Technological Frames: Making Sense of Information Technology in Organizations

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In this article, we build on and extend research into the cognitions and values of users and designers by proposing a systematic approach for examining the underlying assumptions, expectations, and knowledge that people have about technology. Such interpretations of technology (which we call technological frames) are central to understanding technological development, use, and change in organizations. We suggest that where the technological frames of key groups in organizations—such as managers, technologists, and users—are significantly different, difficulties and conflict around the development, use, and change of technology may result. We use the findings of an empirical study to illustrate how the nature, value, and use of a groupware technology were interpreted by various organizational stakeholders, resulting in outcomes that deviated from those expected. We argue that technological frames offer an interesting and useful analytic perspective for explaining and anticipating actions and meanings that are not easily obtained with other theoretical lenses.

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Some fifteen years ago Bostrom and Heinen [1977] suggested that many of the social problems associated with the implementation of information systems (IS) were due to the frames of reference held by system designers.

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Building on this work, Dagwell and Weber [1983] and Kumar and Bjørn-Andersen [1990] examined the influence of designers' values and the views of users on systems development, while Boland [1978; 1979] showed that the conceptual framework of the designer influenced the kind of system designed. Ginzberg [1981], in turn, investigated how users' expectations of a pending information system significantly shaped their attitudes toward it. Since these studies, researchers have considered the perceptions and values of designers and users as part of their investigations into the social aspects of information technology [Hirschheim and Klein 1989; Kling and Iacono 1989; Markus 1984].

While a cognitive thread has clearly run through IS research, this has not led to a systematic articulation of the role of frames of reference in systems development and use. In this article we hope to lay the groundwork for such a socio-cognitive approach toward information technology. We argue that an understanding of people's interpretations of a technology is critical to understanding their interaction with it. To interact with technology, people have to make sense of it; and in this sense-making process, they develop particular assumptions, expectations, and knowledge of the technology, which then serve to shape subsequent actions toward it. While these interpretations become taken-for-granted and are rarely brought to the surface and reflected on, they nevertheless remain significant in influencing how actors in organizations think about and act toward technology. Weick [1990, p. 17], for example, has noted that: "cognition and micro-level processes are keys to understanding the organizational impact of new technologies."

We argue that by examining these taken-for-granted notions, we can gain much insight into how technologies are developed, used, and changed. We propose a conceptual framework for examining the interpretations that people develop around technology, which should be useful for researchers studying the role of technology in organizations, as well as for practitioners managing the implementation of technological change.

In the next section, we discuss social cognitive research on frames of reference or cognitive structures that are shared among groups of individuals. We build on this work to develop the concept of technological frames, which focuses on those aspects of shared cognitive structures that concern technology. We suggest that different groups within an organization may have different technological frames, and introduce the notion of congruence to describe the nature and extent of differences among frames. We then draw on some findings from a field study that analyzed the implementation and early use of a new information technology to examine key actors' interpretations of the technology. The findings reveal significant differences in the technological frames of two primary groups—technologists and users. The incongruence in frames provides an interesting explanation of the difficulties and unanticipated outcomes associated with the technology implementation. We conclude by discussing the power of the technological frames concept in research and practice.

THE CONCEPT OF FRAMES

A major premise of social cognitive research is that people act on the basis of their interpretations of the world, and in doing so enact particular social realities and endow them with meaning [Berger and Luckmann 1967; Smircich and Stubbart 1985; Weick 1979a]. The frames of reference held by organizational members are implicit guidelines that serve to organize and shape their interpretations of events and organizational phenomena and give these meaning [Moch and Bartunek 1990; Weick 1979b]. Borrowing the concept of "schema" from cognitive psychology [Bartlett 1932; Neisser, 1976], an individual's frame of reference has been described as "a built-up repertoire of tacit knowledge that is used to impose structure upon, and impart meaning to, otherwise ambiguous social and situational information to facilitate understanding" [Gioia, 1986, p. 56]. Recent literature in organizational behavior has extended the idea of individual cognitive structures to groups and organizations [Calder and Schurr 1981; Gray et al. 1985]. A variety of terms has been used to convey the idea of shared cognitive structures, including "cognitive maps" [Bougon et al. 1977; Eden 1992], "frames" [Goffman 1974], "interpretive frames" [Bartunek and Moch 1987], "interpretative schemes" [Giddens 1984], "mental models" [Argyris and Schon 1978; Shutz 1970], "paradigms" [Kuhn 1970; Sheldon 1980], "scripts" [Abelson 1981; Gioia 1986], and "thought worlds" [Douglas 1987; Dougherty 1992].[1]

While some of these terms (e.g., mental model, frame, and script) have been used in cognitive science and artificial intelligence, here they reflect our interest in how organizational members make sense of and assign meaning to their environment, organization, and tasks (e.g., Daft and Weick, [1984], Dutton and Jackson [1987], Kiesler and Sproull [1982], and Porac and Thomas [1990]). Frames refer to "definitions of organizational reality that serve as vehicles for understanding and action" [Gioia 1986, p. 50]. They include assumptions, knowledge, and expectations, expressed symbolically through language, visual images, metaphors, and stories. Frames are flexible in structure and content, having variable dimensions that shift in salience and content by context and over time. They are structured more as webs of meanings than as linear, ordered graphs [Gioia 1986].

By shaping individuals' interpretations of organizational phenomena, frames implicitly guide them to make sense of and take action in organizations [Bartunek 1984; Moch and Bartunek 1990]. Frames typically operate in the background and have both facilitating and constraining effects. On the one hand, as Gioia [1986, p. 346] notes, frames are helpful when they structure organizational experience, allow interpretation of ambiguous situations, reduce uncertainty in conditions of complexity and change, and provide a basis for taking action. For example, research paradigms facilitate the practice of a community of scholars by providing shared assumptions about the nature of phenomena, a vocabulary for representing such phenomena,

[1] We will use the term "frames" in this article to refer to this general concept of shared cognitive structures.

and criteria for evaluating scholarly work. On the other hand, frames are constraining when they reinforce unreflective reliance on established assumptions and knowledge, distort information to make it fit existing cognitive structures, and inhibit creative problem solving. For example, Starbuck [1989] shows how the executives of the Facit AB calculator company were so convinced of the superiority of their mechanical calculators, that they could not acknowledge the real threat posed by new electronic calculators until their company was on the brink of failure. As Bolman and Deal [1991, p. 4] point out, frames can create "psychic prisons" that inhibit learning because people "cannot look at old problems in a new light and attack old challenges with different and more powerful tools—they cannot *reframe*."

Sharing of Frames

The social cognitive perspective suggests that while members of a particular community have individual interpretations, they also have a set of core beliefs in common [Porac et al. 1989]. Professional and occupational training and socialization may be seen as an attempt by members of a community to instill the use of particular cognitive schemas in others, especially in new members [Van Maanen and Schein 1979]. The socio-cognitive literature acknowledges the strong effect of group or departmental membership, which influences the particular systems of knowledge, meaning, and norms to which members are exposed, and creates differences in interests and orientations among communities [Dougherty 1992; Gregory 1983; Shibutani 1962; Van Maanen and Schein 1979]. The research on social information processing [Salancik and Pfeffer 1978], power [Pettigrew 1973; Pfeffer 1980], specialization [Burns and Stalker 1961; Daft and Lengel 1986; Lawrence and Lorsch 1967], and organizational cultures [Gregory 1983; Riley 1983; Pettigrew 1979, Schein 1985; Strauss 1978] further suggests that people tend to share assumptions, knowledge, and expectations with others with whom they have close working relationships. Likewise, social interaction and negotiation over time create opportunities for the development and exchange of similar points of view [Gray et al. 1985; Isabella 1990].

A shared frame can take different forms. For example, Weick and Bougon [1986, p. 112] suggest three: an assemblage that ties individual frames together through common dimensions; a composite formed by group members jointly constructing a common understanding through discussion; and an average, which represents the intersection of frames held by individuals comprising the group. Our view of shared frames borrows from Wittgenstein's [1953] notion of *family resemblances*, where individuals can be said to share a frame if some core cognitive elements (assumptions, knowledge, and expectations) are similar.[2] Thus, we recognize that while frames are necessarily individually held, and hence inevitably reflect individual variation, it is nonetheless useful to distinguish those cognitive elements that—through socialization, interaction, or negotiation—individuals have in common. It is

[2]Thanks are due to Dick Boland for suggesting this application.

these collective cognitive elements that individuals draw on to construct and reconstruct their social reality.

While the concept of shared frames is closely related to that of subcultures, it should note be confused with it. Frames are cognitive structures or mental models that are held by individuals. Frames are assumed to be shared by a number of individuals when there is a significant overlap of cognitive categories and content. The concept of subcultures, on the other hand, is not purely cognitive, but refers to the "living historical product of group problem solving" [Van Maanen and Barley 1985, p. 33]. Subcultures are posited to be enacted realities. That is, individuals—drawing on their shared frames—engage in symbolic action and thereby construct a social reality that reflects their common assumptions, beliefs, and understandings, and that includes particular rules, rituals, and customary practices. Thus, while subcultures rely heavily on cognitive elements such as common frames of reference, they are not equivalent [Geertz 1973; Van Maanen and Barley 1985]. Where cultural and subcultural analyses provide interpretations of contexts—socially established webs of meaning and actions—frames of reference offer a crisp and powerful lens for focusing specifically on how people make sense of particular aspects of the world.

Technological Frames

To the extent that technology constitutes a core element in organizations, aspects of its members' organizational frames will concern technology. Most discussions of social cognition do not specifically address technology *per se*, emphasizing instead strategy, innovation, or change management. We think it is useful, at least analytically, to focus on the particular interpretations made about technology and its role in organizations. We use the term *technological frame* to identify that subset of members' organizational frames that concern the assumptions, expectations, and knowledge they use to understand technology in organizations. This includes not only the nature and role of the technology itself, but the specific conditions, applications, and consequences of that technology in particular contexts.

A few researchers have proposed the idea that individuals have assumptions about and expectations of technology [Bostrom and Heinen, 1977; Ginzberg 1981; Goodman et al. 1990], and we want to expand on these ideas, emphasizing the social nature of technological frames, their specific content, and implications for technology development, implementation, and use. While the concept of technological frames is rooted in social cognitive research, we have also drawn on the sociological literature that examines collective cognitions and social constructions of technology [Bijker 1987; Bijker et al. 1987; Henderson 1991; Sætnan 1991]. In this literature, technology frames are the understanding that members of a social group come to have of particular technological artifacts, and they include not only knowledge about the particular technology but also local understanding of specific uses in a given setting. This contextual dimension of frames is one we wish to preserve in our treatment of technological frames, as it is particularly significant. For exam-

ple, Bloomberg [1986] shows how users' perspective of a technology influenced and shaped the way in which it was embedded into their work process. As she notes, the meaning of a technology "can only be described and its significance appreciated in the context of its uses and its users" [Bloomberg 1986, p. 42]. We thus include the contexts of design and use, along with the artifact itself, as formative aspects of technological frames.

Technological frames have powerful effects in that people's assumptions, expectations, and knowledge about the purpose, context, importance, and role of technology will strongly influence the choices made regarding the design and use of those technologies [Noble 1986; Orlikowski 1992a; Pinch and Bijker 1987]. Because technologies are social artifacts, their material form and function will embody their sponsors' and developers' objectives, values, interests, and knowledge of that technology. For example, views of how work should be done, what the division of labor should be, how much autonomy employees should have, and how integrated or decoupled production units should be are all assumptions that are consciously or implicitly built into information technology by systems planners and designers [Boland 1979; Hirschheim and Klein 1989; Orlikowski 1992a]. Time, too, affects interpretation, both for the organization—where understandings of process and product technology rapidly congeal after implementation [Tyre and Orlikowski 1994] —and for society [Winner 1986], where, as Pfaffenberger [1988, p. 16] notes:

> "Once created, however, the opportunity for social choice diminishes. An implemented technology carries with it a powerful vision of the society in which it is to be used, replete with an equally powerful endowment of symbolic meaning and, sometimes, an obligatory plan for the way people will have to arrange themselves to use it."

Congruence of Technological Frames

Pinch and Bijker [1987] argue that because a technological artifact may be interpreted differently by multiple social groups, they will also construct different interpretations of it based on their interactions with it. Such interpretations, to varying degrees, are shaped and constrained by various groups' purpose, context, power, knowledge base, and the artifact itself. For example, automobile designers have different notions and knowledge of automobiles than drivers, who in turn have different interpretations than mechanics, and so on. With respect to information technology in organizations, there are usually a number of critical social groups—in what Kling and Gerson [1978] refer to as the social world of computing—whose actions will significantly influence the process and outcome of technological change. Managers, system developers, and users, at a minimum, will be key actors, and by dint of their membership in particular social groups and the different roles and relationships they have with technology, will tend to share their group's technological frame.

Such group frames are unlikely to be shared across the different stakeholder groups [Calder and Schurr 1981; Dornbusch and Scott 1975]. For example, technologists may be expected to have an engineering perspective of technology, treating it as a tool to be designed, manipulated, and deployed to

accomplish a particular task [Markus and Bjørn-Anderson 1987; Orlikowski 1988]. In contrast, line managers may have a more strategic understanding of technology, expecting it to facilitate certain ways of doing business and providing financial returns, while users may take a more focused or instrumental view, expecting immediate, local, and task-specific benefits.

We define the notion of *congruence* in technological frames as referring to the alignment of frames on key elements or categories. By congruent, we do not mean identical, but related in structure (i.e., common categories of frames) and content (i.e., similar values on the common categories). The notion is akin to that of cognitive consensuality [Gioia and Sims 1986; Isabella 1990], which Finney and Mitroff [1986, p. 320] define as "a reasonable amount of implicit agreement among organization members as to the appropriate meaning of information or events." Congruence in technological frames would imply, for example, similar expectations around the role of technology in business processes, the nature of technological use, or the type and frequency of support and maintenance. Incongruence implies important differences in expectations, assumptions, or knowledge about some key aspects of the technology. For example, a frame incongruence is apparent when managers expect a technology to transform the way their company does business, but users believe the technology is intended to merely speed up and control their work. Alternatively, incongruence may occur when technologists have a different understanding of and experience with a particular technology—say a database system, which they believe is highly malleable and customizable—to that of users who only experience a single structured interface, and hence believe the database system is inflexible and standardized.

We expect that where incongruent technological frames exist, organizations are likely to experience difficulties and conflicts around developing, implementing, and using technologies. For example, one of us observed significant frame incongruence between some organizational members who were participating in design sessions which they believed would create some minor changes to their existing technology and the consultants who understood their mandate as developing new technology around a reengineered work process. The result was a serious breakdown in communication, a lack of participation by users in the design process, and the eventual suspension of the project. Another example is given by Zuboff's [1988] case studies where managers were unable to accept information technology that would increase workers' autonomy and decision-making authority. The managers' frames were so rooted in traditional ideas of managerial authority that they could not "wrest themselves from deep-seated images of managerial control" [Zuboff 1988, p. 278], hence creating substantial incongruence between managers' and users' interpretation of the same technology. Managers would not acknowledge that operators' jobs had changed significantly as a result of information technology use, while the operators—experiencing the technological change—perceived a fundamental shift in their tasks, norms, and responsibilities. These frame conflicts soon led to social clashes around worker grievances and union action.

While we are most interested in the incongruence of frames across groups, since we believe that different world views are likely to be very important in influencing social relations, we also note that frames may be internally inconsistent. That is, while frames are typically self-reinforcing, even to the point of rejecting knowledge that does not fit their system of meaning [Dougherty 1992], they may also embody ideas that are ambiguous, obsolete, incomplete, or incorrect. Such inconsistencies within a group's frame are largely implicit, yet they often have important consequences. For example, group members may believe that a new conferencing technology will increase their collaboration and productivity within the group, while at the same time they may not expect personally to have to input substantial amounts of commentary, expecting everyone else to contribute. In this case, members are likely to promote group conferencing publicly, but not make any changes in their individual work habits to facilitate collaborative use of the technology.

In order to explore the concept of technological frames in more detail and provide a concrete illustration of its application and value, we now present some findings from an empirical study conducted by one of us. Our main interest in discussing these findings is to demonstrate the explanatory power of the technological frames concept, not to discuss the research study in full.[3]

The study investigated the implementation of a new information technology—a groupware system—into one large organization. The research included a focus on how different actors in the organization made sense of the new technology and how and why they interacted with it. Technological frames of the technologists and users were identified and found to be incongruent in a number of ways. This incongruence led to some incompatible actions around the technology, which made the groupware implementation more difficult than had been anticipated. Before presenting and discussing these findings, we first describe the research site and methods used.

RESEARCH STUDY

Research Site and Methods

The field study was conducted within a large professional services firm, Alpha Corporation (a pseudonym), which provides consulting services to clients around the world. With offices in hundreds of cities, Alpha employs more than 10,000 employees. As with other professional organizations such as law and accounting, Alpha has a matrix structure, operating at the decentralized office level through local project teams, but is centrally coordinated through policies set by headquarters. One of the most influential of these policies is the strict "up-or-out" career structure which controls progress of all consultants via four primary milestones—staff consultant, senior consultant, manager, and principal. In addition to the practice offices and headquarters, Alpha has a separate technology office which sets corporate technology standards and supports the firm's technological infrastructure.

[3]For more details on the study see Orlikowski [1992b].

A few years ago, Alpha purchased and distributed a groupware product—the Notes system from Lotus Development Corporation[4]—to all their consultants and support staff as part of a strategy, described by a senior principal as an attempt to "leverage the expertise of our firm." The research described here focused on the implementation of Notes over a five-month period in one large office of Alpha.[5] It investigated how the groupware technology was understood and acted on, both by technologists responsible for implementation and by consultants adopting its use. The research study began in February, 1991, before the Notes system was due to be installed and continued through its implementation and early use (June 1991). About five weeks were spent investigating the work processes and communication patterns before Notes was installed, and the rest of the time was used to focus on the users' attempts to learn, assimilate, and employ the new technology. The findings reflect participants' anticipations of as well as their early exposure to the Notes system. While these findings only reflect the adoption and early-use experiences with a particular technology, they are revealing because they highlight people's initial sense-making of a new technology in light of their existing cognitive structures and current work practices. Research by Tyre and Orlikowski [1994] suggests that early interpretations of a technology are particularly influential because they are established rapidly as the technology is assimilated into work practices and becomes built into organizational routines. Such embedded understandings and assessments of a technology are particularly difficult to change later.

A qualitative approach was used to collect and analyze the data [Eisenhardt 1989; Miles and Huberman 1984; Yin 1989]. Detailed data collection was conducted through unstructured interviews, review of materials, and observations in the field. Over 90 interviews were conducted, each about an hour in length, during which detailed notes were taken. In addition to the office where the study was conducted, key actors in Alpha's headquarters and technology offices were interviewed. Participants spanned all four of the firm's hierarchical levels and many of the functional groupings, including consultants in active practice, administrators facilitating practice activities, and technologists providing centralized technology support (see Table I). Materials reviewed included firm documents such as annual reports and promotional material (used to obtain background information on the firm's size and business), project information such as working papers and schedules, and training materials such as manuals and a video on the Notes technology. Observations of meetings, training classes, and individuals at work were also made throughout the study. The field notes from these observations were used to verify or elaborate the interview data. In addition, access to the Notes technology itself was available through a dial-up connec-

[4]Notes is an integrated working environment that supports communication, coordination, and collaboration through such features as electronic mail, computer conferences, shared databases, and customized views See DeJean and DeJean [1991] and Marshak [1990] for more details on the product.

[5]Henceforth referred to simply as "the office."

Table I. Number and Type of Interviews in Alpha

	Consultants	Technologists	Total
Principals	13	4	17
Managers	26	15	41
Seniors	12	13	25
Administrators	8	—	8
Total	59	32	91

tion to the office server, allowing observation of database use during the time of the study.

The qualitative approach facilitated an analysis of different actors' interpretations of the new technology and their actions around it. The data was first separated into groups—in accordance to whether it reflected statements or actions of consultants, managers, and technologists. Then, for each of these groups, interview transcripts and field notes were examined to identify statements or actions that reflected assumptions, knowledge, or expectations of the Notes technology and its implications for work and the firm's operations as a whole. The examination used a form of content analysis where the data is read and sorted into categories suggested by the data rather than imposed from outside [Agar 1980, p. 104]. Once all the data was examined for each group, cross-group analysis followed, which consisted of comparing the categories generated by each group's data to determine whether it reflected common themes [Eisenhardt 1989, p. 540]. Once these themes were identified, the data of each group was reexamined and recoded using the proposed themes; the goal being to determine that set of themes and categories that covered as much of the data as possible. This iterative examination yielded a set of themes which were posited to constitute core domains of the participants' technological frames. These domains were then inspected for similarities and differences across functions (consultancy versus technical support) and hierarchical levels (e.g., consultant versus manager, technology specialist versus technology manager). While there appeared to be some frame differences due to hierarchy, the most significant differences were evident between technologists and users. These differences in technological frame domains are discussed below.

Research Findings

Three domains were found to characterize the interpretations that participants made about the Notes technology and its role in Alpha and their work:

(i) *Nature of Technology*—refers to people's images of the technology and their understanding of its capabilities and functionality.

(ii) *Technology Strategy*—refers to people's views of why their organization acquired and implemented the technology. It includes their understanding of the motivation or vision behind the adoption decision and its likely value to the organization.

(iii) *Technology in Use*—refers to people's understanding of how the technol-

ogy will be used on a day-to-day basis and the likely or actual conditions and consequences associated with such use.

These frame domains were derived from a specific empirical setting. It is interesting to contrast these to the set of categories we had derived earlier, *a priori*, by examining the literature on systems development and IS impacts [Orlikowski and Gash 1991]. That attempt had yielded a larger set of categories (seven), each of which was quite broad; for example, "relations with other players in the social world of computing" included the relationships and interactions that individuals have with other social groups around information technology such as managers, users, technologists, vendors, consultants, customers, and government regulators. Of the seven, only two appeared in the Alpha data "issues around use" (related to the "technology-in-use" domain) and "criteria of success" (part of the "technology strategy" domain). It is not surprising that in our inductive approach to the empirical data we derived categories that were much more context-specific than those we had identified from the literature. This contrast does, however, substantiate the view expressed earlier, that frames are likely to be both time- and context-dependent, and are always more valid when examined *in situ* rather than assumed ahead of time.

The frame domains that emerged from the Alpha data embody understandings that, simply stated, reflect what the technology is (nature of technology), why it was introduced (technology strategy), and how it is used to create various changes in work (technology-in-use). The three domains clearly interact and overlap, and we do not believe they are independent. For purposes of discussion, however, we find it useful to analytically distinguish among them, particularly since such a distinction highlights the relevant differences between the technologists' and the users' interpretations of the technology.

The grouping of "technologists" here includes the chief information office (CIO) who heads Alpha's technology function, and some 40 people who report to him. Most of these have technical backgrounds, having worked as programmers and computer-support staff for most of their careers. The CIO is a principal of the firm, hired into this position a few years ago from a senior technical position outside the firm. His staff are not considered consultants, they are treated as regular salaried employees and not subjected to the lock-step timing and risk associated with the professional consulting career path.

The grouping of "users" here includes consultants at all levels (from staff consultant through to principal) as well as administrative support staff such as secretaries. Contrary to initial expectations, there were no substantial differences between consultants' and managers' technological frames. At least two reasons appear to account for this. The first is that in Alpha the technology was purchased and installed by the technologists, after they received approval from the chairman of the corporation. No other principal or manager was involved in the investment decision, and hence the only exposure that executives at Alpha had to the Notes technology was as users. Two, the distinction between workers and managers is much less marked in

professional firms, because all employees are considered professionals. While distinctions are still made among professionals on the basis of experience, expertise, tenure, and influence, the users in Alpha (staff and senior consultants) are all aspiring managers and principals, and are actively being socialized into thinking and acting as such. The result is a more homogenous mindset among the various ranks of professionals than might be found in other kinds of organizations.

Technological Frames of the Technologists

In discussing the interpretations of the Alpha technologists around the Notes technology, we consider in turn each of the three domains outlined above: nature of technology, technology strategy, and technology-in-use.

Nature of Technology. Technologists learned of Notes when they were searching for a standard communication technology that would facilitate electronic communication both within and across offices. At the time, such a capability did not exist within Alpha, either in the corporation as a whole or at the local levels.[6] A few weeks after having purchased an electronic mail system, the CIO was shown the Lotus Notes system and was very impressed. He noted:

> "I got a demo copy of it [Notes] and I thought it was dynamite. I knew in an hour that it was a breakthrough product, a revolution. I played with it for just two days and was really impressed."

Having examined Notes, the CIO was persuaded that not only did it have the functionality to match the firm's communication requirements, but also the capability to facilitate electronic conferencing and sharing of databases. He believed that this advanced capability would address another of Alpha's requirements, that of eliminating "reinvention of the wheel" throughout the firm. Consultants in different offices often worked on similar client problems without sharing their knowledge—they did not leverage the existing expertise in the firm. Reversing the decision to acquire simply an electronic mail system, the CIO quickly obtained approval to establish Notes as the standard communication and information-sharing platform in the firm. He recollected:

> "So I went to [my boss] and said, 'We have an opportunity of a lifetime to get involved with a wonderful product. ... I think it's an extraordinary technology.' [My boss] said 'It sounds good to me.'"

Having purchased thousands of copies of Notes for the firm's consultants, the CIO ordered his staff to install it (and the necessary supporting technology—hardware, networks, and servers) as soon as possible in all offices of the firm. He explained his rapid implementation strategy this way:

> "Our strategy was to blast Notes through our organization as quickly as possible, with no prototypes, no pilots, no lengthy technical evaluation. ... We realized Notes was a transformation technology. Our traditional implementation of tech-

[6]Certain groups within a few offices had set up their own local area networks and installed electronic mail systems on them, but these were largely standalone and incompatible endeavors.

> nology was 'creeping technology'—to give it to the technology guys, have them run a pilot, watch special groups use it, monitor and evaluate their usage, then roll it out phase by phase. But if you believe that Notes is a competitive technology you have to deploy it quickly, and put it in the hands of the users as fast as possible. Critical mass is key."

On a subsequent occasion, he reiterated his belief that critical mass was the most important factor in the Notes implementation plan:

> "The value of the technology [Notes] is proportional to the number of users. So the faster we could get to critical mass, the sooner people would use it."

Initially, the CIO's staff were somewhat less enthusiastic about Notes, being concerned about the potential complexity of the technical infrastructure and the CIO's demands for a rapid deployment. One technology manager commented:

> "We had no time to do a formal plan or a grand strategy because [the CIO] had raised the level of enthusiasm in the firm, and there was no way we could say to the principals 'wait while we get our act together.'"

However, as these technologists began to install the product on thousands of consultants' workstations across the country—implementing an office a week in what they termed "SWAT team" fashion—they began to share the CIO's assessments of the product as substantially different from conventional electronic communication systems. One senior technologist observed:

> "I first saw it [Notes] as an email product. I didn't see the grand scope of the product."

While another commented that, initially, "I hated it. I didn't appreciate the potential of the software," but that he had since "seen its value for the firm." A technology manager further observed that while the implementation had been accomplished with "a lot of fear and trepidation," they also realized that:

> "We couldn't give up, even though there were many times we wished we could. But we had to make it work, we had no choice. ...So we got to see it as a challenge, and it became exciting. And now we've really accomplished something in two years."

Many of the technologists' interpretations and actions around Notes reflected an assessment of the technology that emphasized its technical capabilities without reference to an organizational context or to a specific business use, as in the general references to "a breakthrough product," "an extraordinary technology," and "transformation technology." That is, the technologists were caught up in the advanced capabilities of the technology, rather than on its role as a means to some specific organizational end. This and the assumption that the nature of the technology and its potential value were obvious lead the technologists to suppose that Notes did not require much justification, assessment, or trial. This is evident in (i) their assumption that a feasibility analysis of Notes was not necessary, and hence their action in not conducting such an analysis; (ii) their decision not to follow a formal implementation plan, and hence their rapid and broad deployment of Notes; and

(iii) their assumption that once there were sufficient numbers of people connected to the network (critical mass), use would follow.

Technology Strategy. Technologists had a clear and somewhat broad vision of what the Notes technology could bring to the firm. Essentially removed from the day-to-day pressures of consulting work, the technologists couched the rationale and motivation for Notes in conceptual and nonspecific terms. For example, the CIO, the primary driver behind the Notes acquisition, offered a general vision of what Notes would do for Alpha:

> "Notes is capable of changing the culture of our firm, of enabling a view of technology that changes how we share information and deliver client service."

He reiterated this view on various occasions, for example,

> "Notes gives us a competitive advantage by transforming the way the firm does business."

This assumption was generally accepted by many of the technologists, as one manager echoed:

> "We want to transform the way we deliver service to clients."

What such changes would mean for the work, structure, and culture of the firm, or how they would be enacted, was not specifically articulated.

In addition to the motivation behind a technology's adoption, another indicator of peoples' interpretation of a technology's strategy is their view of which success criteria to use in evaluating the technology. When asked how they would assess the effectiveness of Notes within Alpha, technologists tended to employ technical criteria of success citing measures related to the deployment and operation of the Notes technology, rather than its business impact. For example, the CIO explained:

> "One measure of success is that we have 6000 users and 100 servers worldwide. And the number of applications is our other measure of success. We currently have about 200 databases."

Other technology managers had similar reactions, observing:

> "Indicators of success? That we need to add resources. We now need more horsepower because usage and volume have increased. For example, when we installed a fax gateway, our fax load tripled in 2 days.
>
> We have no formal measurement of Notes... We've deployed 7000 copies in two years. I think we have done very well."

Comparing these two domains of technology strategy—motivation for the technology and criteria of its success—some inconsistency in the technologists' assumptions and expectations is apparent. On the one hand, technologists have a view of technology that envisions it producing business changes by transforming the firm. On the other hand, they evaluate the success of that technology through technical measures, without an assessment of business performance, work practices, or client service. The focus on technical measures likely reflects the way in which the firm evaluates the performance of the technologists. Seen as technical problem-solvers, technologists are

often assessed on the performance of the technology, not that of the business. Thus, an inconsistency appears to exist between the (technical) success criteria technologists employ as part of their organizational role and their (business) vision of the value of the technology to the firm. Such internal frame inconsistencies often occur where frames are not articulated and reflected on.

Technology in Use. An important aspect of using technology is to know enough about it so as to appropriate and manipulate it effectively. Such knowledge is usually acquired through education and training. During the Notes installation in Alpha, the technologists decided to minimize the amount of education, training, and support they would provide to users. Their decision was influenced by four assumptions: (i) their own priorities and resources; (ii) the users' interest in training and application development; (iii) the ease-of-use of the technology; and (iv) the adequacy of existing policies and procedures around security, confidentiality, and quality.

First, technologists assumed that their first priority was to get the Notes system up and running across the firm. Because they had limited resources (staff, time, and money), they believed they had to trade-off spending these resources on education or on rolling out the technology. They chose to focus on the latter, as the CIO explained:

> "[The technologists'] focus in life is to keep it [Notes] going. It can never fail. So they are purely focused on the technical implementation. That's the right mental model for them."

A technology manager likewise commented:

> "We made a conscious decision between whether we should throw it [Notes] to the users versus spending a lot of time training. We decided on the former."

Second, the technologists assumed that consultants were busy professionals who would object to spending time on education and in attending training courses. Two technologists said:

> "They [the consultants] don't see training as important. They see it as a pain.
> The professionals want to take a pill and just learn it [Notes]. They don't want to spend the time and effort."

Lack of emphasis on training was consistent with the CIO's view that it is through use and experimentation, not formal education or extensive support, that people begin to appreciate a technology's potential and learn to apply it in different and interesting ways. He remarked:

> "The philosophy behind our implementation is that we see it [Notes] as an empowering tool. We put it in, build a small number of applications, sow the seeds, and see what happens. The development is self-justifying."

On two other occasions, he similarly observed that

> "We allowed an uncontrolled development environment to flourish. This is a tool for the masses, so we said 'do what you like.' ... If the technology is compelling enough, they [the users] will drift into new ways of doing things.
> People are smart; they'll figure out what to do."

This view was echoed by many of the technologists, as one technology manager noted:

> "We expected decentralized application development. We're trying to provide some centralized direction, but we don't want to dampen creativity."

Third, the technologists assumed—on the basis of their experience with the technology and the way it was being marketed by its vendor—that the Notes technology was an "end-user" tool, and hence that it could be learned and used by the consultants with relative ease. For example, two senior technologists observed:

> "Notes does not require formal end-user training. So we minimized training to reduce the period of trial. We didn't want them [the users] to think they had to learn to use Notes."
>
> "Application development is so easy, the average Joe can build his own applications."

While their manager noted that,

> "Notes is so intuitive that you can get a feel for it within minutes, even people who haven't used computers before."

Evident in these interpretations is a view of the user, which, on close inspection, appears somewhat inconsistent. On the one hand, users are portrayed as "smart," hence requiring minimal training and support. The videotape developed by the technologists and supplied to each office was intended to be viewed by consultants on their own. Both the tape and its accompanying workbook are focused almost entirely on the mechanics of using Notes. For example, the workbook includes the following sections: "Database Views and Windows," "Additional Basic Features," and "Using Notes Mail." The assumption is that users will "figure out" how to apply the technology to their own work. As one technologist noted in exasperation by a user's request for extra support:

> "At some point these individuals have got to take some responsibility for finding things out for themselves. ... But they just want to be spoonfed. They expect us to do everything. We feel they should meet us halfway, but they don't think so."

On the other hand, users are patronized, as evident, for example, in a technologist's database of users waiting to receive Notes, which he had labeled "rollout victims," and in the remarks offered by some technologists on why they do not teach application development in Notes training classes:

> "Once users start creating their own applications, they go nuts. So we have to stop them before they do damage."
>
> "We worry about the quality of applications designed by such people, and the inappropriate format, standards, etc. of things that may be created, shared, and used."

On another occasion, a technologist amused his colleagues with a story, recounting a hands-on computer demonstration where a user picked the mouse up and tried to use it by pointing it at the screen as if it were a remote-control device. Such stereotypical views of users are not uncommon in IS departments.

Fourth, the technologists assumed that the new technology did not pose any new issues with respect to security, confidentiality, and data quality. The CIO commented:

> "The privacy and security issues are decided by the owners of the databases [the users]. We have a relatively open environment in the firm; so we leave privacy and security up to the local people. We trust them. ... Client confidentiality is a cultural value for our firm, so those norms will be extended to Notes. Notes does not raise any new issues."

Likewise, a senior technology manager noted:

> "I don't get a sense from the users that they care about security. We also didn't get a sense from Lotus that other companies were concerned about security."

With respect to control over the quality of data that would be entered into Notes, the CIO observed:

> "The issue of obsolete data quality? As Notes—we're a common carrier—we make no guarantees about data quality. As for the problem of obsolescence, if they [the users] don't know it by now it is not my job to tell them. These are not new issues. We have the same issues with paper. You must understand that this is a professional services firm where we have a standard of conduct and procedures which are well established in our practice... This is a firm whose success is based on multiple reviews. So procedures already exist for ensuring that information is checked and reviewed."

The technologists' frame of Notes-in-use—that it is easy to use, easy to create new applications for, and that it does not raise new issues of security or confidentiality—is reflected in their own use of Notes. As was evident from the activity on the Notes system, the technologists were active users of various discussion databases they had created, such as "antivirus discussions" and "hardware and software support." Many technologists frequently accessed and contributed to these databases, sharing information about technical problems, solutions, trouble shooting, and new or upgraded products.

Technological Frames of the Users

As in the discussion of technologists' frames, users' interpretations of the Notes technology will also consider in turn each of the three domains outlined earlier: nature of technology, technology strategy, and technology-in-use.

Nature of Technology. The users in this study received little official information about Notes, or the rationale behind its wide-scale implementation. When they were interviewed a few weeks before Notes was to be installed in their offices (about a year after the firm had purchased the technology), some users had limited knowledge of the technology:

> "With respect to Notes, I know nothing about it. I don't know what it is supposed to do, and I don't know when I am supposed to get it. So I have no expectations about it."
>
> "I first heard that the firm had bought Notes through the *Wall Street Journal*. Then your study was the next mention of it. That's all I know about it."
>
> "I heard about Notes [at the managers' seminar] about eight months ago. I still don't know what it is."

Other users had ideas about the technology, but these were either only partially correct, or somewhat incomplete:

> "I believe Notes is putting word processing power into spreadsheets."
>
> "Is it a new version of 1-2-3?"
>
> "It's the great file in the sky."
>
> "It's a database housed somewhere in the center of the universe."
>
> "I understand that it makes your work environment paperless. It's like taking all your files—your library of information in your office—and putting it on the computer."
>
> "It has something to do with communications."
>
> "It's big email."
>
> "I've heard that it's hard copy of email... but I am not very clear about what it is exactly."

Research in cognitive sociology [Cicourel 1974; Goffman 1974] and organizational studies [Van Maanen 1984; Weick 1979a] suggests that people tend to approach the new in terms of the old. The same may be expected of people confronting new technology. In the absence of other information, they will attempt to interpret it in terms of their existing technological frames, imposing assumptions, knowledge, and expectations about a familiar technology on the unfamiliar one. This is evident in the statements above, where Notes is interpreted in terms of existing technologies. It is also explicit in the comments by two managers explaining why technology in general (and by implication, Notes) would not be useful, given their particular modes of working:

> "My workstyle is heavily interpersonal and oral. So far computers have not really saved me time. I am not interested in doing all that protocol stuff to get access. I don't want to deal with a programmer's conception of the world. If I wanted to be a programmer, I would have become one. I approach Notes with the attitude "Do I really need this?" Other folks are more trained in computers and analytic methods, and don't have the black-box mentality that I do. They tend to work quantitatively rather than textually or with narrative. And they tend to work in black and white while I work in greys. ...These perceptions cloud how you see things like Notes. I see computers as black and white, and so as not really suitable to my work."
>
> "I'm much more of a people or words person than a numbers person. My feeling is that computers are more of a numbers technology than a words technology. I don't use computers. I write most of my memos to my clients by hand, in writing. I think it's more informal, more personal, and I mail it out that way. I have a computer, but I don't use it."

The next comment, by a senior manager, reflects the expectation that the use of Notes would detract from the advantage he has in face-to-face interaction:

> "Face-to-face interaction is the most important mode of communication for me. I do very little written communication unless it is a product such as a research report or there's a need to memorialize it. I prefer to do things face to face anyway as I think it is more effective. I have a very strong physical presence, as you can see."

Finally, a manager noted how Notes reminded him of an earlier unpleasant experience with technology:

> "I don't know much about Notes, but it is coming from the top down. I found out

Table II. Contrasting Technologists' and Users' Technological Frames around the Notes Technology

Domain	Technologists	Users
Nature of Technology	Focus on technological capabilities in isolation, without reference to specific uses in particular contexts: "I knew in an hour that it was a breakthrough product, a revolution. I played with it for just two days and was really impressed." Value of technology seen as obvious, hence formal assessment, justification, or implementation plan not required: "But if you believe that Notes is a competitive technology you have to... put it in the hands of the users as fast as possible." "The faster we could get to critical mass, the sooner people would use it."	Misunderstanding or confusion about the technology: "I know nothing about it." "I still don't know what it is." "I am not very clear about what it is exactly." Interpreting new technology in terms of old: "I believe Notes is putting word processing power into spreadsheets." "Is it a new version of 1-2-3?" "It's big email" Comparing to computers in general: "I see computers as black and white, and so as not really suitable to my work."
Technology Strategy • *Motivation* • *Criteria of success*	Motivation for technology adoption envisioned in terms of major changes in the way of doing business: "Notes gives us a competitive advantage." "We want to transform the way we deliver service." Technical criteria of success, focused on deployment: "One measure of success is that we have 6000 users and 100 servers worldwide." "Indicators of success? That we need to add resources." "We've deployed 7000 copies in two years. I think we have done very well."	Motivation for adoption of technology seen as facilitating incremental changes to the firm: "...it is an efficient tool, making what we do now better. But it is not viewed by the organization as a major change." "Notes will do to fax what fax did to telex, replace it" Technology viewed with skepticism: "But some [of us] are skeptical. ...I have [heard that] there is no value in information technology so you can imagine how I feel!"— "I don't believe that Notes will help our business that much, unless all our business is information transfer. It's not."

today that it is mouse-driven [makes a face]. There's something about a mouse that I believe is inefficient. I took a course in [name of company-specific system]. It was mouse driven. What drove me crazy was the hand-eye coordination—I just didn't have it. It also reminds me of a video game, and so it annoys me."

Thus, users related Notes to computers in general, to particular aspects of the computer (e.g., the mouse interface), to already familiar specific computer applications (e.g., spreadsheets, word processing, electronic mail, files, and video games), or in contrast to other communication media (e.g., oral and face-to-face). Such a reference logic led to ambiguous, incorrect, or partial images of Notes incongruent with those envisioned by technologists (see Table II for contrast).

Table II. (Continued)

Domain	Technologists	Users
		Business criteria of success: "...increased fees or brought in new clients." "...added to our competitive advantage."
Technology-in-Use —*Priorities and resources* —*Training* —*Ease-of-use* —*Policies for security, quality, etc.*	Installation is critical, hence it is the primary focus: "[The technologists] focus in life is to keep it going. ...So they are purely focused on the technical implementation." Users will learn to use the technology on their own: "Notes does not require formal end user training. So we minimized training to reduce the period of trial. We didn't want them [the users] to think they had to learn to use Notes." Users will build their own applications: "Application development is so easy, the average Joe can build his own applications." "People are smart, they'll figure out what to do." Technology does not raise any new issues about the confidentiality, security, or quality of data: "Client confidentiality is a cultural value for our firm, so those norms will be extended to Notes." "As for the problem of obsolescence, if they [the users] don't know it by now it is not my job to tell them. These are not new issues. We have the same issues with paper."	Lack of training seen as an inhibitor to understanding and using technology: "If I had more formal training, the product might be more useful." "Training here is so basic it doesn't tell you much." Lack of understanding seen as an inhibitor to using the technology: "It's no good just putting the technology on our desks. You have to show us practical applications, something with real value to my work." Concern about confidentiality and security of data in the databases: "We need to worry about who is seeing the data." "I have concerns about what goes into the databases and who has access to them and what access they have." Concern about data quality, personal liability, and control over data in databases: "I would be careful what I put out on Notes, though. I like to retain personal control so that when people call me I can tell them not to use it for such and such. But there is no such control within Notes." "I'd be more fearful that I'd put something out there [in a Notes database] and it was wrong and somebody would catch it."

Technology Strategy. The lack of formal communication about the Notes product resulted in users having either a simplistic understanding of the Notes strategy or being highly skeptical of its potential. In the former category were those users who had interpreted Notes as a personal productivity tool, akin to spreadsheets or word processors. Such users interpreted the rationale for Notes in terms of improvements in personal efficiency; that is, as an incremental change in the firm's business, as a few managers com-

mented:

> "The general perception of Notes is that it is an efficient tool, making what we do now better. But it is not viewed by the organization as a major change."
>
> "I think [Notes] will reduce the time of gathering information. I think it will cut down on frustration in transferring information. But it is not a radical change."
>
> "Notes will do to fax what fax did to telex, replace it."
>
> "I see Notes as a personal communication tool. That is, with a modem and fax applications I can do work at home or at a client site and use Notes to transfer work back and forth. In the office, instead of getting my secretary to make 20 copies of a memo she can just push a button."

Other users, however, were skeptical of the value of the Notes technology, both for their own work and that of the firm—as evident from these observations by principals:

> "I don't believe that Notes will help our business that much, unless all of our business is information transfer. It's not. Business is based on relationships. Ideas are created in nonwork situations, socially, over lunch, etc."
>
> "I don't think Notes will have an impact on clients—clients have to have confidence in the people, in their professionalism. Technology should not make a difference here."
>
> "But some [of us] are skeptical. ...I have [heard that] there is no value in information technology—so you can imagine how I feel!"
>
> "I don't see it as a means of communication in the office. I sit within 20 feet of my group, so I don't need electronic communication. If I want to communicate with my people, I have five ways to do so: (1) yell; (2) see them face-to-face; (3) write a note on paper; (4) send voice mail (this is the easiest as I don't have to write); and (5) use Notes. If I had to rank them, I'd always put Notes as number 5."
>
> "I am afraid it [Notes] will slow things down. I can't type as fast as I can talk. I dictate a lot. Also it doesn't have the same portability. I can call in to voicemail from the phone in a hotel room—even from the bathroom. PCs are too heavy to lug around. I only have to take my finger with me to use voicemail when traveling."

and managers:

> "A lot of people's main business is not sharing information. And because they are not dependent on it [Notes] for their work, they won't use it for other purposes."
>
> "I'm skeptical about the successful use of Notes. We're not as close as we think we are. We've committed the financial resources, but that's all so far. We're not going to make sure everyone in the office has 15 hours over next year to spend time learning it. And if they expect us to take it out of our own time I'm not going to invest that time. I have another life too."

One manager's skepticism of firm-wide use of Notes reflected his belief that principals would not use it: "They're still afraid to use computers," and then related a popular stereotype of principals in the firm:

> "The most important criterion of advancement from the senior manager level to principal level is if you don't know how to turn your computer on."

With respect to how users would measure the effectiveness of the Notes technology, most cited business criteria. For example,

> "Criteria for success here is how much money you bring into the firm. Does Notes help that? At lower levels it's more chargeable hours and working on more important clients."

"I can't say [Notes] has increased fees or brought in new clients."
"I would like to know how [Notes] has added to our competitive advantage."
"I would try to see if [Notes] reduced my work load."

Unlike the technologists, the users' understanding of the motivation behind the technology and the criteria of its success were internally consistent; that is, related to improving their and their firm's performance. However, the users' assessment of the strategy behind the adoption of Notes contrasted markedly with that of the technologists (see Table II for contrast).

Technology in Use. When consultants began to use Notes, they used it largely for communicating via electronic mail. Users believed that their education and training on Notes had been inadequate. For example, an administrator, on being asked what she thought of the Notes training, said:

> "Computer training here is awful. It really is. I wish you would come to see for yourself how bad it is. I'm a reasonably smart person but they [the technology support staff] make things so complicated. It really is not very helpful."

Users also believed that they lacked the knowledge necessary to use Notes effectively:

> "If I had more formal training, the product [Notes] might be more useful."
> "Training here is so basic it doesn't tell you much. It showed me how to look at my mail and send messages."
> "I think the Notes training must become much more directed: what one of my colleagues calls 'Day-in-the-life-of...' training. This type of training should emphasize what a consulting manager typically does during the day and how Notes can help the manager do it better and more quickly."

Related to inadequate training was the lack of understanding of what the technology was useful for. Where the nature of a technology is poorly understood, and in the absence of a clear directive on how to use it, users found it difficult to know how to appropriate the technology and use it effectively. They were also less likely to be motivated to do so. For example, consider these managers' comments:

> "I have no great need for Notes. I don't know what it can do for me."
> "We are so task oriented; we are not going to think of applications and creative uses. It's no good just putting the technology on our desks; you have to show us practical applications, something with real value to my work."
> "For me to use Notes I need a better understanding of the applications and their value. I am not willing to invest a lot of time to create or use applications. It's been a terrible year—I've clocked 600 hours of overtime. I'm tired. I don't have time to worry about Notes."

and these comments by two principals:

> "I have not looked at the Notes books [manuals] yet. Other than mail it is unclear to me what I should use Notes for. I wouldn't look through the databases. I looked at the folders and wondered what I should call them. I am hoping I will get a better idea of how I can use it from the books."
> "I don't know 2% of the power of Notes. They [the principals in this group] have talked about Notes. We are not sure what it can do yet, so how can we decide how to utilize it? Now we are using it as a typewriter."

Further, in contrast to the technologists' view that existing policies and procedures around security, confidentiality, and quality were adequate, users had reservations. Principals in particular were concerned about threats to security, confidentiality, and authenticity:

> "Security is a concern for me. Databases will have all the people in our group—their names, compensation, career path, reviews, all very confidential material. ... So there should be prohibitions on information access."
>
> "We need to worry about who is seeing the data. ... Managers should not be able to access all the information even if it is useful [such as] financial information to clients, because they leave and may go and work for competitors."
>
> "I have concerns about what goes into the databases and who has access to them and what access they have."
>
> "The flip side of using Notes to share information is the risk of breaking confidentiality of clients, or undermining the value of special projects. No one would trust the security controls even if they were imposed. There are no guarantees that those who access the information will keep it confidential."

Managers and senior consultants, in turn, were anxious about data quality, personal liability, and embarrassment:

> "I would be careful what I put on Notes though. I like to retain personal control so that when people call me I can tell them not to use it for such and such. But there is no such control within Notes."
>
> "My other concern is that information changes a lot. So if I put out a memo saying X today and then have a new memo two weeks later, the person accessing the information may not know about the second memo which had canceled the first. Also if you had a personal discussion you could explain the caveats and the interpretations and how they should and shouldn't use the information."
>
> "I'd be more fearful that I'd put something out there [in a Notes database], and it was wrong and somebody would catch it."
>
> "I would be concerned in using Notes that I would come to the wrong conclusion; and others would see it. What would make me worry is that it was public information and people were using it, and what if it was wrong? I would not want to be cited by someone who hasn't talked to me first. I'm worried that my information would be misconstrued and it would end up in Wichita, Kansas '... as per J. Doe in New York' being used and relied on. You should be able to limit what access people have to what information, particularly if it is your information. I would definitely want to know who was looking at it."
>
> "Apart from the security concerns, I would want to know if Notes databases were subpoenable. That's scary if our research opinions could be used in malpractice suits."

The users' frame of Notes-in-use—that it is difficult and time consuming to learn and use, and that it raises concerns about control, confidentiality, security, and liability—is reflected in their use of it. Users did not actively or significantly utilize discussion databases in their initial dealings with Notes. Some users found benefit in electronic mail and file transfer, but the majority of users (at least at the time of this study) did not engage in expertise sharing and collaboration.

In these assumptions about Notes and its context of use, it is apparent that for Alpha users, technology was a means to an end. Their primary focus was on client service and on consulting activities. They had to meet tight project

schedules and manage a competitive and uncertain career situation. As a result, they were unwilling to invest time and energy in learning and using a technology that provided no apparent and immediate benefits. Interpretations of the Notes technology-in-use by these users suggest a focus and range of concerns that were not deemed problematic by the technologists (see Table II for contrast).

Outcomes of Technological Change

While the implementation of Notes within Alpha was completed and organizational members began to use the technology, the nature and extent of their early use differed from that expected by the technologists. Differences in expectations and actions between technologists and users can be traced to the differences in the respective technological frames of the two groups. Cognitive incongruence can be found in all three domains discussed previously.

Nature of Technology. The technologists had an understanding of Notes and its capabilities that recognized its broad potential as a platform for information sharing, electronic communication, document management, and on-line discussions. They understood its power in supporting group work, in contrast to spreadsheet and word processing packages that facilitate individual work. Users, in contrast, had a more limited understanding of Notes and the extent of its capabilities. Most recognized its electronic mail features and its potential to substitute for existing communication technologies such as fax and telephone. These interpretations, however, framed the technology as an individual productivity tool, rather than a group tool. The capability of the tool to facilitate group work and collaboration was largely not appreciated. These different views on the nature and functionality of Notes shaped different assessments of its value and influenced different response to it. It is thus not surprising that at the time of the study, those users utilizing Notes did so in support of their individual work, while technologists used Notes to support both individual and collective work.

Technology Strategy. The technologists had expected that Notes would "leverage the expertise of our firm" and "transform the way we deliver service to clients." These expectations suggest a significant change in the work practices, policies, and norms of the firm, and invoke anticipation of second-order changes. Such changes "involve shifting to radically different assumptions and modes of operation, with the shift reflecting a replacement of the status quo" [Gash and Orlikowski 1991, p. 190]. In contrast, the changes enacted by the users in one office of Alpha suggest that where the Notes technology was used, it was to substitute for existing technologies (e.g., fax, express mail, telephone) and to speed up communication flow. Such a change resembles first-order changes, which reinforce the status quo by creating incremental improvements in established assumptions and modes of operation [Gash and Orlikowski 1991]. Technologists believed that the strategy behind the Notes acquisition was to enable fundamental changes in the business practices and culture of the firm, while users believed the strategy

behind Notes was to create incremental improvements in firm communications.

Technology in Use. Technologists assumed that Notes was an end-user tool that the professional and well-educated users could learn and use easily, and largely on their own. Hence, they focused on delivering the technology to all the users and on keeping it operational. They expected users to adopt Notes, change their work around it, develop innovative applications, and extend existing confidentiality policies and quality procedures. Users, on the other hand, lacked the exposure and knowledge to understand the functionality of Notes and its potential to significantly improve their work and that of the firm. They assumed that because Notes was a technological change, technologists should demonstrate its benefits, develop appropriate training materials, provide business-relevant applications, and design guidelines around security, liability, confidentiality, and quality.

While users and technologists interpreted Notes quite differently, group members took actions that were consistent with their particular technological frames. To users, Notes was an individual productivity tool aimed at improving firm communication, while, to technologists, Notes was a different class of product—a group productivity tool—that could enable profound changes in work and interaction. In the first few months of Notes implementation in one office, some benefits from its use were obtained, particularly around electronic mail. However, the incongruence in frames between the technologists and users had also resulted in unanticipated outcomes, such as an initial barrier of skepticism and frustration and the perception that the office had not realized the benefits that were anticipated at the acquisition of Notes.

This study only examined early use of Notes; hence changes in interpretations and actions around the technology are possible in the future. However, because early interpretations of technology tend to congeal [Tyre and Orlikowski 1994], the apparent incongruence may be problematic in the long term, since the cognitive habits formed through initial exposure could prove difficult to change later.

IMPLICATIONS OF THE TECHNOLOGICAL FRAMES CONCEPT

In this article we proposed the concept of technological frames and argued that such a social cognitive perspective on information technology offers a particularly important approach to examining and explaining the development, use, and change of information technology in organizations. We drew on the findings of a research study to apply the concepts of technological frames and congruence in order to illustrate their explanatory power. We were able to explain technology change outcomes by referring to the significant differences in the technological frames of key actors. The conceptual framework developed here has important implications for both research and practice.

Research Contributions

We believe that the concept of technological frames extends earlier work on cognitive structures by focusing on the increasingly salient organizational

arena of information technology. While organizational researchers have examined the role of collective cognitive models in organizational action, few have studied collective cognitions of technology. Drawing on the organizational and sociological literature, we have defined technological frames as the core set of assumptions, expectations, and knowledge of technology collectively held by a group or community. While technological frames are individually held, they are also social phenomena, in that mutual understanding shared by individuals undergirds enactment of a social reality. In this way, social cognitions connect to institutional analyses, which are concerned with the shared, taken-for-granted systems of social rules and conventions that structure social thought and action [DiMaggio and Powell 1991, p. 9]. A focus on the social nature of technological frames allows us to ask a number of useful questions about collective interpretations of technology: What frames do particular groups of individuals share, why, and with what consequences? How are these shared understandings formed, reinforced, institutionalized, and changed over time? What is the underlying process of such cognitive formation, stagnation, and modification? How do shared frames of a group become embedded in technology design and work routines, and with what consequences?

We believe that the concept of technological frames is a particularly useful analytic tool for examining how and why people act around information technology. In particular, this concept allows us to explain and anticipate outcomes that are not captured by other perspectives, such as political or structural contingency models. For example, while a political perspective may explain particular outcomes that are due to the loss or gain of power by a group, it cannot explain contradictory outcomes due to different interpretations of a technology. For example, in the Alpha case users and technologists conceived of Notes differently. The appropriation of Notes as an individual productivity tool stemmed from users' interpretation of Notes as being similar to other already familiar technologies. Technologists, in contrast, understood Notes as facilitating group interaction; hence they appropriated it as a group productivity tool. In this case, frames provided a valuable lens through which to understand the interpretive grounds for human action around technology. The concept of technological frames thus forms a powerful and useful complement to other forms of social analyses, such as power, control, and resource dependency [Gash 1987; Grudin 1988; Kling and Iacono 1984; Markus 1983]. In an overall investigation of technology implementation and use in organizations, we believe that both interpretive analysis of technology frames and institutional analyses of structural, cultural, and political issues are valuable. For example, the detailed analysis of Alpha [Orlikowski 1992b] included an examination of the institutional elements (such as reward systems, career paths, and work processes) that constituted the context within which Notes was introduced and used.

Examining shared cognitions around technology can be a powerful means of articulating and tracing the influence of information systems in organizations. To date, it would appear that contributions of cognitive researchers have been primarily limited to understanding individual cognitive processes

such as learning, problem-solving, and knowledge representation in AI research, and issues concerning human factors such as visual and linguistic interfaces. Our framework focuses on the influence of shared frames and suggests a potentially broader role for cognitive research in studying information systems. It also allows us to trace the often unacknowledged structural influences of shared interpretations. Over time, the assumptions and categories of shared cognitive structures are often externalized and institutionalized [Giddens 1984; Hedberg et al. 1976; 1977; March and Simon 1958; Schein 1985]. Once institutionalized, frames tend to produce cognitive inertia —a conservatism which may protect the organizational status quo, but which may also prevent an organization from adapting to a changing environment. Typically, frames are built into the artifact that technologists design and construct [Orlikowski 1992a], when, for instance, the assumptions and vocabulary of technologists interpret user requirements and drive the design process [Boland 1979; Markus and Bjørn-Andersen 1987]. These artifacts then shape the formation of users' frames, as they attempt to appropriate that technology [Orlikowski 1992a]. Users' frames, in turn, become routinized and embedded in taken-for-granted mental and behavioral habits. The institutionalizing influence of shared technological interpretations over time has largely been unexplored within information systems research. The concept of technological frames can help us investigate it.

Because the concept of frames is a process rather than a variance theory, it is particularly valuable in examining the changes associated with implementation of a new technology over time.[7] Social cognitive research has recognized that mental models are particularly salient sense-making devices during processes of organizational change [Bartunek and Moch 1987; Isabella 1990; Starbuck 1989; Van Maanen and Schein 1979]. Likewise, technological frames may be used to track changes in the meanings people ascribe to information technology over time, thus providing a way of investigating the processes and outcomes of organizational change [Gash and Orlikowski 1991]. Building on the work of Greenwood and Hinings [1988], we propose that technological frames may be used to track both expectations of technological change and the experience of technological change. Because such an approach examines change as anticipated, interpreted, and experienced by different organizational players, both intended and unintended changes can be studied. Through such a process view of technological implementation and use, the complexities, subtleties, and dynamics of technological change can be addressed in a manner not possible with variance theories.

Implications for Future Research

Our research has identified an initial set of domains for technological frames that can serve as the basis for future work. These domains provide guidelines for examining and articulating people's interpretive relations with technol-

[7] For a detailed discussion of the differences between process and variance theories see Markus and Robey [1988].

ogy. Three domains of technological frames—nature of technology, technology strategy, and technology-in-use—appeared to be relevant in the context of a consulting firm implementing a groupware technology. While we believe that these domains are relatively general and likely apply to a diversity of situations, much will be learned by examining them in other organizational contexts and with other technologies. We also expect that further empirical investigations will elaborate the domains of technological frames, adding both domains that apply to technology in general and those that reflect particular kinds of technologies and specific institutional contexts.

Research is also needed to identify the means through which frames around information technology become shared or divergent, and to examine areas of incongruence among the frames of key and associated actors. For example, it would be useful to assess how much difference in assumptions, knowledge, and expectations constitutes frame incongruence, and whether the notion of incongruence varies by context and time. Research studies might focus on determining the conditions that lead to increased or decreased congruence in frames, and on elaborating the different organizational consequences usually associated with varying degrees of frame incongruence.

Assessing and recognizing incongruence may be particularly difficult when frames differ on only some domains when they include considerable ambiguity and inconsistency, or when they are particularly difficult to articulate. Additionally, research may examine the degree of tolerance or rigidity of frames with respect to new and possibly contradictory information, the extent of commitment by various participants to particular frames, and how frames reflect or deviate from organizational realities [Schwartz 1990]. The process view of frames also requires an examination of the conditions under which frames change. For example, identifying the internal and external triggers that typically serve as catalysts for frame changes in various situations is an important area of study, as is determining how effective various triggers are in accomplishing changes in people's frames and how these lead to changes in action [Louis and Sutton 1991].

Assessing incongruence and inconsistency in frames and eliciting deeply held assumptions, expectations, and knowledge poses a number of methodological challenges. We believe there are a variety of methodological approaches amenable to the study of technological frames and frame incongruence across groups. For example, particular kinds of interviewing techniques, such as clinical interviewing [Schein 1987], discourse-based interviewing [Odell et al. 1983], and focus groups [Krueger 1988] provide some guidelines for eliciting assumptions and meanings. Researchers could collect data by directing within-group focus groups or in-depth interviews that stimulate discussion specifically around meanings of technology and expectations around its use. Data gathered at interactions between members of multiple groups (e.g., managers, users, technologists) such as joint application design (JAD) sessions may provide good opportunities for observing congruence (or its absence) and diagnosing reasons for the apparent discrepancies.

Frames are also revealed through the media of action and language, where the former may be discerned through observation, and the latter through analysis of metaphors, imagery, symbols, and narratives. While we focused primarily on interview data, the analysis of the data was also informed by a number of visual images that are often difficult to integrate into journal articles. For example, we had access to training materials such as manuals and a video, physical data gathered through observing people at work, and actual usage behavior obtained through accessing the technology available to the users. Analyzing these visual artifacts can provide important clues as to people's implicit understandings, values, and concerns. For example, in response to a question about the utility of Notes, a user expressed his view quite clearly by fetching a cartoon that graphically depicted skepticism about the value of technology in the workplace.

Another important consideration is determining how best to analyze the data. We posit that content analysis of qualitative data is a viable method for "reading between the lines" to assess underlying assumptions and expectations, much as culture researchers interpret manifest artifacts, symbols, and stories. Researchers might begin by coding the content of their interviews, focus group transcriptions, and observations in terms of the three domains we have proposed here [Eisenhardt 1989]. Such analysis would reveal whether new categories are needed, and if sufficient evidence for categories is found, they can be examined for the underlying domain they reflect. Frames may then be examined for internal consistency (using, where feasible, some form of reliability statistics), and for congruence across groups (e.g., by clustering common domains and determining divergence). The coding, categorization, and interpretation of data by researchers may also be strengthened by being validated directly with sources. In fact, such an exercise may serve to facilitate further discussion, reflection, and articulation of assumptions, meanings, and experiences.

Implications for Practice

Early articulation, reflection, discussion, negotiation, and possibly change of inconsistencies and incongruences may reduce the likelihood of unintended misunderstandings and delusions around the implementation and use of a new information technology. Attempts to bring to the surface the common assumptions, expectations, and knowledge can be particularly useful before the design and implementation of a system, to identify where and why key stakeholders' frames are incongruent, and where and why particular frames may be internally inconsistent. We saw from the field study how domains of people's frames were both incongruent across two key groups, but were also internally inconsistent within one of the groups. This inconsistency and incongruence led to certain action and inaction that hampered the implementation of a new technology. Early identification of these inconsistencies and incongruencies may have avoided some of the difficulties experienced during the implementation.

Our conceptualization of technological frames also provides a means for influencing groups' frames as the technology development and implementation process proceeds. Initial assessment or benchmarking of frames will indicate the degree to which participants share an understanding of the organizational changes intended by a new technology. Tracking groups' frames over time provides practitioners with insight into the underlying reasons for different conceptions and actions by key stakeholders. It may also provide insight into the source of the incongruence and hence the nature of appropriate interventions. Different types of incongruences should likely be treated differently. That is, distinguishing between incongruences due to political differences and those due to information deficiencies would allow for developing specific interventions that dealt with the particular difference at hand. Specific data about the sources of incongruence or inconsistency around a technological change may be used to design a number of interventions to attempt clarification or alignment of people's understanding, including reframing the change effort. For example, Bartunek [1984] notes how a school principal—realizing the political concerns of the teachers—was able to effectively introduce microcomputers by reframing the desired change as a more acceptable incremental change to the curriculum (computers as a learning aid) rather than as the more radical and threatening change initially anticipated by the teachers.

Technological frames also have implications for the practice of IS development itself. In their design and construction of information systems, technologists have tended to rely on structured methodologies to elicit information requirements from managers and users. Traditionally these methodologies have paid little attention to technologists' assumptions, expectations, knowledge, and how these may differ from the frames of managers and users for whom the technology is being built. Some of the techniques of frame articulation and assessment mentioned above might usefully be applied to technologists, so as to track the degree to which their interpretations of the technology and associated organizational changes relate to those of other stakeholders. These techniques would be particularly important in the case of external systems consultants since they have no common organizational context with their clients; hence congruence in frames may be even more difficult to accomplish.

CONCLUSION

In this article we have developed the concept of technological frames and suggested that people's technological frames influence their actions toward technology. We further posited that technological frames are shared by members of a group having a particular interaction with some technology. We defined the notion of frame incongruence and suggested that different groups may have incongruent technological frames, which could lead to difficulties around technological use and change. Different technological frames imply different ways of knowing and making sense of technology. As these different interpretations are typically not articulated or discussed, they may, as we

saw in the case of the Notes implementation, result unintendedly and unknowingly in misaligned expectations (such as technologists intending improvements in group work while users perceive improvements in individual productivity), contradictory actions (such as technologists installing and operating a technology while users wait for training and applications), and unanticipated organizational consequences (such as resistance, skepticism, and spotty adoption).

By articulating the interaction between shared interpretations, social action, and technological artifacts within an organizational context, technological frames offer a number of theoretical and practical contributions. We believe that the concept of technological frames and the broad domains of technological frames proposed here are a useful starting point for examining key actors' interpretations of technology, and the nature and extent of differences among them. We also believe that the framework of technological frames has utility for the diagnosis, explanation, and anticipation of outcomes around technological change in organizations, and hence may be particularly useful to implementors and practitioners attempting to manage such change processes.

REFERENCES

ABELSON, R. P 1981. Psychological status of the script concept. *Am. Psychol. 36*, 7, 715–729.

AGAR, M. H. 1980. *The Professional Stranger: An Informal Introduction to Ethnography*. Academic Press, New York.

ARGYRIS, C. AND SCHON, D. 1978. *Organizational Learning*. Prentice-Hall, Englewood Cliffs, N.J.

BARTLETT, F. 1932. *Remembering: A Study in Experimental and Social Psychology*. Cambridge University Press, London.

BARTUNEK, J. 1984 Changing interpretive schemes and organizational restructuring: The example of a religious order. *Adm. Sci. Q. 29*, 3, 355–372.

BARTUNEK, J. AND MOCH, M. 1987. First order, second order, and third order change and organization development interventions: A cognitive approach. *J. Appl. Behav. Sci. 23*, 4, 483–500.

BERGER, P. L. AND LUCKMANN, T. 1967. *The Social Construction of Reality*. Anchor Books, New York.

BIJKER, W 1987. The social construction of Bakelite: Toward a theory of invention. In *The Social Construction of Technological Systems*. MIT Press, Cambridge, Mass., 159–187.

BIJKER, W., HUGHES, T., AND PINCH, T., EDS. 1987. *The Social Construction of Technological Systems*. MIT Press, Cambridge, Mass.

BLOOMBERG, J. L. 1986. The variable impact of computer technologies on the organization of work activities. In *Proceedings of the Conference on Computer Supported Cooperative Work*. ACM, New York, 35–42.

BOLAND, R. J., JR. 1979. Control, causality and information systems requirements, *Account. Org. Soc. 4*, 4, 259–272.

BOLAND, R. J., JR. 1978. The process and product of system design. *Manage. Sci. 24*, 5, 887–898.

BOLMAN, L. G. AND DEAL, T. E 1991. *Reframing Organizations: Artistry, Choice, and Leadership*. Jossey-Bass, San Francisco, Calif.

BOSTROM, R. P. AND HEINEN, J. S. 1977. MIS problems and failures: A socio-technical perspective, Part I—The causes. *MIS Q.* 1, 3, 17–32.

BOUGON, M., WEICK, K., AND BINKHORST, D. 1977. Cognition in organizations: An analysis of the Utrecht Jazz Orchestra. *Admin. Sci. Q. 22*, 4, 606–639.

BURNS, T. AND STALKER, G. M. 1961. *The Management of Innovation*. Tavistock, London.

CALDER, B. AND SCHURR, P. 1981. Attitudinal processes in organizations. *Res. Org. Behav. 3*, 283–302.

CICOUREL, A. 1974. *Cognitive Sociology*. Free Press, New York.

DAFT, R. L. AND LENGEL, R. H. 1986. Organizational information requirements, media richness and structural design. *Manage. Sci. 32*, 5, 554–571.

DAFT, R. L. AND WEICK, K. E. 1984. Towards a model of organizations as interpretive systems. *Acad. Manag. Rev. 9*, 2, 284–295.

DAGWELL, R. AND WEBER, R. 1983. Systems designers' user models: A comparative study and methodological critique. *Commun. ACM 26*, 11, 987–997,

DEJEAN, D. AND DEJEAN, S. B. 1991. *Lotus Notes at Work*. Lotus Books, New York.

DIMAGGIO, P. J. AND POWELL, W. W. 1991. Introduction. In *The New Institutionalism in Organizational Analysis*. The University of Chicago Press, Chicago, Ill., 1–34.

DORNBUSCH, S. M. AND SCOTT, W. R. 1975. *Evaluation and the Exercise of Authority*. Jossey-Bass, San Francisco, Calif.

DOUGHERTY, D. 1992. Interpretive barriers to successful product innovation in large firms. *Org. Sci. 3*, 2, 179–202.

DOUGLAS, M. 1987. *How Institutions Think*. Routledge and Kegan Paul, London.

DUTTON, J. E. AND JACKSON, S. E. 1987. Categorizing strategic issues: Links to organizational actions. *Acad. Manag. Rev. 12*, 1, 76–90.

EISENHARDT, K. M. 1989. Building theories from case study research. *Acad. Manage. Rev. 14*, 4, 532–550.

EDEN, C. 1992. On the nature of cognitive maps. *J. Manage. Stud. 29*, 3, 261–265.

FINNEY, M. AND MITROFF, I. I. 1986. Strategic plan failures: The organization as its own worst enemy. In *The Thinking Organization*. Jossey-Bass, San Francisco, Calif., 317–335.

GASH, D. C. 1987. The effects of microcomputers on organizational roles and the distribution of power. Ph.D. dissertation, Cornell Univ., Ithaca, N.Y.

GASH, D. C. AND ORLIKOWSKI, W. J. 1991. Changing frames: Towards an understanding of information technology and organizational change. In *Academy of Management Best Papers Proceedings, 51st Annual Meeting*. Academy of Management, 189–193.

GEERTZ, C. 1973. *The Interpretation of Cultures*, Basic Books, New York.

GIDDENS, A. 1984. *The Constitution of Society: Outline of the Theory of Structure*. University of California Press, Berkeley, Calif.

GIOIA, D. A. 1986. Symbols, scripts, and sensemaking: Creating meaning in the organizational experience. In *The Thinking Organization*. Jossey-Bass, San Francisco, Calif., 49–74.

GIOIA, D. A. AND SIMS, H. R., JR. 1986. Introduction: Social cognition in organizations. In *The Thinking Organization*. Jossey-Bass, San Francisco, Calif., 1–19.

GINZBERG, M. J. 1981. Early diagnosis of MIS implementation failure: Promising results and unanswered questions. *Manage. Sci. 27*, 4, 459–478.

GOFFMAN, I. 1974. *Frame Analysis*. Harper & Row, New York.

GOODMAN, P., GRIFFITH, T. L. AND FENNER, B. 1990. Understanding technology and the individual in an organizational context. In *Technology and Organizations*. Jossey-Bass, San Francisco, Calif., 45–86.

GRAY, B., BOUGON, M., AND DONNELLON, A. 1985. Organizations as constructions and destructions of meaning. *J. Manage. 11*, 1, 83–95.

GREENWOOD, R. AND HININGS, C. R. 1988. Organizational design types, tracks and the dynamics of strategic change. *Org. Stud. 9*, 3, 293–316.

GREGORY, K. L. 1983. Native-View Paradigms: Multiple cultures and culture conflicts in organizations. *Admin. Sci. Q. 28*, 3, 359–376.

GRUDIN, J. 1988. Why groupware applications fail: Problems in design and evaluation. *Off. Tech. People 4*, 3, 245–264.

HEDBERG, B., NYSTROM, P., AND STARBUCK, W. 1977. Designing organizations to match tomorrow. *TIMS Stud. Manage. Sci. 5*, 2, 171–181.

HEDBERG, B., NYSTROM, P., AND STARBUCK, W. 1976. Camping on seesaws: Prescriptions for a self-designing organization. *Admin. Sci. Q. 21*, 1, 41–65.

HENDERSON, K. 1991. Flexible sketches and inflexible data bases: Visual communication, conscription devices, and boundary objects in design engineering. *Sci. Tech. Hum. Val. 16*, 4, 448–473.

HIRSCHHEIM, R. A. AND KLEIN, H. K. 1989. Four paradigms of information systems development. *Commun. ACM 32*, 10, 1199–1216.

ISABELLA, L. A. 1990. Evolving interpretations as a change unfolds: How managers construe key organizational events. *Acad. Manage J. 33*, 1, 7–41.

KIESLER, S. AND SPROULL, L. 1982. Managerial response to changing environments: Perspectives on problem sensing from social cognition. *Admin. Sci. Q. 27*, 4, 548–570.

KLING, R. AND GERSON, E. 1978 Patterns of segmentations and intersections in the computing world. *Symb. Interaction 1*, 1, 24–43.

KLING, R. AND IACONO, S. 1989. The institutional character of computerized information systems. *Off. Tech. People 5*, 1, 7–28.

KLING, R. AND IACONO, S. 1984. Computing as an occasion for social control *J. Soc. Iss. 40*, 77–96

KRUEGER, R. A. 1988. *Focus Groups: A Practical Guide for Applied Research*. Sage Publications, Newbury Park, Calif.

KUHN, T. 1970. *The Structure of Scientific Revolutions*. University of Chicago Press, Chicago, Ill.

KUMAR, K. AND BJØRN-ANDERSEN, N. 1990 A cross-cultural comparison of IS designer values. *Commun. ACM 33*, 5, 528–538.

LAWRENCE, P. R. AND LORSCH, J. W. 1967. *Organization and Environment*. Harvard University Press, Cambridge, Mass.

LOUIS, M. R. AND SUTTON, R. I. 1991. Switching cognitive gears: From habits of mind to active thinking *Hum. Rel. 44*, 1, 55–76.

MARCH, J. G. AND SIMON, H. 1958. *Organizations*. John Wiley and Sons, New York.

MARKUS, M. L. 1984. *Systems in Organizations: Bugs and Features*. Pitman, Boston, Mass.

MARKUS, M. L. 1983. Power, politics and MIS implementation. *Commun. ACM 26*, 6, 430–444.

MARKUS, M. L. AND BJØRN-ANDERSEN, N. 1987. Power over users: Its exercise by system professionals *Commun. ACM 30*, 6, 498–504.

MARKUS, M. L. AND ROBEY, D. 1988. Information technology and organizational change. Causal structure in theory and research *Manage. Sci. 34*, 5, 583–598.

MARSHAK, D. S. 1990. Lotus Notes· A platform for developing workgroup applications. *Patricia Seybold's Off. Comput. Rep. 13*, 7.

MILES, M. B. AND HUBERMAN, A. M. 1984. *Qualitative Data Analysis: A Sourcebook of New Methods*, Sage Publications, Newbury Park, Calif.

MOCH, M. AND BARTUNEK, J. 1990. *Creating Alternative Realities at Work: The Quality of Work Life Experiment at Food Com*. Harper Business, New York.

NEISSER, U. 1976. *Cognition and Reality: Principles and Implications of Cognitive Psychology* W. H. Freeman and Co., San Francisco, Calif.

NOBLE, D. 1986. *Forces of Production: A Social History of Industrial Automation*. Oxford University Press, New York.

ODELL, L., GOSWAMI, D., AND HERRINGTON, A. 1983. The discourse-based interview: A procedure for exploring tacit knowledge of writers in nonacademic settings. In *Research on Writing: Principles and Methods* Longman, New York, 220–236.

ORLIKOWSKI, W. J. 1992a. The duality of technology: Rethinking the concept of technology in organizations. *Org. Sci. 3*, 3, 398–427.

ORLIKOWSKI, W. J. 1992b. Learning from notes. Organizational issues in groupware implementation. In *Proceedings of the Conference on Computer Supported Cooperative Work*. ACM, New York, 362–369

ORLIKOWSKI, W. J. 1988. The data processing occupation: Professionalization or proletarianization. *Res. Soc. Work 4*, 95–124.

ORLIKOWSKI, W. J. AND GASH, D. C. 1991. Changing frames: Understanding technological change in organizations. Working Paper 3368, Massachusetts Institute of Technology, Cambridge, Mass.

PETTIGREW, A. M. 1979. On studying organizational cultures. *Admin. Sci. Q. 24*, 4, 570–581.
PETTIGREW, A. M. 1973. *The Politics of Organizational Decision Making*. Tavistock, London.
PFAFFENBERGER, B. 1988. *Microcomputer Applications in Qualitative Research*. Sage Publications, Newbury Park, Calif.
PFEFFER, J. 1980. *Power in Organizations*. Pitman, Boston, Mass.
PINCH, T. AND BIJKER, W. 1987. The social construction of facts and artifacts. In *The Social Construction of Technological Systems*. MIT Press, Cambridge, Mass. 17–50.
PORAC, J. F. AND THOMAS, H. 1990. Taxonomic mental models in competitor definition. *Acad. Manage. Rev. 15*, 2, 224–240.
PORAC, J. F., THOMAS, H., AND BADEN-FULLER, C. 1989. Competitive groups as cognitive communities: The case of Scottish knitwear manufacturers. *J. Manage. Stud. 26*, 4, 397–416.
RILEY, P. 1983. A structurationist account of political culture. *Admin. Sci. Q. 28*, 3, 347–414.
SÆTNAN, A. R. 1991. Rigid politics and technological flexibility: The anatomy of a failed hospital innovation. *Sci. Tech. Hum. Val. 16*, 4, 419–447.
SALANCIK, G. R. AND PFEFFER, J. 1978. A social information processing approach to job attitudes and task design. *Admin. Sci. Q. 23*, 2, 224–253.
SCHEIN, E. 1987. *The Clinical Perspective in Fieldwork*. Sage, Newbury Park, Calif.
SCHEIN, E. 1985. *Organizational Culture and Leadership*. Jossey-Bass, San Francisco, Calif.
SCHUTZ, A. 1970. *On Phenomenology and Social Relations*. University of Chicago Press, Chicago, Ill.
SCHWARTZ, H. 1990. *Narcissistic Process and Corporate Decay: The Theory of the Organization Ideal*. New York University Press, New York.
SHELDON, A. 1980. Organization paradigms: A theory of organizational change. *Org. Dynam. 8*, 3 (Winter), 61–80.
SHIBUTANI, T. 1962. Reference groups and social control. In *Human Behavior and Social Processes*. Houghton Mifflin, Boston, Mass., 128–147.
SMIRCICH, L. AND STUBBART, C. 1985. Strategic management in an enacted world. *Acad. Manage. Rev. 10*, 4, 724–736.
STARBUCK, W. H. 1989. Why organizations run into crises ... and sometimes survive them. In *Information Technology and Management Strategy*. Prentice-Hall, Englewood Cliffs, N.J., 11–33.
STRAUSS, A. 1978. A social world perspective. *Stud. Symb. Interaction 4*, 171–190.
TYRE, M. J. AND ORLIKOWSKI, W. J. 1994. Windows of opportunity: Temporal patterns of technological adaptation in organizations. *Org. Sci.* To be published.
VAN MAANEN, J. 1984. Doing new things in old ways: The chains of socialization. In *College and University Organization*. New York University Press, New York, 211–247.
VAN MAANEN, J. AND BARLEY, S. 1985. Organizational culture: Fragments of a theory. In *Organizational Culture*. Sage Publications, Beverly Hills, Calif., 31–53.
VAN MAANEN, J. AND SCHEIN, E. 1979. Toward a theory of organizational socialization. *Res. Org. Behav. 1*, 209–264.
WEICK, K. E. 1990. Technology as equivoque: Sensemaking in new technologies. In *Technology and Organizations*. Jossey-Bass, San Francisco, Calif., 1–44.
WEICK, K. E. 1979a. *The Social Psychology of Organizing*. Addison-Wesley, Reading, Mass.
WEICK, K. E. 1979b. Cognitive processes in organizations. *Res. Org. Behav. 1*, 1, 41–74.
WEICK, K. E. AND BOUGON, M. G. 1986. Organizations as cognitive maps: Charting ways to success and failure. In *The Thinking Organization*. Jossey-Bass, San Francisco, Calif., 102–135.
WINNER, L. 1986. *The Whale and the Reactor: A Search for Limits in an Age of High Technology*. University of Chicago Press, Chicago, Ill.
WITTGENSTEIN, L. 1953. *Philosophical Investigations*. Macmillan Press, New York.
YIN, R. K. 1989. *Case Study Research: Design and Methods*. Rev. ed. Sage, Beverly Hills, Calif.
ZUBOFF, S. 1988. *In the Age of the Smart Machine*. Basic Books, New York.

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