptance of the system.[61] On the other hand, announcing a very lengthy training session at a time that conflicts with known medical timetables in the organization will lead to distrust of the system and will reinforce any negative perceptions that physicians may have acquired. Once a series of negative reinforcers begins in the system, there is a snowball effect on the new system.

Computers will be increasingly used to support clinical practice. When adopting and utilizing information technology are seen to enable and empower people and groups, people will support the system and its development. The issue is ownership. If the group members perceive that they own the problem and the solution, they will work with the developers to make the system work.[62–64]

Culture

The culture of an organization will draw upon the culture of the society in which it is set and the other organizations and individuals with which it interacts. Social anthropology is the study of how and why cultures are created and mediated within a society.[65] The

mediation can only take place through the application of a social structure and a communication process.

Every culture supports a political and social value system,[66] and these systems are used to create and define a social control system[67] to support and aid the organization in fulfilling its aims and objectives with regard to the political and social value system. Within a given organization, every individual will perform a given set of roles[39] that are derived from the aims or objectives of the organization and its social control system. Roles are only meaningful when they stand in relationship to, and interact with, other roles. A health care organization has a culture that is unique to that organization. The health care organization will have a given set of social and political power structures, roles, and languages that support that power structure. To successfully develop and utilize a significant information system, the change leader must examine how that information will change the work that is performed by the individuals within that system and the groups to which they belong. When developing information systems, we need to identify the group values that the information system is required to support.[67,68]

Leadership

A concept that has long excited and baffled the world, leadership remains as elusive today as it was in the sixteenth century, when Niccolo Machiavelli wrote *The Prince*.[69] Machiavelli saw success and failure for states as stemming directly from the qualities of the leader. Antony Jay states that today "success and failure for corporations also stem directly from the qualities of their leaders. Management techniques are obviously essential, but what matters is leadership."[70]

Early leadership research tried to discover the traits that differentiate leaders from followers, effective from ineffective leaders, and higher echelon from lower echelon leaders. One researcher reviewed 70 years of trait research covering approximately 280 published and unpublished studies and review articles and found that only five traits consistently correlated positively with leadership: (1) intelligence, (2) dominance, (3) self-confidence, (4) high energy, and (5) task-relevant knowledge.[71]

The debate over the value of leadership traits shifted to studies of what separates effective from ineffective leadership. These studies looked at the behaviors of leaders, the effectiveness of their leadership, and their situational leadership capabilities. The effectiveness of leadership research is based on the assumption that to be effective a specific leadership style should be used in specific situations. These theories typically treat leadership as an independent variable.[72–76]

Although there is a tremendous amount of research and many suggestions on leadership success traits or characteristics, experts do not agree on the definite traits necessary for success. What constitutes success is very dependent on the individual situation.

Management of Information Issues

Information has traditionally been managed through a combination of people's memories and a variety of paper-based systems that were limited in their capacity and convenience. The advent of information technology enabled substantial changes in work practices. The first applications were principally labor-saving ones—the replacement of tedious clerical tasks, particularly in areas of well-defined data such as finance.[77] People later found they could use the technology for providing new services, including organizational coordinating and integrating.[78,79]

Computers interact in complex ways with the organization and can significantly affect peoples' attitudes.[80–82] Other important factors are the relationship between the technology and normal information processes within an organization.[83,84] In particular, there are important differences between vertical and horizontal communications. The vertical communication relates mainly to the management control and accountability processes and was typically what managers sought first.[85,86] However, performance gains have been most notable when systems perform horizontal communications at the process level: linking activities together, supporting front line decision makers, and enabling the business to flow more efficiently. The types of system and the types of information handled by these two dimensions are typically very different, and inappropriate use of technology can be destructive.[87,88] The role of information technology creates a very complex picture.[89] Its impact is often immense and has an extensive impact on how organizations are operated and managed.[90] The key is to understand where information technology will be successful and what problems might be anticipated.[91,92]

Implementation

Few topics in information technology management have attracted more attention from both researchers and practitioners than implementing systems. This is not a simple, straightforward area to examine or discuss, because implementation covers such a broad variety of issues. Knowledge of implementation has evolved throughout the years, driven by less than ideal implementations experienced.[93] Because the field of inquiry is so large, relatively few common themes have emerged.

The role of people and organizational issues was heightened when it appeared that people issues were more responsible for implementation failure than the technical abilities of the system.[94–97] Viewed chronologically, implementation was initially identified as an organizational change project, and implementation leaders suggested that an "Unfreeze, Change and Refreeze" approach was important.[98] Later, larger organizational issues started to be identified as important. Some of these issues included: management support,[99] goals and objectives,[100] commitment to change,[101] and user acceptance, satisfaction, and attitudes.[102,103] Keen focused on the organizational change requirements and suggested that a small project or incremental approach would facilitate communication.[104] This has come to be known as the rapid prototype approach to change. Also, studies of packaged software found that organizational issues were as important as the capabilities of the software to complete the ultimate task requirements.[105] Users' perceptions of their organizational situations are also important, whether it is their perceived control[3] or their perceptions of how fairly they have been treated relative to others.[106]

Medical informatics researchers have also examined health care system implementations from the viewpoint of both the hospital or clinical systems[107–111] and the physician.[112–114] There is much room to delve further into implementing medical information systems, building upon the work discussed above and enhancing the methodological approaches for example, using both quantitative and qualitative methods.[115]

Social–Technical Implications

Computers are increasingly used within the workplace to support organizational, group, and individual activities. Introducing computers into an organization can be seen either as an enabler and empowerer of groups (with a consequent positive effect on the organization) or as a prohibitor, inhibitor, and disempowerer of individuals and groups (with a corresponding negative effect on the organization).[116]–[118] When the adoption and utilization of information technology is seen as an enabler and empowerer of individuals and groups, people support the system and its development. Again, the issue is ownership. If the group members perceive that they own the problem and the solution, they will cooperate with the developers to make the system work.[119]

Social–technological issues refer to the issues surrounding the interaction of the technology with the people using the technology to perform a task. This area has been studied by Management of Information Technology researchers over the past 20 years.[120,121] The focus is on how to facilitate the successful implementation, adoption, use, and positive outcomes of information technology in business organizations. Without successful and positive impacts of information technology at the user level, it is difficult to realize positive outcomes at the organizational level.[122]

User involvement and participation in system development and adoption were identified early as critical factors of system success.[123] The importance of user involvement has been supported empirically,[124] but some of the research has not been guided by well-defined theories.[125] This research stream has focused on the attitudes, intentions, and beliefs of technology users; these were seen as precursors of system utilization. It was assumed that higher utilization resulted in more and better performance impacts.[125,126] A number of important research streams drawn from psychology have guided work into understandings attitudes, intentions, beliefs, and behavior.[127,128]

In reviewing over 20 articles, Ives and Olson found that involvement plays a role in better defining user requirements, providing better understanding on how to use the system in the organization, avoiding inappropriate features, and enhancing the user's knowledge of the system.[129] Participation leads to increased user acceptance and use by encouraging realistic expectations, facilitating the user's system ownership, decreasing resistance to change, and committing users to the system.

The broad topics of user involvement and participation incorporate a variety of factors that can be categorized into three groups:

- **Cognitive.** These factors are the more rational ones and are the easiest to understand and measure. They include knowledge of technology, role in system development, experience, and other task and technology characteristics.
- **Motivational.** These factors try to get at the individual's motivational tendencies to use technology. They include interest, self-efficacy or confidence, and expectations of, beliefs about, and desire for technology.
- **Situational.** The last category refers to the factors that describe the individual's social system or environment. These factors include social norms toward technology,[130] facilitation conditions, role of system department, management expectations, how an individual is treated relative to others,[131] and the nature of user involvement.[132]

There have been a number of attempts to further refine and develop an integrative theory that can guide future work,[133,134] to further refine measurement instruments,[135] and to understand the process of user involvement.[136,137]
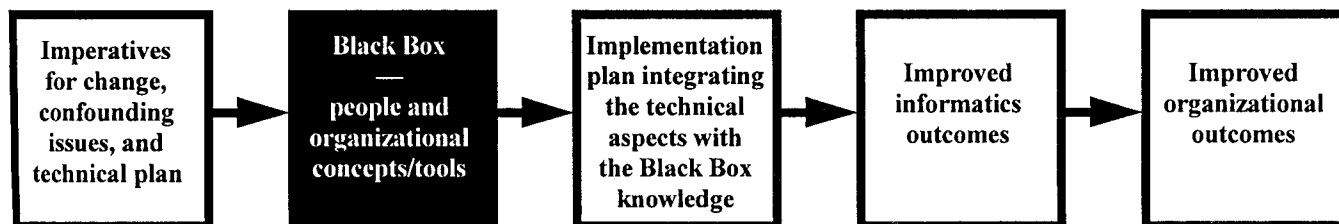
Figure 2 Relationship of the black box to the overall implementation process.

User acceptance of technology research grew out of the user involvement research and some of the criticisms about its theoretical underpinnings. User acceptance research focused on perceived ease of use of the system, the perceived usefulness, and how these perceptions affect the user's acceptance of technology. Usefulness was found to be a very important predictor of system use intentions.[137–139] This research targets a sub-set of the variables in the user involvement research. Cyert and March[140] clearly outlined how user involvement works within an organization. They explained how conflicts developed between users and developers and then what processes were used to resolve the conflicts. Medical informatics researchers have adopted these scales to measure physicians' attitudes toward adopting technology.[141]

User satisfaction is a set of factors that measure the users' attitudes of satisfaction with their information technology. These factors include system-specific factors (e.g., the quality of the data) and service quality factors. User satisfaction has enjoyed widespread use both in academia and in industry[142] because user satisfaction is viewed as a proxy for the overall success of information systems and, more tenuously, positive organizational outcomes.

Recent attempts at frameworks to categorize past work and suggest a causal relationship between information technology and organizational success are important first steps in guiding future information systems research, but the frameworks themselves remain largely theoretical or theoretically eclectic.[143] It is not surprising, then, that research into causal understanding of information technology success has been decidedly mixed.[125,144]

Two popular User Satisfaction surveys include the instrument produced by Ives, Olson, and Baroudi[145] and the Bailey and Pearson[146] instrument that measures a wide variety of constructs theorized to be important. Enhancements to the work by Ives and Bailey have been used in medical informatics research.[147–149]

Usability of technology refers to the human factors that impact the user's ability to work with the system. These directly affect the usefulness and ease of use of the system. The increase in systems based on the

Graphical User Interface (GUI) provides much more power and flexibility to system developers. How developers present information and control system use has tremendous impacts on the users. Usability research has a long history of studying the human–machine interfaces, but it is a relatively new field for information technology. The GUI interfaces have provided many opportunities to develop systems that are not intuitive and thus are more complex than earlier character-based system interfaces. Researchers have identified a number of fundamental issues that technologists should know.[150] Several books are available that offer practical advice for designing user interfaces.[151,152]

Implications for Informatics

Effective change requires that the proposed technical plan—plus the information about both the current situation and the historical perspective—be filtered through the black box of knowledge that is derived from the referent discipline areas of sociology, psychology, business, organizational development, etc., as shown in Figure 2. Effectively incorporating the Black Box concepts and tools can improve the design and implementation of systems, the acceptance/use of the systems, the management of the change process, and the management of the altered organization after the technological changes are implemented. This in turn leads to improved informatics outcomes and improved organizational outcomes.

Core Principles

Many past and current organizational gurus have advanced their systems for implementing the black box, and many of these systems have worked rather well for those organizations that have made a true commitment to implementation. However, management is often guilty of seeking "Band-Aid" solutions that can work magic without the painful costs of cultural change in the organization.[153] Also, some of the gurus' disciples are often not as competent as the gurus are in communicating the complete message of the changes required.[154,155] Following a poorly communicated or poorly understood prescription often leads to

unwanted side-effects, leaving the organization at a loss as to what to do. By the time the leaders discover that the prescription is not working—and perhaps is even toxic for the organization—the organization may require heroic measures for survival.

Lorenzi, Riley, Ball, and Douglas outline a set of core principles underlying most of the various managerial systems that have been espoused in recent years.[20] These principles, rooted in the social sciences and behavioral research, form the underlying structure or guides to more effectively managing change.

Vision Oriented

In any change effort, it is crucial to establish a vision that sets the direction. Without a clear direction, the organization tends to "throw resources" at the issues until its resources are depleted. In a dynamic environment, the vision may well alter over time because of the external imperatives for change and the internal responses. However, a well-defined and communicated vision gives the people in the organization a context that helps in understanding the probable directions of change and the desired outcomes.

Information technology leaders must be vision oriented, and their responsibilities include educating top management as to the opportunities that information technology offers the organization as well as the strategic issues that information technology must address. Medical informatics leaders must clearly define the vision and effectively communicate it to all the stakeholders who may directly or indirectly be affected by the vision.

Respect for People

A cornerstone of all interpersonal transactions is treating people with respect through honesty and trust. All the other principles, in turn, follow and enrich this basic respect. This principle includes issues such as how information is presented to the stakeholders, how people are incorporated within the change process, and so forth. Respect must be given to all the people within the organization regardless of their diverse backgrounds, educational levels or disciplines, hierarchical levels, or ethnic groups.

Involvement

For people to embrace change, they must be actively involved in the change process, not merely informed of it. A major involvement aspect is the aggressive seeking of inputs at the earliest possible stages of the overall process. Further, there needs to be continuous feedback on the status of the inputs and detailed explanations of why some inputs cannot be utilized or implemented; i.e., the inputs must be treated with respect.

Empowerment

People must be empowered if they are to move beyond involvement to the next stage, commitment. True empowerment often enables a significant flattening of the organizational structure, effectively eliminating some traditional middle management positions, which can in the short run contribute to insecurities about what empowerment really means.

Teamwork

Another core principle is people working together to make change happen. In today's complex organizations, changes affect far more than just one job or one area; therefore, high degrees of teamwork are needed. The use in many organizations of self-directed work teams is an integration of the empowerment and teamwork principles. This also means actively investing in people at all organizational levels to develop their skills. The teamwork must be not only among the decision makers, but also among people at all levels of the organization.

Customer First

The customer must come first. This principle places the customer in a central position and requires those inside the organization to shift from their traditional internal perspective and view the organization from the external or customer point of view. According to Price Waterhouse, "Serving customers is a powerful common denominator in your organization; customers are the raison d'être of the organization. Their needs, rigorously examined, should dictate change."[156] Once employees feel comfortable with themselves, it is only natural to refocus the thinking of the organization to determine what its customers need.

Openness to Change

All prescriptive programs imply that a system and its people must be open to change. This cannot happen in a closed and highly structured bureaucratic system. In our traditional systems, stability has been viewed as the norm, with change being a temporary deviation from that norm. However, as modern chaos theory tells us, complex systems thrive only close to the edge of chaos. Our organizational cultures must accept that change is the norm and stability is the deviation. Further, this openness to change must be at the emotional or "gut" level, not just at the intellectual level.

A Memory Aid

This section has outlined seven core principles for effectively managing change. When planning for an information systems change, it is helpful to think of the word "victory." However, in this case, the word is

spelled, "victore"—**v**ision, **i**nvolvement, **c**ustomers, **t**eamwork, **o**penness, **r**espect, and **e**mpowerment!

Strategy

While many health care organizations are facing generally similar issues and situations, no two institutions are precisely alike. The strategy that each institution develops must meet its particular needs, goals, and culture. The knowledge from the various black box disciplines must be selected and applied to maximize the probability of success in the specific organization. Using the guiding principles as a base, the change leaders must develop an effective strategy. Based on the antecedents of the people and organizational issues, the organization's strategy must encompass five major areas: (1) clarification of organizational direction, (2) design strategy, (3) implementation strategy, (4) evaluation strategy, and (5) diffusion strategy.

Clarification of Organizational Direction

Any information technology change strategy must focus on the specific desired outcomes for the total organization. Therefore, those responsible for information technology changes must make every effort to: (1) ensure that they and the overall organization's plans and needs are the same, and (2) educate the overall organizational leaders on both the potential opportunities and the potential threats that stem from the information technology efforts within the organization. The best practice is to seek input and information revolving around the seven guiding principles. What is the vision for the change? What are the true needs of the customers? How will all of the stakeholders be actively involved—or at least represented—in the process? How open is the organization to change?

Design Strategy

To meet its current and future information needs, the organization must be willing to invest the appropriate economic resources into the technology, the infrastructure, and its people. A seemingly elementary but quite key issue in systems design is whether the proposed system will indeed enable the organizational changes required. Does it have the necessary features, flexibility, and expandability to support the necessary organizational changes, or will it leave the people feeling that they are trying to extinguish a forest fire with a garden hose? Another key issue is the management of expectations. It is often easier for the person responsible for designing the information system to "promise the moon" either to gain support or to avoid conflict at the design stage. Similarly, it is often tempting to understate the costs to the end users in terms of training time, changes in daily routines, etc. Finally,

the organization must actively involve its stakeholders in the overall system design or selection process.

Implementation Strategy

A best practice implementation plan has the traditional technically-oriented financial, training, and project management components. The plan must also include an effective change management plan that involves the relevant people and organizational issues and incorporates the seven core principles into the total process. There must be an economic investment in the people-side of technology transfer. The organization needs to continue to manage the expectations of both the organizational leaders and the end-users as an important component of success.

Evaluation Strategy

Evaluation strategy is concerned with two areas. The first is the implementation process itself and whether it succeeded. What changes could be made in future implementations? The second is the outcome of the new system: namely, will it help the organization accomplish its overall desired outcomes? All of the best practices that we know have included the collection of baseline data about the attitudes and perceptions of the end users to compare with follow-up information. These comparative data can be used to help map the organization's diffusion strategy and can also be a baseline to view the total organizational changes.

Diffusion Strategy

The complexity of health care organizations often makes it impossible to bring up new information systems simultaneously throughout the organization. Therefore, informatics systems must be implemented or "diffused" throughout the entire organization according to a specific strategy. Those organizations with the best practices have looked beyond the current implementation (evaluation strategy) to determine the phases and strategies for the diffusion of informatics process and technologies throughout the enterprise.

Tactics

Tactics are the processes that implement strategies. How do we achieve the desired outcome? What are the appropriate tactics from the black box that will be right for the current environment? Tactics include a variety of areas. Several people and organizational issues areas are: communication and involvement processes, design processes, change management practices, project management processes, training, and evaluation processes. One goal is a better, more effective, less painful implementation process as well as greater acceptance and use of the new information

Table 2 ■

Sample Tactics and Processes for Implementing Change

Tactics/Processes	Positive Impacts
Communication and involvement	More involved staff
	Better understanding how the changes will impact the organization
	Better knowledge of the changes
	Better ability to cope with the changes
Design process • Process reengineering • Quality management efforts • Responsibility modeling • Site visits • Vendor demonstrations	Better systems design More effective work processes
Change management • Design of the change structure/process	Less stressful organizational change Smoother implementation Better acceptance of the changes Better management of the altered organization
Project management	Better implementation of systems
Training • Demonstrations • One-on-one • Classes • Discipline-specific examples	Better use of the new system Better management of the altered organization
Evaluation • Surveys • Interviews • Observations	Determination of actual vs. expected systems outcomes Input data for process improvements in future implementations

system. There are many tactics available. Table 2 outlines a sample of some current common tactics and the type of outcomes they are designed to produce.

Just as different organizations require different strategies, the same is true for tactics. Specific choices of tactics depend heavily upon the particular organization's needs and culture.

Summary

Positive outcomes come to health care organizations that are doing the right things well; that is, their organizational strategies are aligned with their environments, and they are executing those strategies well. Likewise, the informatics strategies must also be aligned with the organization's strategies. Without this congruence, informatics does not have the poten-

tial to have a substantial positive impact on the overall organizational outcomes.

The execution of the informatics strategies must also be exemplary; however, the change processes required for achieving the desired informatics and organizational outcome goals are demanding and complicated. Implementing them in extremely complex organizations that operate on a 7-day by 24-hour basis is not easy. However, we are constantly learning more about complex change processes and the ways we can better manage them to improve our needed informatics outcomes. The challenge is to build upon the existing research base to move us even further ahead.

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