Innovation and Diffusion of Technology
A Human Process

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In this article, I argue that the overarching problem in the innovation and diffusion of technology is that efforts to introduce computer systems and advanced telecommunications fail because technical experts and managers ignore the underlying psychological dynamics of organizational change. A brief case is presented that illustrates this common problem in technology transfer: the failure to recognize change and innovation as a human process and the consequential resistance to change and learning (Diamond, 1993), which is combined with workers' anger and resentment at the "experts" and the technical manner in which the innovation is introduced. After discussing some of the contributing factors to this problem, I present the concept of organizational resilience *as a description of the ideal context for innovation and diffusion of technology—a* transitional space *from which ideas and technologies can be tested and critically examined for their appropriateness and relevance to practice.*

Much has been written in the past 25 years on the issue of technology transfer and the diffusion of new knowledge and technique in both public and private organizations (Burns & Havelock, 1976; Gow, 1992; Kennedy, 1993; Rogers, 1983; Senge, 1992; Stacy, 1992; Stalker, 1961; Taylor & Van Every, 1993; White, 1975; Zaltman, Duncan, & Holbeck, 1973). Still, these seemingly welcome changes are fraught with difficulties for organizations. In this article, I argue that the main problem is that efforts to introduce computer systems and advanced telecommunications, for example, often fail because technical experts and managers ignore the underlying psychological dynamics of organizational change and innovation (Czander, 1993; Diamond, 1993; Hirschhorn, 1988; Ingersoll & Adams, 1992; Schwartz, 1990; Turkle, 1984).

I begin with an example: One state agency undergoing enormous expansion in public works projects enlisted the help of the state's data processing people to design a better computer system to assist project managers. The agency director and his deputies met with the state's data processing people several times to convey their technological needs and requirements. The data processing agency for state government then went to work on developing a computerized project management program for the public works agency.

The system was designed and installed 6 months later. After another 6 months, the project managers were not using the new system. In fact, the new system was incomprehensible to them—only the data processing experts understood how to access it. Not only had little training of the project man-

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agers taken place, but the data processing experts had never consulted the project managers on the actual design and implementation of the computer management system. The project managers then were trained to use the new system, but they found it to be cumbersome, excessively time-consuming, and of little value to them. In fact, it seemed to have value only to the accounting office as a tool for budgetary review and evaluation of projects and as a tool for upper management in assessing progress on construction sites. The project managers had little incentive or motivation to use the new system because it did not help them manage projects. To the contrary, they viewed it as additional work because it required more time for them to update the computer on construction progress and budgetary matters. Because they viewed the new system as an effort by upper management to establish greater controls over their work, the project managers came to view the technology with either disdain or cynicism that often took the form of humor. Project managers were known to joke about the time they spent playing various computer games on their terminals.

What went wrong there? This case exemplifies a common problem in technology transfer: the failure to recognize change and innovation as a human process and the resultant resistance to change and learning (Diamond, 1993), which often is combined with workers' anger and resentment at the "experts" and the technical manner in which the innovation is introduced.

In what follows, I make five major points: First, technology transfer often is based on the notion of "expert authority." This results in a control-oriented, information-dominated, top-down, hierarchical, and defensive approach to innovation, which limits learning and responsiveness on the part of clients and customers (users) of technology. Second, technology transfer ignores the psychological fact of resistance to change based on a central and unavoidable human conflict between cognitive learning and emotional (interpersonal) security. Third, technology transfer similarly denies the organizational psychodynamics of change, which acknowledges that change at work implies emotional and cognitive loss among organizational participants. This experience of loss suggests that change efforts must include a process for workers to develop ownership and endorse the rationale behind the technology transfer, as well as an opportunity to emotionally and cognitively separate from the "old way" in order to assume the "new way" of doing things. Fourth, technology transfer ignores the degree to which the organization's culture is receptive or resistant to change (i.e., the need for a "transitional space" to facilitate the innovation; Diamond, 1993; Winnicott, 1965). In other words, the degree to which the organization is defensive and bureaucratic rather than resilient and capable of systemic learning needs to be taken into consideration as a critical factor in measuring the potential for successful and valuable technology transfer. Fifth, the concept of "organizational resilience" is introduced to describe the ideal context for innovation and diffusion of technology—a transitional space from which ideas and technologies can be tested and critically examined for their appropriateness and relevance to practice.

The Problem of Expert Authority in Technology Transfer

In the case of the public works agency and state data processing cited earlier—the experts were in data processing and the nonexperts were the project managers and their executive team—the two work groups had polarized. The executives asked data processing for a more sophisticated tool for project management, and, without consulting project managers, data processing acted as if they "knew" what that system and program should look like. Their design was simply the product of the executive request

and their technical, rational notion of what the agency needed for more efficient and effective project management.

Even when savvy systems engineers or managers extensively consult the users, the end product often is simply turned over to the users (sometimes with training, sometimes without). In this case, the introduction of the new technology into the workplace was not a collaborative, participative endeavor. Rather, it was a hierarchical, unilateral process in which information was shared but little communication occurred between the users of technology and the designers. Consequently, little reflective and systemic thinking and innovation took place. The executives (customers) contracted the services of data processing, and data processing reinforced the image of expertise by developing a highly sophisticated computer system for project management that had questionable relevance for their actual work. In other words, the experts acted as if they knew what the project managers needed without talking directly to them, and, as experts, the data processing people were "in charge." Authority and technical expertise are most often synonymous in instances of technology transfer. Thus, in this example, the task of developing technology for the public works agency was delegated to data processing and they in turn told the project managers what information was needed to design the program.

Criticizing the limits of technical rationality, Schon (1983) suggested that consulting psychologists need to pay more attention to the human process of "problem setting" as well as problem solving. He wrote that

> [professionals] are coming to recognize that although problem setting is a necessary condition for technical problem solving, it is not itself a technical problem. When we set the problem, we select what we will treat as the "things" of the situation, we set the boundaries of our attention to it, and we impose upon it a coherence which allows us to say what is wrong and in what directions the situation needs to be changed. Problem setting is a process in which, interactively, we name the things to which we will attend and frame the context in which we will attend to them. (Schon, 1983, p. 40)

Technical problem solving differs fundamentally from problem setting. The latter, as Schon (1983) suggested, is an interactive and reflective process that questions the status quo of governing norms and values that name and frame what one looks at. In the example cited earlier, the data processing group might have engaged in problem solving but clearly not problem setting, and, consequently, their nonparticipative, technical approach shut out the potential for learning about the uniqueness of the problem and thus limited their effectiveness.

Technical rationality comprises an ideology of expert-as-authority, and this belief system is governed by the scientific norms of positivism and empiricism. As a framework for rigorous research and problem solving, it is nonreflective and nondialectic and ignores the psychological side of innovation and technology transfer. Thus, it does not acknowledge the possibility that technical processes for problem solving, which exclude participative feedback and reflective thinking, can themselves be defensive in nature—a social defense against the anxiety over loss of control and (the assumed position of) authority (I address the notion of technology transfer as a social defense later). I now discuss the individual's response to organizational change as it relates to technology transfer.

Psychological Resistance to Organizational Learning and Change

Technology transfer, like many different kinds of organizational innovations, often runs into employee resistance. One reason many technology transfers are unsuccessful, I believe, is that they tend to ignore the inevitability of psychological resistance to

change in the status quo (Diamond, 1993). Asking people to approach their work differently requires cognitive shifts in the naming and framing of problems (as noted in the previous section) and places emotional demands on their feelings of self-competence and self-confidence: their self-esteem at work.

As noted in the example just provided, the introduction of many new technologies into the workplace usually is handled by technicians or computer experts. Typically, these experts are not only insensitive to the human component of change, but they assume that rational people should readily comprehend the efficiencies and virtues of adopting the latest technology. My experience with large-scale technology transfers and organizational change efforts contradicts these assumptions, particularly at the emotional level of experience; I suggest that attempts to innovate and adopt new technology ought to combine the instruction of technical knowledge with the facilitation of organizational change as a fundamentally psychosocial process. This combined approach to technology transfer operates on the assumption that the human personality is conflicted about learning and interpersonal security and that change works to stimulate the anxiety associated with the inherent conflict.

What do I mean by this? The fact that individuals want to learn and be competent on the one hand and want to feel psychologically secure and anxiety-free on the other hand is a universal but often ignored human dilemma for workers. This predicament is triggered by the imposition of organizational change and workplace innovations. In other words, the dilemma has been there all along in a latent form; it needs only the anxiety of uncertainty associated with change to activate it.

> The problem of psychological resistance to change is well-known to psychologists. Both the psychoanalytic psychologist's conception of unconscious defensive techniques as modes of adaptation and the cognitive psychologist's notion of limited learning and of contradictions in what people say and what they in fact do illustrate compulsive, repetitive, security-oriented, error-inducing, and self-sealing human behavior. These defensive and adaptive tendencies usually protect the status quo and therefore block learning (Diamond, 1993). The successful adoption of innovations and technology transfer depends on the individual's openness to learning and change, and that openness requires minimal defensiveness and adequate self-competence.

Stress is a factor here; if individuals experience the change as stressful because of uncertainty, lack of information, and insufficient participation, they will feel disrespected, angry, and resistant to learning. Moreover, the degree to which these stressful circumstances trigger neurotic anxiety will negatively affect their self-esteem at work.

Technology transfer and innovations often leave workers feeling powerless—more so than before the change—and specifically because the technology transfer has been imposed on them. They frequently are not involved in change efforts such as technology transfer that directly affects their jobs. Thus, one way to minimize the defensive reactions to technology transfer is to make certain that personnel participate in the designing (framing and naming) of the new systems. Workers must be part of the selection of new technologies and the reasoning behind their acquisition and implementation. Symbolic "window-dressing-style" participation, inviting workers to a meeting or two, will not do. Rather, at an emotional level, workers must reach the point at which they feel ownership of the new system.

I now focus on the psychological fact that individuals experience change as loss. In doing so, one may consider the value of designing a *transitional space* (or holding environment) at work in which organizational members can work through their feelings and thoughts about the change and assume responsibility for it.

Change as Emotional and Cognitive Loss

Technology transfer often represents a fundamental change at work and thus a transformation in the way people experience and interact with their tasks and the organization's mission. Successful adoption of technological innovations requires the internal commitment of workers, who need to endorse the rationale behind the innovation.

The human process for adoption of new technology ought to provide organizational members with an opportunity to examine where they are, where they have been, and where they are going, an emotional and cognitive map of the organization. This process of mapping requires facilitation of workers' thoughts and feelings about the change. An outside organizational consultant may be helpful in providing participants with a safe, nonpunitive, environment—a transitional space—in which they can explore the implications of change.

At a deeper emotional level, workers will need to acknowledge what they are losing and, subsequently, what they will gain. The latter cannot be reached without passing through the former. This process often involves some degree of grieving over the way things were and then letting go of the old way and trying on the new way of working on tasks. In addition, the opportunity to deal both emotionally and cognitively with this technological innovation often promotes reflective learning (e.g., problem setting, problem solving) and internal commitment to the change. Workers are able to acknowledge the problems with the old system and consider the degree to which the transfer of technology will help to solve these often annoying problems. The extent to which organizational members engage in this sort of learning will positively influence their willingness to commit to the innovation and use of new technology. Moreover, the provision of a transitional space can offer workers an opportunity to confront their fears and anxieties related to organizational change. A psychodynamic approach to organizational change takes seriously the disruption of everyday work routines, rituals, processes, and procedures. People attach themselves emotionally to the predictability of organizational structures and procedures, and that attachment is severed with the introduction of change at work. This separation produces anxiety drawn from the stress of uncertainty and the phases of emotional loss.

Finally, and most critically, I challenge the assumption that technological change is always an appropriate solution to organizational problems. It is more often the case, I think, that technological change is a defense against organizational problems. Thus, organizational members must come to the same conclusions as executives and technical advisors about what is required. Subsequently, the deeper emotional level of change is facilitated with helpful consultation that recognizes change as a combination of emotional loss and cognitive reframing. Indeed, the phases of grief and mourning can be viewed as a metaphor for organizational change. The following brief description of mourning serves this purpose.

Grief, according to the experts, is made up of four phases: (a) numbing—a sense of shock and outrage; (b) yearning—a search for what is lost and anger and disbelief that the loss has occurred; (c) disorganization and despair—a discarding of old patterns of thinking, feeling, and acting and a redefinition of oneself; and (d) reorganization—a reshaping of one's internal world and a reframing of social reality (Bowlby, 1982). In organizations, the numbing phase may be a near-paralysis of operations and a general state of confusion. The yearning phase follows, in which members act as if the change has not occurred. Suppression and denial are common defensive reactions, as is a nostalgic orientation to the past.

These defenses conceal the underlying anger and outrage among workers.

Once participants are able to confront their anger and outrage over the loss of old routines and procedures, they experience the phase of disorganization and despair. Here, they not only start letting go of old thinking, feelings, and acting to incorporate the new, but they also feel the despair of helplessness and lack of control. In addition, although their participation and collaboration in planning can aid the process, they must face the reality of a constantly changing environment over which they have little or no control. This knowledge is depressing and precedes reparation and organizational renewal.

Finally, the reorganization phase is typically a time in which workers rethink and reframe their feelings and actions. Unlike in earlier times in which they felt resistant and possibly hostile to the imposition of change, they are now ready to assess their work relations, strategies, structures, and technologies. There is a willingness to experiment with new ideas and feelings; problem setting and problem solving, error detection, and correction are more plausible outcomes than ever before. A transitional space for learning and change has emerged in the nascent organizational culture; these are signs of organizational resilience (discussed later). In the reorganization phase, members appear willing and able to make "real" changes that require them to critically examine their beliefs, norms, rules, and values, what Argyris and Schon (1978) referred to as "single and double-loop learning." However, more than a cognitive exercise in organizational learning, fundamental change as it is reflected in the four phases of grief requires an emotional awareness of one's emotional attachments to the fantasy of control and the psychological security found in pedestrian and routine work.

Finally, one needs to look at the role of organizational culture in technology transfer and innovation. When is it resistant to change, and when is it responsive to change?

Organizational Culture: Defensive or Resilient

Bureaucratic organizational cultures are unintentionally constructed on the model of psychological defenses, what might be called externalized ego defenses. These particular organizational cultures originate and are then perpetuated by *ritualistic defenses* that limit the processing of anxiety-producing information and thereby minimize the potential for learning and change. In these *defensive organizations,* information and feedback that oppose the status quo of norms, policies and procedures, or data that contradict planned schedules and routines are typically censored. The organizational story of the public works agency and the state's data processing division exemplifies the tangibility of externalized and ritualistic organizational defenses that not only obstruct technology transfer and innovation but also promote among organizational participants selective inattention to deeper structural and psychodynamic problems at work.

Ritualistic organizational defenses act as blinders to reality, defensive screens that conceal problems, deny conflicts, and resist change. Human energy (cognitions and emotions) that otherwise might be channeled into the correction of errors and actual problem solving is often displaced by the influence of anxiety onto substitute objects (which can include new technology), promoting the illusion of safety and security without substantive reflection and change. Under the stress of uncertainty and anxiety, form (e.g., procedures, regulations, impersonal rules, red tape, etc.) takes precedence over organizational mission and substantive output (e.g., problem solving, provision of services, personal responsibility, and the quality of product). Managerial control and accountability take priority over

organizational learning, collaboration, and problem solving.

Technological transfer and workplace innovations often produce excessive levels of worker stress. Thus, a process of intervention that assists participants in acknowledging and working through their social defenses is crucial because resistance to change is psychological at its roots, and technical approaches to innovation tend to ignore the psychological anchors of attachment to prevailing ways of working and to bureaucratic organizational cultures. This defensive organization censors anxiety-producing information antithetical to the status quo; technology transfer represents a challenge to organizational equilibrium. More important, however, is the fact that technology transfer is often itself a manifestation of these defenses and is frequently mistaken for a solution to cultural, systemic, and interpersonal problems at work. In these instances, technology transfer is a camouflage for more deeply rooted organizational pathologies.

Organizations are fundamentally constructs of the mind; they acquire a reality of their own through the individual's reliance on their structures for protection and security against anxiety. In extreme situations, modern organizations consume individual initiative and will. As the example of the public works agency demonstrates, proponents of technology transfer will find it helpful to consider the subjective experiences and reflective knowledge (rooted in the actual practice) of organizational members before purchasing, designing, and installing the new technology. Next, I examine the concept of organizational resilience as a culture and leadership style that is more receptive to learning and change.

Organizational Resilience

The term *organizational resilience* refers to a minimally defensive social system of collaboration and participation that is capable of responding to change. In fact, on the basis of my many observations as an organizational consultant to change, organizational resilience is the result of exploring resistances and grieving the loss caused by change. It is the result of what Klein called *reparation,* a term stemming from Kleinian object relations theory, that emphasizes the human desire for connectedness and integration signified by the human effort to make whole that which is broken (Klein & Riviere, 1964).

Organizational resilience is characterized by leader–follower relations that are minimally defensive and nonauthoritarian. In this sort of organizational culture, in contrast to the aforementioned case, leaders share information and decision making with staff, and staff are in turn willing to give and receive critical feedback and take responsibility for their actions. This must be done behaviorally, not just rhetorically. Both supervisors and subordinates feel affiliated with the same system and are committed to a common mission. Many organizations lacking resilience are characterized by insecure and compulsive human relations in which individual members have only a partial comprehension of the total system and its public. These workers lack a cognitive and emotional connection to the organization as a whole, an absence of organizational identity (Diamond, 1993). In the case study, these features of a defensive organizational culture unwittingly assisted in discouraging upper management and data processing from consulting project managers in the design and implementation of a new computer system.

In practice, organizational resilience requires trust and mutual respect among organizational members, who stand or fall on their collective esteem. Organizationally, resilient leaders and followers relate primarily on the basis of consciously shared meaning and purpose rather than on unconscious emotional needs. Despite being under the pressures of stress and the uncertainty of

perpetual technological innovations, each leader's sense of self is adequately integrated and does not require constant aggrandizing from staff and the public. Organizationally resilient leaders do not attract subordinates who are driven primarily by emotional deficiencies. Indeed, such leaders may promote greater self-worth among those with low self-esteem.

To promote organizational resilience, organizational leaders must be aware of self- and other-boundaries in their interpersonal relationships at work. They cannot have a pressing emotional need to displace bad feelings onto others, and they must be aware of the tendencies of others to do the same to them. Unconscious displacement and projection of bad feelings are more common under stressful conditions. Thus, organizational leaders able to manage interpersonal boundaries and minimize defensive tendencies will foster healthier and more productive interactions with and among their staff. They will tend to consult staff when necessary and delegate authority and responsibility appropriately. In addition, leaders of resilient organizations are aware of the unique character, talents, and skills of individual staff members. Hence, individuality and interdependence are values consciously emphasized and intended to counteract the regressive pull of homogeneity and uniformity.

Conclusion: The Case of the Data Processing Manager Group

In conclusion, I describe briefly an ongoing change effort. I mention the case of the data processing managers group here to reiterate my central thesis that technology transfer and innovation is a human process, not just a technical one.

Data processing managers representing more than 12 departments and agencies are meeting for the first time in the state's history to integrate and design computer and telecommunications systems throughout state government. Struggling against their departmental tendencies to view themselves as separate entities with well-defended boundaries, these managers are attempting to find common ground. Reparation is at work.

Entertaining the idea of sharing resources and information across divisions and departments to enhance technological innovations for all of state government has forced managers to confront their anxieties over loss of control and over protection of their perceived organizational boundaries. As their consultant, I am encouraging them to express publicly their reservations and anxieties about integrating systems and sharing resources. Monthly meetings have become the transitional space in which they experiment with new ideas, thoughts, and feelings related to a common mission to improve technological services for all of state government.

In short, this effort has challenged the status of data processing managers as expert authorities because of the requirement of participation and collaboration. It has confronted psychological resistance to organizational change by acknowledging the feelings of insecurity associated with reflective thinking and learning that challenges the status quo. It has meant a public acknowledgment and letting go of the old way of inefficient technology use so that the new way of technology sharing and participation can be incorporated. Finally, it has meant challenging directly the defensive culture of bureaucracy. Departments can no longer view themselves as being relatively independent from other departments and agencies within state government. Technology and data processing experts must learn about their counterpart agencies and the technological needs of those agencies. Thus, they must come to accept more complex roles and more integrative operations. Interagency boundaries are being transcended and are becoming more flexible and less forbidding (Hirschhorn, 1988). Collaboration

based on mutual respect and a shared mission will eventually facilitate a more resilient organizational culture. This organizational culture is therefore better able to respond to change by engaging shared resources and expertise to advance the appropriate and effective use of technologies.

By addressing the underlying psychological dynamics of change described earlier, I assisted the data processing managers group, composed of approximately 12 agency representatives, in overcoming the inevitable resistance to innovation and diffusion of technology. Their fears and anxieties over the loss of control and the sharing of information were eliminated through the public testing of assumptions and plausible scenarios among the group members—a level of openness and trust that would not have prevailed had we not addressed the participants' thoughts and feelings about the implications of the more integrated and advanced technological innovations.

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