THE IMPACT OF INFORMATION SYSTEMS TECHNOLOGY ON ORGANIZATIONS: A REVIEW OF THEORY AND RESEARCH

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ABSTRACT

This paper reviews the results of recent studies on the impact of office-oriented information technologies. It also summarizes studies of the organizational impacts of other forms of information technologies. A model is presented to interpret and explain the impacts found.

Technologies and organizations are both human contrivances [32]. And many of the ways people look at and react to the world are socially learned. Consequently, the question of how information technology (IT) affects organization and human behavior is a question of how people -- individually and socially -- reconstruct their organizations and behaviors to fit with the technologies. But it doesn't end there. Because technologies are socially constructed, they can be reconstructed as well. Thus, our working assumption in this paper is that IT has impacts, but they are evolutionary, developmental, and reciprocal -- the technology itself is also impacted.

A number of theoretical and empirical research studies have been done on IT's effect on organizations. However, not all relevant topics are addressed in the existing literature. There are several reasons for this. First, although much of the literature is recent, it is rapidly being outdated by the advances in the technology itself. We have, for example, little reason to believe that the impact of a mainframe will be similar to that of a network of professional work stations. Second, much existing research fails to consider what is known from organization theory about organizational growth and development and about how context factors influence "planned change."

We will begin this review by surveying some current thinking on the types of changes that planned change programs like IT might produce. Then we will consider previous research. Finally, we will present a theoretical point of view on organizations to help integrate the research findings and guide future studies.

Throughout the paper we assume that whatever impacts the new technology has will not change the basic nature of human beings. Its impacts will be on human contrivances and social and personal constructions. When these change, people's relationships to them will be affected, but those relationships will be determined by the nature of humanity. The question is, and always has been, which phenomena are caused by the fundamental characteristics of human beings and which are part of the contrivances?

Information Technology And Change

Sources of Change

Three sources of uncertainty and change are associated with information technology. First, the technology itself is still evolving. We and our organizations will be confronted continually with unforeseeable, or at least unforeseen, technology changes.

Second, whenever IT is implemented in an organizational setting, it, like any other organizational change, creates short-term ambiguity and uncertainty accompanied by unanticipated organizational responses.

A third source of change stems from the technology itself and will be present even when the first and second sources disappear. In most implementations of a technology, at least the technology itself is relatively static. The uncertainty lies in the human and organizational contexts -- how people will respond and how organizational structures and practices will change. With IT, however, this uncertainty is compounded by the technology's ability to be adapted to feedback. The technology itself can be changed by those using it.

There are four orders of information feedback in goal-oriented behavior and technology [66].

No Feedback: In situations with no feedback the technology produces an output based on original input. No goal-oriented functioning occurs. Output is completely determined by the input and the technology.

First-Order Feedback: In first-order feedback, output is adjusted on the basis of feedback about how closely it is corresponding to its goal. The goal and the technology remain constant; level of output varies to keep the system in a goal-oriented equilibrium.

Second-Order Feedback: The preprogrammed technology and goals change in second-order feedback according to circumstances. Essentially, the technology has multiple functions with switching rules activated by feedback. Goals and technology are contingent upon the situation, but in a predetermined way.

Third-Order Feedback: In third-order feedback, the technology is adapted to achieve new goals. Feedback provides the inputs for these adaptations of goals and technology, neither of which were predetermined or preprogrammed.

Feedback can be performed in a number of ways, through various technologies or through human agents. All technologies are parts of systems with all four feedback states. Most industrial technologies, for instance, are relatively inflexible once installed. Either they have no third-order feedback loop in an organizational setting or they require much time for adaptation. On the other hand, there is always a larger system in which a third-order feedback loop leads to redesign and evolution of industrial technologies. Eventually, all technologies can be changed to achieve different goals. The important determination is in the locus of the feedback loops.

The development of IT has allowed third-order feedback at the user level. This is made possible by the increased multifunctionality of the technology, flexible hardware configurations, and accessible and flexible software. Up to now the technology has been generally configured for use by particular organizational units and roles for specific purposes (for example, word processing by secretaries or computer graphics by designers). Although we have ample evidence that the technology frequently engenders interdependencies among organizational functions [83], in the past there were few linkages among different technological functions and organizational roles. Word processing technologies used by secretaries could not access data analysis technologies used by professionals, for instance. But networks linking specialized applications and multifunctional work stations are now available to all office roles. The potential result is increased flexibility in how the organization and individual can choose to use the technology in relation to roles and task structures. The degrees of variation and the prospects for continuing change are greatly increased [6]. Unlike many industrial technologies, IT can literally be designed and redesigned by users--especially through software but also in component configurations [30, 31].

Kinds of Change

The paradox of researching IT impacts is that the installation of IT may involve many fundamental changes, and the more fundamental the change the less its nature can be known beforehand. If they are unable to anticipate changes, researchers do not know what to look for and to measure as bench marks. Furthermore, the very natures of the measurement and what is measured are subject to change and may muddy the

water by affecting the change that is being studied. To cope with this issue, the literature on organizational change has articulated different kinds of change -- alpha, beta, and gamma -- and offered ways of measuring them [21, 76].

Alpha change refers to changes in level of phenomena while the type, dimensions, and criteria for evaluating the phenomena remain constant. People who contemplate the productivity impacts of IT usually have an alpha change of preexisting outputs in mind.

Beta change occurs in situations where the dimensions and type of phenomena remain the same but the criteria or calibrations used to evaluate and measure them change. For instance, one might expect IT to open new levels of output potential so that what used to be considered very high output would become moderate. The technology would bring with it a new standard for evaluating output, although the kind of output might remain essentially the same.

Gamma change reflects changes in world view and reality so that phenomena before and after change are not directly comparable. Not only might things be done in different ways because of the technology, but they might come to seem different in nature and therefore be evaluated in new ways.

Introduction of a new IT into an organization can produce alpha, beta, or gamma change. Recent studies suggest that IT produces more than alpha change. The research so far has usually focused on the alpha change associated with IT. As a result it may well have missed IT's most important impacts. Readers of IT studies should remember that different kinds of change in addition to the one the researchers have considered may be occurring.

Research On Information Technology

We begin our survey of research on IT where others have ended. Rather than review studies that have been included elsewhere, we will summarize the earlier research and then focus on three recent studies that break new ground.

Research reports and reviews of impact research have made the following points:

1. Research results are mixed and even contradictory [4,15]. The organizational impacts of IT are not deterministic, and as a tool or network of tools we can adapt IT to support a number of organizational forms [5,70].
2. We need to frame our research and its results in theory so we can make some progress toward explaining and usefully understanding them [36].
3. We need to conduct our research in a way that recognizes and is designed to deal with difficulties in assessing IT impacts [36].
4. The implementation process has more impact than the nature of the technology [4], and some say participative methods should be used in designing and implementing IT [6].
5. Impacts depend less on the nature of the technology and more on the human choices that designers and managers make and the models of human beings they use [5].
6. The impacts of IT are best understood as political in source and nature [35].
7. The major individual and organizational issue in the study of IT is the balance between freedom and order [78].
8. The impacts of IT are best understood in terms of the technology's cybernetic nature; the basic cybernetic issue is control [26].
9. As the technology advances, the freedom available to designers will increase and any deterministic aspects of IT will be lessened [6].

10. The "effects" of the new IT can only be understood in specific applications of microelectronics to organizations. The basic technology has no characteristic effect [71].

Taken together, we believe the above points provide clear guidelines for further research. First of all, we can see that the technology itself is undeterministic, that this is so because of the large element of human choice involved in how IT is applied, that consequently each application has a number of idiosyncratic (or organization-specific) aspects, and that these idiosyncrasies can lead to contradictory results. On the other hand, it is equally clear that we need more theoretical underpinnings to help us generalize beyond our atomistic knowledge of IT impacts in unrelated situations and that these theoretical models need to address the themes running through most past research studies: the cybernetic and rationalistic nature of the technology, the political nature of ITS impacts and the choices made, the role of participation in these choices, and, finally, the tensions between freedom and order (or autonomy and control or decentralization and centralization) that the technology brings forth.

In summary we need a model for the organizational impact of IT that is based on an understanding of how human beings tend to construct their organizational worlds by making basic human choices between freedom and order. The model must incorporate the roles of elements such as participation, technology, and politics in these choice processes. Before we propose a model, however, let us summarize some recent research.

Current Research on Office Technologies

Three recent studies of the new office technologies reflect both the researchers' response to new technological developments and grounding in previous research on the impact of IT on organizations. The work of Allan Mohrman and Luke Novelli, Tora Bikson and colleagues, and Bonnie Johnson and colleagues provides examples of current research in the field.

Mohrman and Novelli [52,53] looked at the alpha, beta, and gamma effects of freestanding multifunctional word processors and professional work stations in an office environment that included about 80 managers, professionals, and secretaries. The majority had dedicated work stations; some professionals shared work stations. Alpha, beta, and gamma changes in perceived individual effectiveness were measured with two questionnaires, one at the time of implementation and the other after one year of use. The first survey listed job activities and asked the respondents how effective they were at each [T1]. The second repeated the list and the question [T2], but asked respondents to recall their effectiveness at the time of the first questionnaire (Memory).

If answers to the T1 and Memory questions were not different, then the researchers assumed that no beta and gamma changes took place and that the T2 responses revealed alpha change. If T1 answers and memories were different, the researchers reasoned that the frame of reference had changed, either because of the scale shifts associated with beta change or through a more fundamental gamma change of world view that redefined the activities and therefore the nature of effectiveness in doing them. Beta change was gauged by comparing the T1 and Memory answers to see the direction of scale shift. Gamma change was tested for by comparing

factor analyses of the T1, T2, and Memory responses. Similar factor structures would indicate no gamma change. If the T2 and Memory structures were similar to each other but different from T1, a gamma change would have taken place. If gamma change had occurred, then any measured beta change would have been caused by a fundamental change in the nature of the activity and would not be simply a scale shift.

Table 1 summarizes Mohrman and Novelli's findings. It compares three factor analyses of perceived effectiveness -- at T1, at T2, and by Memory -- to test for gamma change. If there were no gamma change, all activities would be grouped in factors that would fall along the major diagonal of the matrix. Each cluster of activities is also marked to indicate whether it showed no change, alpha change, or beta change in effectiveness measures. As can be seen, four activities (filing, searching files, handling mail, and collating) showed no change in effectiveness and always factored together. The technology was not often used for these. Four other activities -- writing, calculating, preparing presentation materials, and proofing -- showed alpha changes. Most respondents had had previous experience (vicarious or direct) in using computer-based technology for these activities (secretaries had used an earlier generation of word processors from another vendor and some professionals had done programming). So it appears that respondents had already adopted evaluative standards appropriate for the technology in these cases. The new implementation, nevertheless, further reoriented the way people thought about these activities, especially in relation to all the other activities. In general, when the technology was used to mediate activities it was accompanied by a gammalike redefinition of activity effectiveness. Further, people's

TABLE 1
COMPARISON OF FACTOR ANALYSIS OF PERCEIVED ACTIVITY EFFECTIVENESS
ILLUSTRATING GAMMA CHANGES

POST FACTORS,
T2

PRE FACTORS T1	A	B	C	D	E
1	Filing Searching Files Mail Handling Copying, Collating, Sorting (No Change)			*Recordkeeping (Beta Change)	
2		Using Telephone Conferring Meetings (Beta Change)	**Writing, Composing (Alpha Change)		
3			Reading (Beta Change)		
4			*Creating designing conceptualizing *Analyzing reviewing (Beta Change)	*Scheduling keeping calendars *Planning organizing (Beta Change)	**Preparing presentation materials (Alpha Change)
5			*Calculating (Alpha Change)		**Proofing, correcting, revising (Alpha Change)

Then Factors T2 Memories of T1

**Over 85% use Technology for this activity

*Over 33% use Technology for this activity

Table 2

Mohrman and Novelli Study: Activity Groupings

	Factor Groupings of Activities	Significant Change in Perceived Effectiveness	Information Systems Levels
1.	Handling Information		
	Filing	o	
	Searching, pulling files	o	Technical
	Mail handling	o	
	Copying, collating, sorting	o	
2.	Reformatting Information		
**	Preparing presentation materials	+	
**	Proofing, correcting, revising	+	
3.	Analyzing and Giving Meaning to Information		Semantic
**	Writing, composing	+	
	Reading	o	
*	Creating, designing, conceptualizing	+	
*	Analyzing, reviewing	+	
*	Calculating	+	
4.	Managing Intentions through Information		
*	Record keeping	o	Influence
*	Scheduling, keeping calendars	+	
*	Planning, organizing	+	
5.	Communicating Information		
	Using telephone	+	Channels
	Conferring	+	of Communi-
	Meeting	+	cation

* ≡ Over 33% of respondents use work station to do this activity.
** ≡ Over 85% of respondents use work station to do this activity.
\+ ≡ $P \leq .05$ for paired T-tests comparing T2 levels of perceived effectiveness with memories of T1 levels of effectiveness.
o ≡ No significant change in perceived effectiveness.

memories of these activities before the technology's introduction for the most part retain this new view.

Table 2 [51] repeats the final T2 groupings of the activities with tentative titles. It shows how respondents saw effectiveness to have been impacted (their memory of effectiveness is compared with the present). It also classifies these activities according to their information system levels [46]. Besides yielding activity groupings more in line with IS models, the new technology seems to have increased the effectiveness of people doing the activities, at least from their new perspective.

Because of beta shifts within the gamma change, comparing T2 with T1 ratings (not shown) provides quite different results. This comparison makes it seem as if technology did not change or even lessened effectiveness. Actually, definitions of what is effective changed, so in most cases the new criteria of effectiveness were more stringent. From their new perspective people rated their former effectiveness in an activity significantly lower.

Because individuals tend to see the past with their present perspective, they may be blind to the important differences between their old and new views. But these perceptual changes can have real impact on not only the content of peoples' jobs but the relationship among their roles. For instance, some activities in the office (for example, preparing presentation materials, proofing, record keeping, scheduling, and planning) came to be more equally performed by all roles [51]. This suggests that when users regroup activities conceptually they will eventually regroup them behaviorally and structurally.

We cannot be sure what caused the gamma change Mohrman and Novelli measured. Many of the changes can just as easily be ascribed to the

implementation approach as the nature of the technology. For instance, the freestanding work stations were made available to all personnel without prejudice. Then all employees were encouraged to adapt the technology to their tasks. Frequent formal and informal opportunities were created to share ideas and issues, make suggestions, and solve problems. As users gained experience they could change the nature and the distribution of technology as well as the social and organizational arrangement. Employees who were both technically and interpersonally skilled acted as resources for the others. In short, everything was conducive to creating and fostering gamma change. Although we know that gamma change occurred in this case, we need multiple cases to determine how much it happens in general, and to what extent it is caused by the technology or the implementation choices.

Bikson and her colleagues [2,3,4] have researched the contributions of organizational context and especially the implementation process to technology impacts. They have focused on advanced office systems. Their sample contained 26 organizations equally divided between manufacturing and service. These were represented by 55 "offices" or work groups ranging in size from 4 to 37, with an average of 10. The offices were "early adopters" of the new office oriented IT and were divided into four categories based on their organizational missions: management and administration; text-oriented professionals; data-oriented professionals; and secretarial, clerical, and technical support.

Questionnaire, interview, and documentary data were collected. Sixty-seven percent of the 530 respondents used a computer-based technology during their regular work. This usage was relatively uniform

across all job categories except for executives, whose usage rate was 36%.

The researchers gathered additional data on the information activities for which people used the technology, employing a list similar to Mohrman and Novelli's. Factor analysis of these data revealed four factors that were roughly comparable to the four types of offices in the sample. Clerical and administrative activities were together in the first factor. The second factor included text creating and text altering activities. The third and fourth factors, programming and computation and filing, manipulation, and distribution of numeric data, respectively, were activities associated with data-oriented professional offices. Although to some extent the distribution of activities reflected role and office differences, all activity groupings were performed by all types of offices and all role classifications. These results are very similar to Mohrman and Novelli's.

To date, Bikson and her colleagues have focused on two kinds of impacts: satisfaction with the technology and work performance. They factored various features of the technology on the basis of respondent satisfaction. Four factors emerged: functionality, equipment performance, environment, and interaction. Respondents were most satisfied with functionality -- the technology's capability for alteration, entry, storage, error detection, and so on. They showed low satisfaction with equipment maintenance aspects of equipment performance, but high satisfaction with quality of video and print output. Environmental features, such as the arrangement and comfort of space and furniture tended to foster low satisfaction. The lowest satisfaction, however, stemmed from interaction features -- computer response time and the operating manual. (Type of dialogue with the

computer was generally satisfying.) Of the four factors, only functionality "predicted" how much the technology was utilized and integrated into the individuals' regular work flow. Only functionality and environment were associated with overall satisfaction with the technology.

The respondents felt the technology, once utilized, positively affected every aspect of work performance. This was so for speed, quantity, type, and quality of work done by the office as a whole and was even more true for productivity and quality of individual performance.

Two organizational characteristics affected implementation of the technology. The first was variety in work; in this sample broad jobs facilitated implementation. The second was the organization's orientation toward change. A problem-solving and positive approach aimed at doing what is achievable was found to be important.

Overall, these results paint a rather positive picture of acceptance and functionality of the new technology in office settings. At least in these early adopting units, a problem-solving and multi-functional (as opposed to fragmenting) approach resulted in success -- both in terms of implementation and subsequent performance. We do not know, however, whether this same spirit will prevail in future applications or what the long-term effects of this technology will be.

Johnson and her colleagues [30,31,62] have been investigating the degree to which a "reinvention" process, when allowed to occur after initial implementation, leads to certain organizational impacts. In addition, they are interested in the variation in impacts depending on how the process takes place. They started with a narrowly defined form of the technology, word processing. Their findings indicated that word

processing has come to be increasingly integrated with other office and organizational IT. Thus, they are being empirically driven to a more broadly defined technology, similar to that studied by Bikson and her colleagues.

For their study of 200 word processing unit, Johnson and her colleagues collected interview data structured around a sociotechnical systems approach. They focused on the "effective use of word processing," which they defined as an "increase in capability directed toward organizational mission." Specifically they wanted to know if the technology was being used for tasks that would be "impossible or impractical without it." In this sense, they were looking for gamma changes, not efficiency-oriented alpha changes in effectiveness.

For the most part, they found that efficiency was the major reported benefit of the technology--remember, however, Mohrman and Novelli found that respondents often were blind to gamma changes. Johnson and her colleagues rarely saw the technology being used to increase organizational capability. When they did find such improvement in effectiveness beyond efficiency, the following principles were in operation:

1. Involve People Jointly in Changes of Technology: Most technology changes were unilaterally initiated by management; however, when operators were jointly involved in changing their own jobs, they developed uses of the technology (tracking loan authorizations or establishing coordination mechanisms, for example) that increased organizational capability.

2. Encourage Experimentation: Few units encouraged experimentation, but when they did -- by allowing time to play with the

technology and showing appreciation for new methods -- capability was extended.

3. Maintain Flexible Procedures: Units in the study typically started with substantial flexibility. This impeded efficiency, so pressure emerged to decrease flexibility. Nevertheless, within some degree of necessary routinization, flexibility produced expanded capability. Means of achieving flexibility include direct contact between word processors and authors, and authors' use of the technology.

4. Increase the "Response Repertoire" and Information of Employees: Vendor training has generally been inadequate; the most useful training has been employees instructing one another.

5. Promote Self-regulation of Employees: Employee self-regulation happens in at least two ways. The first is associated with the nature of the technology; it allows employees broader responsibility for document creation and for each document as a whole. The second is related to control and monitoring systems that regulate performance. Organizations showing high capacity involved the employees in developing performance measures to encourage motivation.

6. Build Discretion into the Job: Seldom was the technology installed to increase quality of work life or enrich jobs. Nevertheless, some situations did seem to engender increased discretion, creativity, autonomy, and ability to work on whole projects without interruption. When increased discretion resulted, personnel administration typically would not accept it as a job dimension involved with word processing. Higher capacity was associated with situations where pay systems reflected increased discretion.

7. Encourage Communication: Although respondents generally felt that relationships and communication with co-workers were motivating

sources of creativity, problem solving, and quality of work life, word processing centers tended to foster a sense of isolation from the rest of the organizations that had to be overcome. Conversely, distributed word processing hindered communication among peers. Communication was seldom encouraged, but when it was -- either formally or informally -- it was associated with more capabilities.

One implication of these findings is that the kinds of impacts organizations experience depend on what they want and expect. Most of these word processing units, it seems, implemented the technology as a means to accomplish existing performance needs more efficiently. Most realized these goals. A few, however, achieved increased capabilities not originally envisioned. Focusing on either type of impact may blind one to the other, because the methods for achieving and the criteria for measuring each stem from different logics of organizational effectiveness.

Summary

Taken together these three recent studies raise many important points. First, the technology has often been successfully used to automate predefined activities efficiently and productively. This depends on a rationality that combines the technology's capabilities with the flow of the activity. Technical rationality affects the users' world view, the nature of their work, and eventually the technical relationships among individual tasks, jobs, and roles. The way this rationality is incorporated into organizational arrangements is variable, as is the meaning individuals ascribe to it. In general, users are satisfied with the technology and are able to employ it. Whether or not the technology brings capabilities that are not possible without it depends on the extent to which individual users can be

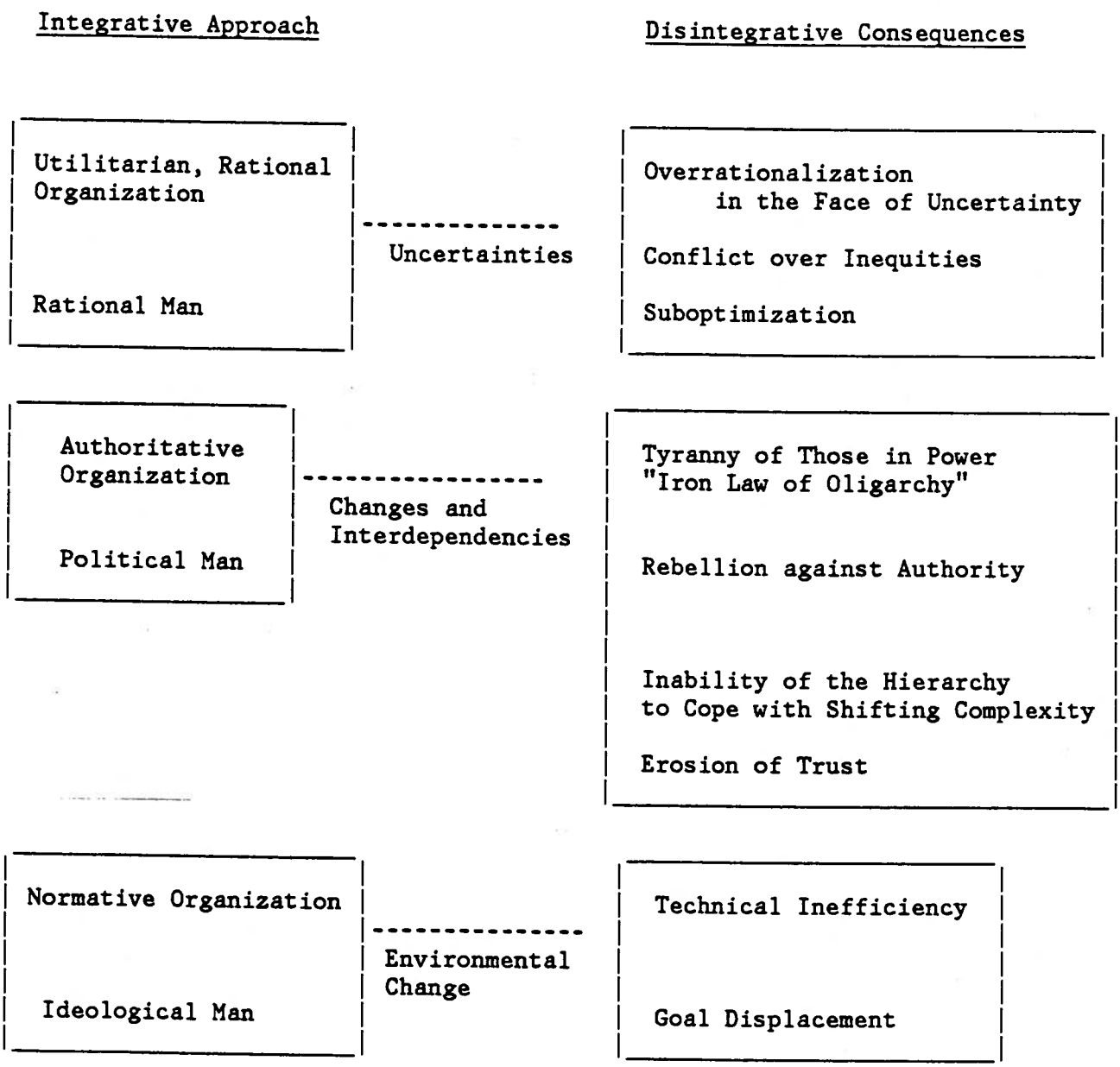
involved in a continuing process of sociotechnical systems design in which the technical rationality is applied to new activities that in turn can yield a reinvention of the technology -- third-order feedback and gamma change. Without such an involving and evolving process, the tendency is simply to use the technology for more efficient performance of predefined activities.

Model For Interpreting Research

We offer the following model, which we call the integrative/disintegrative model, as a heuristic for interpreting research on IT impacts. It is based on considerable previous study of how organizations evolve and operate [3,17,19,32,55]. It assumes that the fundamental organizational choice is how to integrate the organization's needs with those of individuals and individual units. Human beings tend to adopt three modes of organization to integrate a system: utilitarian, authoritative, and normative (Figure 1). Each mode follows a different logic and flows from a different set of assumptions about why and how human beings behave. Paradoxically, each approach engenders a characteristic disintegrative reaction that threatens the integration it seeks. Each organizational mode complements the others; it deals with their disintegrative consequences but fosters yet another set of disintegrative forces through its own weaknesses. Because of this, we usually find all three forms of organization in any situation, although one or two are usually stressed more.

Figure I

Integrative/Disintegrative Model of Modes of Organization



Utilitarian Integration

The first mode of organization uses a utilitarian and goal-oriented logic. Organizational tasks are rationally configured in the attempt to optimize achievement of organizational goals. The same characteristics are assumed of people employed in organizations: that they are rational, utilitarian, and goal-oriented. Because individual and organizational goals are not assumed to be the same, the utilitarian rationality is used to set up ways to integrate organizational and individual needs. Employees receive inducements they value in exchange for contributions that the organization values [46]. The feasibility and efficiency of this organizational mode depends on the degree to which inducements and contributions and the logic of how contributions combine to achieve organizational goals can be specified. The organizational rationality is related to the technologies used and their underlying logic.

The utilitarian approach breaks down when its assumptions cannot be met. Uncertainties and ambiguities caused by lack of knowledge and information can prevent specification. Overspecification runs the risk of appearing and being irrational. Ambiguities about contributions increase the probabilities that actors will perceive inequities between their own inducement-contribution exchanges and those of others. Inability to specify the relationship between individual contributions and organizational goals leads to suboptimization. Thus, uncertainties can result in disintegrative, segmented concerns and conflicts unless an integrative approach can be found to deal with them.

Authoritarian Integration

The integrative organizational approach traditionally used to deal with the ambiguities of the rational mode is legitimate authority [19]. This assumes that within certain bounds people are willing to give authority to others, especially in situations of ambiguity. The bases on which such authority is granted may vary--organizational position, expertise, personality, organizational experience, democratic election--but the important thing is that people will give authority to others. Those given authority are allowed to make decisions in the ambiguous realms, and thus to control the relevant actions of others. Their power can be extended to establishing goals for others. Authority also lies in the way decisions are made [13], including determining who should be placed in authority positions. Because of the way authority is related to uncertainty, legitimate authority structures in organizations can complement the utilitarian organization. Many aspects of the authoritarian decision-making structure nevertheless reflect other influences, such as historic sources of power and conventional notions of governance.

Because authority is granted by organizational actors carrying out the decisions made by those in authority positions, it is subject to change by them. An obvious source of such change is a change in the rational organization that would shift the areas of ambiguity. Existing authorities may not be willing to participate in such a shift, because authority positions often become bases of power that exceed the authority granted. An "iron law of oligarchy" often prevails; those granted authority can use it to perpetuate and even exacerbate the uncertainties at the base of their authority as well as to acquire other

sources of power. When this happens the integrative balance between the needs of the organization and those of the individuals in it is tipped so that the decision-making process attends to the needs of only some organizational segments. People rebel when the power structure is out of balance with the authority necessarily granted to complement the rational organization. Support for the authoritarian decision-making system breaks down, and demands on it escalate [13]. The more frequently changes occur and the more uncertainty there is, the more exacerbated this dynamic becomes.

Typically, the uncertainties authority deals with are exceptional cases that cannot be specified or anticipated in the task definitions at lower levels. Authority breaks down when it is unable to handle the uncertainties that are passed up the hierarchy.

One important source of these uncertainties is increasing interdependencies among organizational tasks. As interdependencies among tasks increase, performance of tasks becomes more contingent on what is done and how it is accomplished in other tasks. Authority figures are assumed to know the contingencies of multiple tasks and therefore to make decisions based on this knowledge. But as interdependencies increase, task contingencies overload authorities' cognitive capabilities. The hierarchy's inability to cope with this shifting complexity undermines its authority. One solution can be to create tools and understanding that allow one to cope with the uncertainty by specifying the contingencies and the decision rules to deal with them -- a rational, utilitarian approach. The other remedy is to absorb the uncertainty in a much different way, through normative organization.

Authority breaks down when the variety of needs and values come to be differentially considered because power is differentially aggrandized by those in authority positions. Those granting authority will no longer trust that those in authority are operating in their interests or the interests of the organization as a whole. On the other hand, those in authority will tend not to trust that other organization members will act according to what they consider to be organization needs and will escalate controlling behaviors accordingly.

Normative Integration

Utilitarian and authoritarian integration depend on the existence of underlying norms -- reciprocity in the utilitarian mode and legitimacy in the authoritarian [55]. Utilitarian integration breaks down because it is either impossible or too expensive to specify and measure contributions and inducements to set up an equitable exchange in which both individual and organizational needs are met. Authority breaks down when either those granting authority or those in authority positions do not trust the others to consider their needs or the needs of the organization. The alternative integrative approach in these cases is to bring individual needs, goals and values and those of the organization into alignment with each other. In addition, these values and norms must be internalized by all, and all must trust that the others have done so. Among the methods for achieving this mode are socialization processes and consensual and participative processes. The vehicle for normative integration is a common culture with norms of behavior, beliefs, and values that are not dictated by utilitarian or authoritarian logics but by tradition and informal social processes leading to social conformity.

Normative integration breaks down because of environmental change. Traditional ways of doing things that may once have been best do not always remain so. Organizational and technological contrivances in the environment are subject to change. Organizational output can result in environmental feedback that leads organizational actors to question the organization's goals and methods. Success of competitors can cause the organization to question its technology. As knowledge and techniques evolve in the environment, they supply new models of rationality that people compare with those (implicitly) in use in their organization. Disintegrative conflicts arise between segments of the organization which adhere to the status quo and segments which claim that the normative organization has displaced and obscured its original goals and that practices are accepted only because they are normal and are no longer judged on their efficiency and effectiveness. A growing push for understanding and clarifying the goals of the organization and for explicating and rationalizing its practices evolves.

All three integrative and disintegrative modes are at work at all times in all organizations. Each integrative mode complements the others. Organizations vary in the degree to which they stress one or more integrative approaches, and disintegrative issues likewise vary among organizations, parts of organizations, and individuals.

Applying the Model to Information Technology

Rob Kling and Walt Scacchi [39] developed a framework for classifying research on the impact of IT that partially corresponds to the integrative/disintegrative model. They divided the research into two general theoretical perspectives: those assuming "systems rationalism" and those assuming "segmented institutionalism." The

former approach stresses the integrative uses of the technology; the latter stresses that IT must deal with a reality in which disintegrative social forces are always present. The technology might integrate organizational segments, but it can also exacerbate disintegration.

Research on the roles of computer-based modeling [11] has derived a similar typology. Models can be classified in terms of how they affect the various modes of integration. They can be used "rationally" to provide information that guides decisions according to the accepted utilitarian rationality. They can be used "technocratically" or "bureaucratically" to legitimate proposals or adopted policies. Finally, they can be used "consensually" as bases for interactive building of common beliefs and norms.

The technology can be directly used to impact any of the integrative or disintegrative modes in Figure 1, and it can have indirect effects by engendering organizational activity in the other modes. Depending on what antecedent conditions exist in the organization and on which we choose to focus, the technology will generate some immediate effects. For instance, if the organization has been in a state of high normative integration that fostered growing disintegrative concerns about technical inefficiency, then a rational system could have immediate integration effects. These, however, might have disintegrative consequences that drive or perhaps are preempted by changes in authoritative integration. Eventually, there will be a series of direct and indirect consequences, both integrative and disintegrative in nature. And they will be further modified by reactive or anticipatory organizational responses.

Using the Model to Interpret Impacts

Much of the theorizing about and research on the impact of automated technology has focused on the integration of the individual with work and the organization. Often the focus has been on the disintegrative side, especially alienation of individuals from the organization and their work.

Jon Shepard [69] compared the alienation of white and blue-collar workers in jobs representing various stages of the automation continuum. His dependent measures of alienation, drawn from the classic sociology literature, fit into our model.

Instrumental work orientation refers to the degree to which workers labor for the money only and is a consequence of the utilitarian organization. In addition, this orientation forecasts worker focus on economic inequities and the disintegrative conflicts it engenders.

Powerlessness is the lack of influence over their own labor that workers feel. It reflects a source of illegitimacy of existing authority structures if the areas of powerlessness result in an inability to meet the individual's personal or task needs. Powerlessness is the result of granting authority.

As operationalized by Shepard, normlessness refers to the extent to which workers consider authority illegitimate. Normlessness would indicate the degree of the authority structure's disintegration.

Self-evaluative involvement is the extent to which workers derive an identity and status from their work as opposed to the nonwork aspects of their lives. This reflects how much workers are normatively integrated with the organization.

Meaninglessness refers to workers' ability to make rational sense of how their jobs integrate with the others in the organization and contribute to the goals of the organization or the organizational unit. Meaninglessness signals a disintegrative breakdown from an extremely normative state and lays the groundwork for a positive, rationalizing impact of the technology.

Shepard looked at the effects of automation or integrating alienation by comparing blue and white-collar workers who had automated jobs with those who had mechanized or traditional jobs. Two kinds of jobs were created by computer automation: jobs monitoring automated processes, which were found in both blue and white-collar settings, and white collar jobs dealing with computer software. Shepard's findings are summarized below.

-- Half or over half of all white-collar clerks with either traditional or mechanized jobs showed alienation of all kinds. Mechanized blue-collar workers showed considerably more alienation in all forms than did white-collar workers.

-- Blue and white-collar workers who had jobs involving the monitoring of automated equipment showed converging degrees of less alienation.

-- Except in the case of white-collar powerlessness, where no differences were noted (60% for both mechanized and automated), both blue and white-collar monitors of automated equipment were less alienated than any of the workers with mechanized jobs. Not only did they have less alienation, but both blue and white-collar monitors showed similar levels (30%-50% depending on the type of alienation).

-- In another form of job created by automation, computer software, only a minority of workers showed powerlessness (10%) and instrumental work orientation (20%). Only one-third reported job meaninglessness. People in these jobs showed comparable normlessness (33%) and self-evaluative involvement (60%) comparable to automation monitors.

Shepard's results lend credence to the notion that automated jobs will increasingly involve processing information in second and third-order feedback loops and will therefore narrow the differences between blue and white-collar work. Workers in the automated settings of his sample tended to be more integrated with the organization than those in mechanized settings. Their levels of integration with job and organization were closer to those of craftspeople, who were also included in the study. Others have reported similar findings [26,28,85]. Nevertheless, Shepard's work also shows that significant percentages of people in automated settings are just as alienated as the majority in mechanized settings. And many other studies also have shown automation to be more alienating in some situations [6].

We can partially predict the impacts of the technology through the integrative/disintegrative model. To some extent the seemingly contradictory results of various studies can be explained by the fact that they represent impacts in different integrative and disintegrative stages.

The obvious starting point is the rational, utilitarian organization. Often the primary intent of IT is to affect this mode. Intentions can be at two levels: either the technology is used to bolster the existing rationality in the organization, or it is used to

change it, to install a new view of how to design the organization rationally. As Mohrman and Novelli [53] make clear, even when the technology is implemented to augment existing organizational roles and no attempt is made to influence the rationale behind those roles, the organization's rationality can eventually change.

The technology, in its particular hardware and software combinations, embodies knowledge and its underlying rationality. Its strengths are speed and reliability in performing complex logical maneuvers [83]. Therefore, we would expect its most direct impacts to be on the rational and utilitarian forms of organization and individual behavior. Many of the reasons for adopting IT in the first place are such expectations, and the bulk of the research literature reports on the generally positive impact of IT on organizational rationality and utility.

For instance, a study of the impact of computer systems (ranging from real-time, on-line to batch) in five banks in four countries [6], yielded the following generally applicable findings: error detection by computer replaced detection by people, there was faster error feedback, the clerk job became more structured and programmed, much learning about the technical system occurred on the job. A general narrowing of the clerk job was matched by some workers' satisfaction with the technology and interest in it. In this case, the technology is having some positive rational and utilitarian impact. On balance, it is serving the existing rationality of the banks rather than bringing in a new one. Johnson's [30] findings are similar.

The effects of the new rationality, or the responses to it, depend upon the state of the organization at the time of implementation. If, for instance, an organization's normal practices and traditions are not

leading to success in the environment and technical inefficiencies are becoming salient, then the effect of the new rationality, provided it attends to the inefficiencies, will be accepted. Ken Eason [12], for example, found that IT changed managers perceptions of their jobs' complexity and nature. This improved view of their task led to new ideas and new methods. Managers saw all these results as useful progress from their previously poorly understood roles. In this context, they evaluated the standardizing and routinizing nature of IT positively. These attributes clarified the managing role and fostered development.

But even favorably received and useful changes in the rational structure must be followed by adjustments in the organization's other integrative modes. And each of these commensurate adjustments will be driven by the disintegrative forces that arise out of the others. For instance, Eason also found that the nature of IT's rationality not only elucidated the managers' jobs but also made information available to subordinates that clarified their perceptions of their roles and the relationship of their roles to those of the managers. This increased information and understanding led to an argument--based on the resulting redistribution of sources of uncertainty, inequities, and suboptimizations -- that in certain areas subordinates should be more involved in decision making. Thus, the new rationality began to drive a new authority structure by questioning the legitimacy of the old and proposing a replacement.

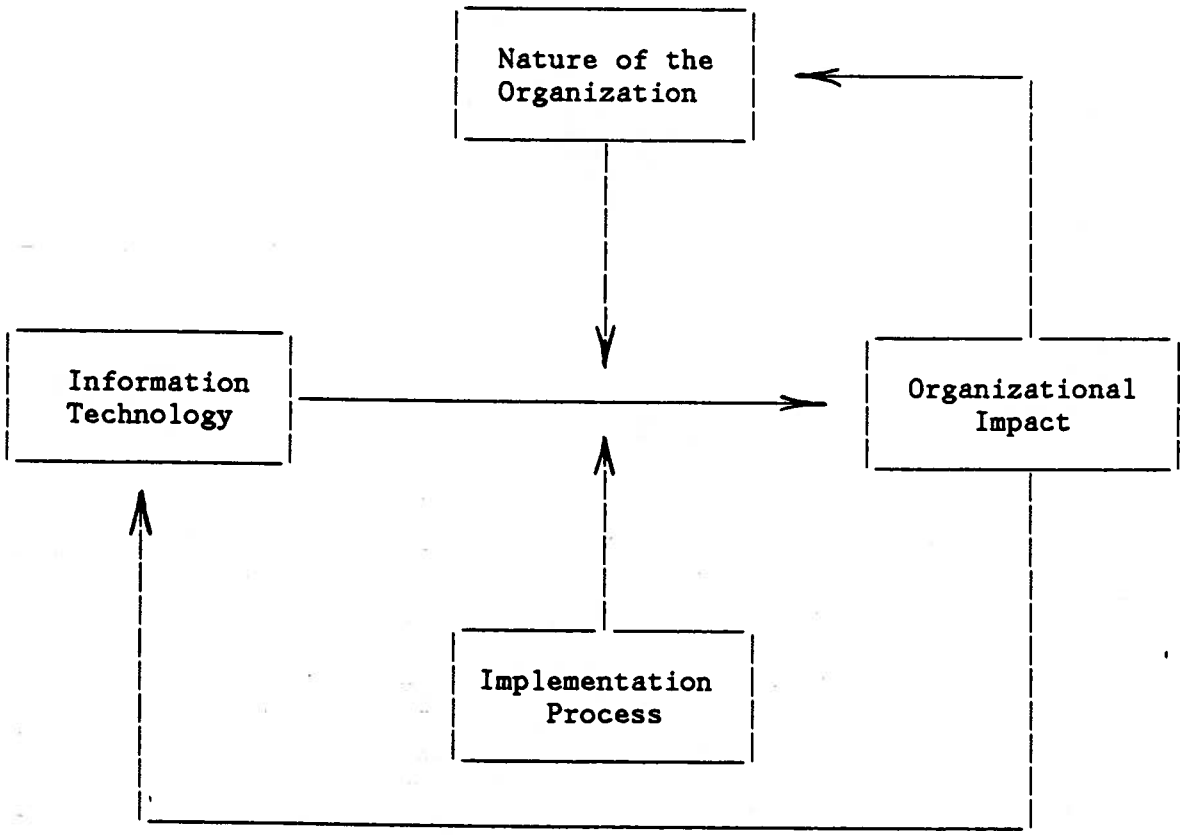
Even though the IT is, on the surface, a rational intervention, its uses and effects can occur in the other integrative modes. For instance, IT is frequently employed to bolster a disintegrating

authority structure, through increased monitoring of subordinate performance. It is important to distinguish between the technical rationality of the monitoring and its authoritarian uses. It may well make technical sense--consistent with the new rationality--to centralize certain kinds of performance information, to achieve economies of scale, perhaps by processing the information centrally. As Derek Stone's research [74] shows, however, it is a mistake to assume that centralization of information is tantamount to centralization of authority and control. Stone reported that, despite the advice of consultants, an organization wisely refused to use information centralized for efficient processing to make decisions. Decision-making was left decentralized. Centralization of the routine created more local time for attention to management issues. The results included lower costs, increased customer service, and, in general, better local management that was able to respond to local issues. Local issues were the sources of uncertainty upon which management authority was legitimated.

Rationalization brought with IT can also affect the normative mode of integration. Perhaps the most common example of these effects is when IT is used to fragment jobs on the basis of an analytical rationale. Although this might make utilitarian sense -- as long as compensating attention is given to rationally integrating these differentiated parts--it can undermine normative integration. People develop a level of integration and involvement with their jobs that is based in part on socially learned characteristics of the tasks. Job fragmentation can disrupt these modes of integration and undermine the organizational culture [1]. If, however, the organization is already

Figure 2

Effects of Information Technology



strongly based on a rationality, and especially if that rationality has reached or exceeded the limits uncertainty places on it, then a further intervention, for instance, fragmentation of existing tasks, will foster or strengthen the disintegrative forces that evolve out of extreme rationality [6].

Conclusion and Implications

Figure 2 displays the major relationships we have identified so far. It shows that the impact of a particular IT is a function of the nature of the organization in which it is installed as well as of the implementation process. The research quite consistently points out that involvement of employees is key to a successful implementation. This finding seems to hold for all types of technologies. This is because participation not only fosters normative integration but resulting norms are necessary underpinnings of both utilitarian and authoritarian integration. The effects of the nature of the organization are much more complex. Organizational nature moderates the impact of particular technologies, so unless the type of technology and the nature of the organization are specified in terms of the integrative/disintegrative model, the organizational impact of the technology is not predictable.

Figure 2 also shows two feedback loops. The one from organizational impact to the nature of the organization highlights the point that IT can change the state of an organization. Specific predictions about how this will occur require knowledge of the technology and the existing organization. The feedback loop to the technology itself highlights the cybernetic nature of IT. Again, a specific prediction requires knowledge of the technology's starting point. However, this argument suggests that, in general, organizations will gravitate toward higher and higher levels of technology.

The cybernetic nature of IT and its adaptability to third-order feedback loops imply that adaptive and participative research techniques are appropriate for assessing the impacts of IT [16,52]. In fact, the same rationale can be used to argue that organizational use of and response to the technology should also be adaptive and participative [6]. These normative statements are not mere indications of a value stance independent of the technology; they reflect the technology's impacts. Indeed, we find examples again and again in the literature of IT creating a pressure for increased participation and adaptation, either as a reaction to an inappropriate application that purposefully limits such participation, or as a natural extension of an implementation that allows such participation to take its course.

The impact of IT is not toward more order or more freedom. This debate is a fruitless one -- the technology can be utilized to support either. Research is replete with examples of both. As our knowledge of organizations establishes, every approach to organization is a two-edged sword that carries the means of its own destruction. The impact of IT is to sharpen the sword. It exacerbates the potential negative and unintentional consequences of the positive and intentional "cuts" it makes. This is because the technology highlights not physical activity or interpersonal behavior, on which previous iterations of organizational models have concentrated, but cognitive behavior, "patterns of attention, learning, and mental engagement" [85] that are more and more being recognized as fundamental to understanding much of organizational behavior. Information technology is providing organizations with a higher order test of their ability to balance their needs and goals with those of the individuals within them.

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