Case Report ■

Use of the Equity Implementation Model to Review Clinical System Implementation Efforts:

A Case Report

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Abstract This paper presents the equity implementation model (EIM) in the context of a case that describes the implementation of a medical scheduling system. The model is based on equity theory, a well-established theory in the social sciences that has been tested in hundreds of experimental and field studies. The predictions of equity theory have been supported in organizational, societal, family, and other social settings. Thus, the EIM helps provide a theory-based understanding for collecting and reviewing users' reactions to, and acceptance or rejection of, a new technology or system. The case study (implementation of a patient scheduling and appointment setting system in a large health maintenance organization) illustrates how the EIM can be used to examine users' reactions to the implementation of a new system.

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Advances in information technologies present challenges and opportunities to organizations. To remain competitive in today's marketplace, organizations must identify and harness new technologies to improve productivity. Such efforts may include streamlining operations, enhancing operational efficiency, cutting costs, and reducing cycle times through an appropriate application of information systems and technologies.

In view of recent consolidation of health care organizations and the intensification of competition among them, medical organizations are under increased pressure to improve productivity. The effective implementation of information systems and technology can improve productivity through reduced costs, better control over operations, better coordination, streamlined processes, increased throughput, reduced lead times, and more efficient organization of the workplace (see, for example, Applegate et al.[1]).

Harnessing the new technology is not easy, however. There are many obstacles to the implementation and effective utilization of technology. Attempts at implementing information technology in organizations have resulted in widespread failures on account of behavioral problems involving users.[2–4] While technical problems can be solved with additional resources or outside expertise, there is frequently no easy solution to end-user resistance. Often, too, the source of these problems is not properly understood by implementers. In summing up research on the implementation of medical information systems, Anderson[5] notes that "several decades of experience with computer-based information systems make it clear the critical issues in the implementation of these systems are social and organizational, not solely technical." Researchers have generally favored user acceptance of systems as a key criterion for their success.[6] Successful implementation has been explained by having the right factors, as well as employing the right process.[7–9] In medical settings, the same phenomenon of failures mixed with success is also evident. In a recent review of physician order entry (POE),[10] a familiar theme is espoused:

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> While the logic of eliminating the middleman through POE is easy to comprehend, actual implementation of POE is more difficult than one might imagine. A small number of institutions have had success, but the vast majority of institutions that attempted POE, as well as corporations that have attempted to sell POE, during the 1970s and 80s met with failure of varying degrees.

More recent research shows continued commitment to these systems.[11] Implementation success continues to be problematic,[12] with user resistance and staff interference as major factors in implementation failure.[13]

Success of point-of-care systems[14] and document imaging[15] attest to the viability of using computing to enhance the health care setting. However, according to a 1993 survey by the Healthcare Information and Management Systems Society (HIMSS),[16] opinion is less than positive concerning widespread usage of computing in health care, especially for nonadministrative functions. Nearly half the survey respondents thought that computer-based medical record systems would not be implemented before the turn of the century, if at all. Negative attitudes, resistance, and high turnover have been associated with medical information systems implementation.[17,18] Similar results have been reported by other researchers, such as Anderson.[19]

The paucity of success and the abundance of failures have set medical information researchers looking for explanations. These include causal models (e.g., nurses' use of bedside systems, as reported by Dillon et al.[20]), patterns of professional relation among physicians,[21] communication networks among physicians,[22] key factors such as broad and committed involvement by clinicians (e.g., usage of POE as reported by Weir et al.[23] and usage of ambulatory electronic medical records as reported by Krall[24]), and attitude change (e.g., use of medical expert systems as reported by Gardner and Lundsgaard[25]). These models have helped identify relevant issues, presented likely explanations of implementation difficulties, and aroused the attention of researchers to this interesting area of inquiry.

The objective of this paper is to introduce an equity implementation model (EIM) into the medical informatics literature. We illustrate the potential for EIM analysis to provide insights into implementation difficulties through the application of the EIM to a case —the installation of a medical appointment scheduling system in a health maintenance organization (HMO) setting. We use the case to illustrate the potential usefulness of the EIM for analyzing and identifying areas where the new technology may have affected users' work environments.

Although the EIM is grounded in theory, it has not undergone validation through controlled studies, and it does not qualify as a quantitative predictive model. It provides a means for retrospective explanation of system implementation events. In addition, it provides insights that may serve as useful heuristics for those responsible for planning system implementation. The model embodies three levels of analysis, involving changes users must make in their job performance to use a new system as well as system benefits and outcomes.[26] The model helps us understand users' resistance to or acceptance of a new system. Experience using the EIM might help system implementers anticipate users' concerns and possible reactions to a new implementation.

Overview of the Equity Implementation Model

The EIM provides an understanding of issues useful in determining users' acceptance of or resistance to a new system, technology, work practice, or other change in their work environment.[26] It is based on equity theory, which has a sound, well-established theoretic base with support from hundreds of studies in laboratory and field settings (see, for example, Walster et al.,[27] Greenberg and Cohen,[28] and Miles et al.[29]). The EIM is based on the assumption that there is no fundamental or irrational resistance to a change. Each change is evaluated as being favorable or unfavorable by each individual affected by it. On the basis of equity theory,[27] the EIM embodies a three-level framework for evaluating the effects of a change resulting from the implementation of a new technology or system. Table 1 summarizes the details of analysis for the three levels.

The first level of analysis deals with the changes from the perspective of a user. Individuals are generally concerned about how system implementation will affect the skills, effort, and education they need to perform their jobs; the fairness of the social-engendered changes in the overall social setting; and what benefits they each derive from the exchange, e.g., salary or satisfaction. Users will assess the changes brought about by a new system in terms of how they value each aspect of the changes. If the net change in equity status (''perceived benefit'') is viewed as favorable, the system will be welcomed. Otherwise, the new system will be resisted. The important issue at this level is the nature of the factors that are relevant to users who are making such judgments and how implementation affects these factors. The EIM identifies possible user stresses and benefits that may be affected by the implementation of a new information system. (Notice that, in the original formulation of the EIM, the terms

Table 1 ■

Three Levels of Analysis in the Equity Implementation Model

Level of Analysis	Focus	Criterion
Level 1	Change in equity status of the user (self)	Net change in equity status = change in benefits weighed against user stresses
Level 2	Comparison with the employer	Perceived outcome for the user compared with perceived outcome for the employer
Level 3	Comparison with other users	Perceived outcome for the user compared with perceived outcomes for other users

NOTE: Perceived outcome indicates the net change in equity status.

''inputs'' and ''outcomes'' were used instead of ''user stresses and benefits.'' Inputs are not necessarily negative and outcomes are not necessarily positive.) Table 2 summarizes possible changes in users' stresses and benefits that have been identified in the literature.[26,32] Previous research concerning implementation, such as that of Bailey and Pearson[30] and Ives et al.,[31] focused on user satisfaction. Joshi[32] showed that equity perception explained more variance than factors previously identified in the user satisfaction studies. In addition to considerations of changes in users' own stresses and benefits, the users may also be influenced by changes in their unit's or department's user stresses and benefits. Thus, issues at the work-group level may also be relevant at the first level of analysis as well as at the second and third levels, which are discussed below.

At the second level, the EIM examines fairness in relation to the employer in sharing the gains or losses brought about by a change (''perceived benefits''). Therefore, changes in the perceived benefits to the user are compared with changes in benefits to the employer. Perceived benefit for a party encompasses changes in benefits as well as the deservingness of the party based on user stresses, merit, or other criteria. In the analysis at the second level, the EIM evaluates the effects of system implementation on the employer and examines whether the terms of exchange have become more pronounced in favor of the employer. Employees who participate in implementing such changes expect the benefits to be shared with them. They would judge the change to be negative if the employer benefits at their expense, increasing their effort or stress, for example.

Table 2 ■

Possible Changes in User Stresses and Benefits Because of Implementation

Benefits	Stresses
Possible increases:	
More pleasant work environment	More work to enter data
Less tension, more job satisfaction	More tension
More opportunities for advancement	Need to bring higher-level skills to the job
Better service to customers	More effort to learn new system
More recognition, better visibility	Assignment of additional tasks
Salary increase, grade increase, or higher-level title	More effort to perform tasks in view of increased monitoring
Increase in power and influence	Need to spend more time on tasks
Learning a marketable skill	Fear of the unknown, e.g., failure, and the resulting anxiety
Reduced dependence on others	
Increased usefulness of the system	
Possible decreases:	
Reduced job satisfaction	Ease of use
Reduced power	Less effort
Reduced bargaining power relative to the employer or others	Less searching for solutions or information
Threat of loss of employment	Less manual effort
Loss of value of marketing skills	Less cognitive effort
Reduced importance or control	Less rework, because of fewer errors
Increased monitoring	
Reduced scope for advancement	
More role conflict and ambiguity	
Potential failure in learning and adopting the new system	

NOTE: Adapted from Joshi.[26]

Finally, at the third level of analysis, the EIM compares changes perceived by individual users with the effects of implementation on other users or user groups in the organization. The individual user is viewed as comparing changes in his or her benefits with those of other users in the organization. Departmental affiliation may also provide a frame of reference for comparing the changes in the benefits to one user's department with benefits to users in other departments. At the third level of analysis, the EIM provides an opportunity to examine the relative impact of the technology on different departments or users in the organization. Often, empowerment can be thought of as a level-three gain, because it implies reduced dependence and greater autonomy, which translates into greater power compared with others.

The model suggests a basis for developing a better understanding of users' reactions (ranging from system acceptance to system resistance) to the changes brought about by a new technology or system in their work environment. It can also serve as a useful framework for analysis to help identify and assess the effects of changes on users' work environments, such as changes in communication patterns, organizational structure, and the reward system. The three levels of analysis help identify issues relevant to users in examining a change. For a particular user or user group, and for a particular implementation, one level may assume a greater importance than the other two. After presenting the following case study, of the implementation of a medical appointment scheduling system, we use the EIM to examine the effects of changes on users.

Implementation of a Medical Appointment Scheduling System

This section describes the implementation of a computer-assisted appointment scheduling system package called Cadence (Epic Systems Corporation, Madison, Wisconsin) in three medical centers of Exelcare, an HMO in Michigan. Each medical center has approximately 12 medical departments, which are staffed by about 28 physicians and 50 support personnel. The health centers service a total of 45,000 patients per year. To develop the case, we asked an administrator working for Exelcare to participate in a two-step process. In the first step, she wrote a retrospective description of the implementation of the Cadence system, which included descriptions of the functionality of the system, the different populations of users, and their reaction to the implementation (whether they resisted or accepted the system). In the second step, she analyzed the implementation from the standpoint of the EIM to see whether the model could adequately describe underlying events and be used to analyze the resistance or acceptance of users. Specifically, she sought evidence to relate each of the three levels of the model to the reactions of the different user groups. She also provided information about steps the implementers took to lessen inequities or the perception of inequities.

The system handles the patient scheduling options required in a multidisciplinary medical health center environment. It also accumulates the data necessary for decisions about professional staffing, patient profiles, and financial trends. Standardized reports are accessible from the system via menues. Additional modules such as ad-hoc reporting, medical record management, accounts receivable, and word processing were under consideration for future implementation.

The software was installed on VAX machines (Digital Equipment Corporation, Maynard, Massachusetts) located in Exelcare's central administrative offices. The health centers access the system via digital communication lines. Additional hardware, including CRTs, printers, and mainframe equipment, was required as part of the system installation. This new equipment was installed throughout each health center, in the centralized appointments office, and in the administrative offices.

Implementation Strategy

A special task force was created to oversee the implementation of the system. The team members included Exelcare's upper management, health center management, appointment scheduling staff, and MIS representatives. Other users were consulted when needed. The MIS vice president was the initial leader of the implementation team. However, after a few months, the responsibility was assigned to a systems project leader because of personnel changes and matters of system expertise.

The system was implemented in phases. During the first phase, the smallest health center was chosen for implementation of advance appointment scheduling, which provides for appointment scheduling about six weeks in advance. In the next phase, advance appointment scheduling was implemented in the two other centers, with a gap of one month in each case between implementations. Six weeks after the first implementation, ''same-day'' appointments were also implemented in the first center and then, after one and two months respectively, in the other two health centers. The phase-in allowed medical staff to adjust to the new system and to develop suitable changes in

various procedures in response to the automation of appointment scheduling.

Employees were trained to use the system in small groups of six or seven at a time. They were given an opportunity to use the system individually in training sessions, and additional time was set aside for individual practice. Users were also paid for overtime, and a free lunch or dinner was provided when needed.

Users Affected by the Implementation

Several groups of employees were involved in implementing the system, including schedulers, receptionists, nurses, appointment supervisors, medical records clerks, and MIS staff. A brief description of the roles and functions of each employee group follows.

A central scheduling department was created as part of the new system implementation. Volunteering staff members were selected from each health center and moved to the major administrative center to form the new department. These individuals already had an understanding of the scheduling process and a general knowledge of health center operations. Patient calls for appointments are routed to the central scheduling department. Patient data are keyed to a medical record number and name, which allows the scheduler to retrieve patient details and schedule the appointment.

Center receptionists are located at each health care center and perform typical receptionist functions. They handle patient check-in and may schedule or modify appointments. Thirty-five departmental receptionists are employed throughout the organization. They are also responsible for verifying HMO membership for billing purposes.

Nurses are responsible for scheduling same-day appointments. They have the latitude to decide whether a patient should see a physician immediately. They can schedule an appointment in a vacant time slot, overbook a time slot, or schedule an appointment beyond a physician's normal working day.

An appointment supervisor was assigned to each health center to oversee the scheduling operations of the center. The supervisor's responsibilities include maintaining the physician's schedules, maintaining the staff database, updating the system to make appointment changes, calling patients to reschedule appointments, training new scheduling staff, and maintaining quality scheduling procedures and practices.

Ten medical records clerks are responsible for retrieving and filing medical records from records storage for the scheduled patients before and after their appointment.

MIS Staff Involved in Implementation

In addition to users from different functional areas, the jobs of various MIS staff members were also affected by the new system. Two main areas of responsibility that were affected by implementation are discussed below.

The MIS staff was located in Exelcare's administrative offices. The analyst was responsible for providing systems support and overall maintenance of the Cadence system's four databases. As a consequence, the analyst had to learn the system in depth and develop comprehensive knowledge of the new package. The analyst leader was also responsible for initial user testing and training activities. As the main support person responsible for the scheduling system, the analyst leader was also required to act as a liaison between users, MIS operations staff, and the package vendor. Initially, the analyst served as support staff. After some time however, the entire responsibility for implementing and operating the system was assigned to the analyst as a full-time activity.

The operations department was responsible for the day-to-day operation of the system. Its responsibilities included performing the nightly reporting and printing tasks of the Cadence system. This department also extracted patient eligibility data from the claims system module of Exelcare's main processing system to update the scheduling system daily.

Analysis Using the Equity Implementation Model

To assess the implementation and examine its effects on different employees, interviews were conducted with users and MIS staff. Responses of each employee group are discussed and then analyzed using the EIM.

Before the implementation of Cadence, management had decided to maintain current staffing levels. Therefore, no additional hiring or laying off of existing staff was permitted. Establishment of the centralized scheduling department necessitated staff redistribution, however. A high level of resistance to the system installation was evident as the implementation progressed. The affected users had a limited knowledge of computers and expressed their fear and distrust of computers in general. Senior health center management, also unfamiliar with computer usage, did little to ease this fear. "Selling" of the appointment scheduler and its potential benefits to users as an operations

Table 3 ■

Changes in User Stresses and Benefits for Different User Groups and MIS Staff

	Central Schedulers	Center Receptionists	Department Receptionists	Appointment Supervisors	Nurses	Records Clerks	MIS Operations Staff
Stresses:							
Learning computer skills	+	+	+	+	+		
System crashes, lack of trust in computer data	−	−	−	−			
Fear of job loss	−	−					
Early preparation of physicians' schedules					−		
Increased coordination with users							+
Less responsiveness							−
Printing problems							+
Benefits:							
Moving close to home and shopping	+						
Fewer distractions	+						
Less exposure to illness	+						
Increased skills	+	+	+	+			
Responsiveness to patients		+					
Having current information		+	+				
Other tasks easier			+				
Recurring appointments easier			+				
Patient waiting list			+				
Scheduling across centers			+				
Standard physician work schedules				+			
Ease of rescheduling				+			
Appointment book searches					+		
Getting patient charts					+		
Ease in pulling patient records						+	
Ease in distribution and tracking of records						+	
Learn new system							+

NOTE: Plus signs indicates increase; minus signs indicate decrease.

management tool was left to the MIS staff. Thus, there was no overt support for user functions from the senior management. The MIS staff ''sold'' the system and promoted user acceptance through user training sessions and small-group presentations.

First-level Analysis

The positive and negative changes in user stresses and benefits for each user group are summarized in Table 3.

Central Schedulers

The centralized schedulers were already employed as schedulers for the HMO but had been located at different health centers. Final selection was made from a pool of volunteers who wanted to transfer to the new department. Many cited closeness to their home and the proximity of a shopping mall and other shopping areas as reasons for their willingness to transfer.

Initially, the central schedulers were apprehensive about learning and adapting to the new system. Since none of them had computer skills and all were proficient in manual scheduling, they were somewhat resistant to the new system. They felt it would require more work and take more time, which would result in frustration for them and their patients. They were also apprehensive about the validity of the data from a ''sister'' system, which provided the scheduling system data, and about the reliability of the computer system in general, particularly the possibility of system crashes. Finally, they expressed a fear of losing their jobs, since they believed that computerization would lead to a need for fewer employees.

Since the implementation, however, central schedulers have developed proficiency in the system and are extremely pleased to be at its ''hub.'' They also feel that they have entered the high-tech age with their new skills.

When questioned about the new system, they all agreed that the advantages of the computerized system outweighed the disadvantages. Among the advantages they mentioned was a more pleasant work environment. The centralized scheduling department is located in a separate room in the back of administrative offices. Each scheduler has his or her own cubicle. Previously, these employees had worked at the reception desks of either a health center or a specialized department in a health center. They had been constantly exposed to sick patients, many of whom were crying children. Because of the new system and their relocation to the ''back room,'' they were less tense and less fearful of becoming ill themselves. They also felt that they could provide better service to the patients because of the fewer distractions.

The only criticisms of the change were that they had received no pay increase for the increased skill level and they had less visibility since they were tucked away in the back room. They also expressed some fear of the increased monitoring capabilities of the system.

It appears that, subjectively, central schedulers experienced a net gain in equity. Their initial apprehension can be attributed to their inability to foresee the gains in their benefits due to the new system and their overestimation of increases in user stresses that stemmed from learning and using computer-based systems. The main increase in benefits at this initial stage was proximity to home and easy access to shopping, which prompted them to adopt the change. However, after learning and actually using the system, their assessment of net changes in user stresses and benefits was more favorable.

Center Receptionists

Most of the 20 center receptionists were very apprehensive about the new system. These users were very proficient in manual scheduling. A commonly expressed expectation was that a change to computerized scheduling would require more effort, take more time, and result in additional work in gathering patient information. One receptionist summed it up in this manner:

> The lines of patients standing in front of my desk are already long, and now you're asking me to make appointments, check patients in, verify their phone numbers and addresses, plus handle incoming calls! And we're not getting any more help! Just what I need, more work! More stress!

Although most receptionists had similar sentiments, after the system was implemented, they expressed more confidence in it and more job satisfaction, because of patient acceptance and general enthusiasm for the new system. Receptionists indicated that patients feel that the move to computers equates to high technology and means improved patient service and care. As the receptionists developed proficiency in using the system, they reported that they were able to provide better service to the patients. They also felt that they received more recognition for their increased skills. In spite of this, they had many of the same criticisms of the changes as the central schedulers, which included increased monitoring and no additional pay for the higher-level skills that they brought to the job.

The reactions of these users can be reviewed using the EIM. Initially, these users were very apprehensive about the new system because of their estimation of learning difficulties and anticipation of problems serving patients in a timely manner on a new, unfamiliar system. However, their apprehensions melted way when they found the system easy to learn and use (i.e., it required fewer user stresses). After the installation of the new system, the receptionists had to enter fewer changes in patient data, because the database kept up-to-date information—a clear decrease in user stresses. The benefits to these users also increased, because of improved service to patients, greater patient appreciation, and improvements in other conditions that enabled them to enhance their job performance. Some increase in user stresses was experienced because of the need for higher-level skills. However, there was, on the whole, a net increase in benefits. Thus, initial user apprehension and an eventual favorable response after using the new system are important aspects that can be represented in the EIM.

Departmental Receptionists

The feelings of the departmental receptionists, as a group, about the new system changes were nearly identical to those of the center receptionists. One significant reduction in user stresses was easy access to current patient membership data and phone numbers, which was considered a ''great advantage.'' In addition to updating appointments, these users were also responsible for daily verification of HMO membership for billing purposes. Under the new system, their jobs were made significantly easier by direct online access to the relevant patient data in the screen header area. Another advantage cited in the departments was the ease of scheduling recurring appointments. For instance, regular weekly or monthly appointments—e.g., for allergy injections or for obstetric visits throughout a pregnancy—could be automatically scheduled by the system without the departmental receptionist paging through reams of paper as before. This was viewed as a real time-saver. Other significant

advantages of the system implementation included the ease of maintaining a patient waiting list and scheduling from it; the system's ability to display pertinent scheduling information, such as location records for physicians who maintain schedules at the different health centers; online procedure instructions for the schedulers as well as the patients; and the ability to schedule across centers when necessary.

The departmental receptionists' complaints about the system included additional tasks to perform, system crashes, doubts about the reliability of information, and the increased possibility of monitoring. Although there was an increase in some user stresses, these were overshadowed by increases in benefits and decreases in other user stresses. Although increased monitoring could have developed into a significant issue, management did not decide to use the information in the system to pressure employees. Thus, on the whole there was a net gain in equity because of increases in benefits and decreases in user stresses, which is consistent with the departmental receptionists' eventual favorable reaction to the new system.

Appointment Supervisors

Initially, the predominant feeling among the appointment supervisors was apprehension about the new system. These supervisors generally had not used computers previously. The new system required that they obtain physician schedules in advance and maintain them on the system. It was difficult to obtain physicians' schedules in a timely manner. Moreover, physicians' schedules were also constantly changing, largely because of emergencies. After the implementation of the new system, appointment supervisors' requests for physicians' schedules in a timely manner were backed by Exelcare's Chief Medical Officer. The CMO standardized the physician work schedule format and set deadlines for turning them in. The supervisors felt they would not need to ''nag'' physicians to get the needed information in a timely manner to get their jobs done. One supervisor commented:

> There is more work in entering the physician schedules, and the tension created from possible mistakes or frustration due to my lack of knowledge is aggravating. But I'm getting better. And when one of the doctors changed his schedule last week, the canceling and rescheduling of the patients was a breeze. I think I'm going to like this system after all.

These supervisors were also given extensive training and responsibility for developing procedures to train their staffs and for meeting the goals set for them by the corporate offices. After implementation, their enthusiasm for the system increased when they found top management actively supporting the new system.

Initially, supervisors were generally noncommittal about the new system. However, after their training and experience with the system, they accepted it and were enthusiastic about using it. Increased benefits included the new skills they obtained and the overall improvement in scheduling through standardization of physicians' schedules. Their user stresses declined, mainly because of ease of use and easier handling of schedule changes. There was thus a net increase in equity, and this group expressed a favorable reaction to the new system.

Nursing Staff

The nurses were very skeptical of the system when first informed about the implementation. ''We're nurses, not computer people.'' This group of approximately 20, although initially resistant to the change, was later impressed with their ability to access online information about patients. They no longer had to search for the appointments book, and getting the patient chart from medical records had become ''a button-push away.'' These two advantages decreased their dependence on others, which in turn translated to better service to the patient. Thus, on the whole, their net equity increased because of fewer user stresses and less dependence on others, resulting in favorable attitudes toward the system.

Medical Records Clerks

System implementers had not considered it necessary to train records clerks, because they did not schedule appointments. These users were not contacted prior to implementation. After implementation, they cited the following increased benefits and reduced user stresses: medical records retrieval lists could be generated online (sorted and printed in the same order that the medical records are filed) from the schedules by department, either for the entire day requested or for individual updates only; the new ability to track medical records by the date, department, and physician to whom a medical record was delivered; and, the capability of the system to identify duplicate medical records for the same patient and merge them. The clerks' main gripe was that they did not receive the extensive training, overtime, and ''free meals'' that the other groups received.

Overall First-level EIM Analysis

Overall, the analysis at the first level of the EIM suggests that, even though there were some increases in user stresses, for most users there was a net gain in

equity as increases in benefits and reductions in user stresses outweighed any loss of benefits (e.g., the possibility of increased monitoring by supervisors) and increase in user stresses (e.g., more skills required for the job). In fact, the learning of new, computer-based, marketable skills was viewed by most employees as an important increase in net benefits. Users' increased self-confidence from mastering new skills was noticed by some managers. After the completion of implementation, users were, on the whole, very satisfied with the new system and its favorable impact on their jobs.

MIS Staff Operations

The MIS operations department staff was not considered for inclusion in the study prior to implementation. However, difficulties experienced in the working relationship between the operations staff and the health center staff focused attention on the operations staff and led to an examination of their situation using the EIM.

The Cadence system uses the MUMPS language. The operations people did not know MUMPS and were not scheduled for training in it. Problems that arose after implementation required coordination with the vendor and significant additional time and effort. The difficulties impaired system performance and worsened the working relationship between the health center staff and the operations staff. For the operations staff, the bottom line was that they were expected to have expertise that they had had no opportunity to acquire.

Another area of contention was the nightly processing of reports for the health centers. The system had no batch processing capabilities at that time. Reports were run from operations and printed in the health centers. When there were printing problems, the system did not have the functionality to inform the operations staff, which prevented them from resolving the problems. Overall, there was increased accountability and monitoring of operations staff. The added responsibilities and the nature of work also resulted in frequent failures. These failures were highlighted to management because of the importance of the new system for the smooth operation of the health centers. The operations staff felt they were working in a vacuum, with no training, no system communication functionality, more responsibility and accountability, and a very high risk of failure arising from factors beyond their control.

This group felt that the only advantage of this system was the possibility of learning a new programming language. In the meantime, they felt the new system ''was a pain'' and they reported feeling shortchanged. It is clear that, on the whole, their net equity declined. For them, there was hardly any increase in benefits, but there were many decreases in benefits because of system failures and higher accountability without adequate resources. Their user stresses also increased, in the form of increased effort required to operate the new system in the absence of additional resources.

Information systems research has focused mainly on the reactions of users and the effects on users of new system implementations. However, this case suggests that MIS staff may also dislike and resist a new system implementation because of a net decrease in their equity.

Second-level Analysis

At the second level, users compare their relative benefits with those of the employer. Users were asked about their perceptions of benefits of the new system to the company. Exelcare stands to benefit from the new system. Better service to patients through upgraded technology and faster service should result in increased membership and revenues in the future. As a result of the implementation, Exelcare benefited from the development of a closer relationship between the health centers and the administrative offices. Previously, there had been a stand-off relationship between them, with poor cooperation. Health centers were not consulted in decision making. Since the implementation, staff from the administrative offices have visited each of the health centers frequently. Interaction between administrative staff and health center staff has increased significantly. There is an expectation that the reporting data generated by the system will prompt management to increase levels of professional and support staff, better utilize staff throughout the health centers, and pay attention to meeting health center needs for resources. A number of users expressed the feeling that better performance by Exelcare and increased attention from senior management would eventually benefit them through increased resource allocations and better job security. Users also gained by accepting the new system in terms of reduced user stresses and gains such as learning new marketable skills and providing better service to customers served. Thus, on the whole, users were satisfied in comparison with their employer in terms of the relative gains of the two groups resulting from the implementation.

One group that was not happy in this context was the MIS operations staff. They felt that organization had benefited but at their expense, since no additional resources were provided for their group even though their workload had gone up.

Third-level Analysis

At the third level, individuals compare themselves and their group with other individuals and groups in the organization. Users from various departments perceived the system to be beneficial to all users. None of the user groups expressed a concern about unequal benefits among departments or units in the organization. However, the MIS operations staff expressed a strong sense of inequity on this issue. There was a strong feeling that positive benefits from the system were mostly channeled to the medical and support staff, while the MIS operations staff were harnessed with the responsibility for making it work technically. The operations staff received no additional resources to provide the increased service. Furthermore, the operations staff felt that they received no recognition for the successful operation of the system when it worked normally, but they were blamed whenever problems arose, even if the problems were beyond their control. Thus, at the third level of analysis, the MIS operations group experienced a stronger sense of inequity.

Some groups experienced level-3 gains. As the appointment supervisors' authority and responsibilities increased, they perceived an increase in their power and influence relative to others and, as a result, felt greater job satisfaction. A number of center receptionists indicated that, with the new system, the health centers have more current patient information than the central administrative office has. This they interpreted as having "one up" on the administration. The nursing staff found that their ability to access appointment and medical chart information reduced their dependence on others. They interpreted their new empowerment as a gain relative to others.

Both the discontent of the MIS operations staff and the acceptance of the system by the appointment supervisor, center receptionists, and nursing staff were captured in EIM's third level.

Guidelines for Implementers

Experience with the EIM can provide information that is useful in planning a new information system implementation. Those responsible for the implementation should first identify the individuals (i.e., users) and groups (e.g., functional units) who will be affected by the implementation, in addition to the organization itself. The next step is to assess the anticipated effects of changes brought about by the implementation of the new system on the identified user populations. In its analysis of user stresses and benefits, the EIM provides suggestions on where and how system implementation can affect employees. The next phase of analysis is to determine whether the changes or effects would be considered fair by the affected individuals, using the three-level analysis proposed in the EIM. For example, potentially affected users could be interviewed to assess their concerns and perceptions regarding the issues related to the EIM. Thus, the EIM could be helpful in identifying problems that may arise during a new system implementation.

The EIM emphasizes that, in implementing systems, it is important to pay attention to the fairness concerns of affected users. In this respect, implementers can attempt to improve actual benefits and reduce the necessary user stresses by developing better system designs that make the systems easier to learn and use; by providing improved training and posttraining assistance (e.g., a help line); by supplying additional clerical help during implementation; by providing higher pay and revised titles (or criteria for raises based on future performance) for individuals assigned to jobs that require higher-level skills as a result of implementation; by budgeting for overtime pay for extra work during the changeover phase; and by giving cash awards to users who learn new technologies. In training programs, users may be treated to good food, souvenirs, and plush surroundings. Users who attend such programs may view them as a net benefit rather than as an increased user stress (learning effort).

In addition, the EIM indicates that the perceptions of users should always be considered and, when possible, favorably influenced. It is very important to explain, prospectively, why some groups will receive more attention or better treatment than others during implementation, so that other users do not feel unfairly treated. For example, if new systems benefit doctors and nurses, other users can be briefed about the value of their time and the importance of their contribution to customer service within the medical organization. Similarly, users must understand how changes may benefit the organization. Users can also be influenced to view the efforts to learn a new system or skill as an enhancement to their marketability rather than merely an increased effort. In managing user perceptions, training and communication play a key role. Use of the EIM helps focus the training and communication programs on issues of concern to users.

Finally, users also expect that fair procedures will be used during system development and implementation. Changes that are negotiated through a process that includes and values input from user representa-

tives is more likely to be considered fair than are arbitrary changes made by implementers. Furthermore, users may expect to be asked to participate in system development efforts. When fair procedures are not established for their participation, of if they feel that they cannot influence the design, they may develop perceptions of unfair treatment and resist the new system regardless of its apparent quality. In this way, the importance of fair procedures is emphasized by the EIM. Exposure to the EIM can help sensitize implementers to issues of concern to users, enabling implementers to avoid certain unwelcome design choices and stimulating them to look for system design and development alternatives that will lead to a perception of fair treatment by users affected by a new system.

Conclusion

This paper presents the EIM in the context of a case that describes the implementation of a medical scheduling system. The EIM is based on equity theory, a well-established theory in the social sciences that has been tested in hundreds of experimental and field studies. The predictions of equity theory have been supported in organizational, societal, family, and other social settings. The EIM thus helps provide a theoretic basis for collecting and reviewing users' reactions to a new technology or system and understanding their acceptance or rejection of it.

The case study—implementation of a patient scheduling and appointment setting system in a large HMO—illustrates how the EIM can be used to examine users' reactions to the implementation of a new system. The effects of an implementation effort can be systematically reviewed through examination of changes in user stresses and benefits for different stakeholders. In addition to indicating why the system was well-accepted by a number of user groups, the EIM suggested the basis for the negative reactions of the MIS operations staff. Experience with the EIM also suggests that, in planning for an information system implementation, implementers should assess and then take steps to reduce possible inequities for affected employees. Increasing actual benefits can be accomplished through pay raises, higher titles, certificates of recognition, letters of appreciation, cash awards, and other means. User stresses can be reduced by improved system design, including interface design, and by better-designed training programs that reduce learning efforts. Employee training and communication initiatives can explain the rationale for system design choices, improve user understanding, and alter the perceptions of users about system-related stresses and benefits.

This paper introduces the EIM to the medical informatics literature. It appears that the EIM can be relevant to implementation in medical settings. Also, consideration of the EIM and the issues it embodies may be useful to researchers in the medical informatics field. Methods and heuristics based on the EIM can be of practical value to medical informatics practitioners who are developing strategies for implementing new systems or are attempting to understand the basis for behavioral difficulties related to system implementations. The paper has presented a case study to indicate the potential applicability of the EIM in a medical setting. Future research should examine the model for medical informatics using appropriately designed studies.

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