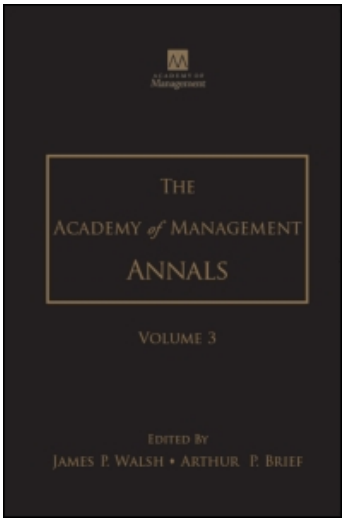

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What's Under Construction Here? Social Action, Materiality, and Power in Constructivist Studies of Technology and Organizing

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What's Under Construction Here?

Social Action, Materiality, and Power in Constructivist Studies of Technology and Organizing

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Abstract

Over the past two decades, organizational scholars have increasingly argued that technology's affects on organizations are socially constructed. Constructivists who study implementation generally hold that organizational change emerges from an ongoing stream of social action in which people respond to a technology's constraints and affordances, as well as to each other. Although most students of technology and organizing generally agree on the ontology of constructivism, there are considerable differences in what scholars mean when they say that a technology's affects are socially constructed. We show that research on the social construction of implementation clusters into five coherent perspectives, which we call *perception*, *interpretation*, *appropriation*,

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enactment, and *alignment*. The perspectives differ with regard to the social phenomena they study and the processes by which they claim that construction occurs. The perspectives also focus on different phases of the implementation process and operate at different levels of analysis. After elucidating each perspective, we argue that students of technology and organizing could more directly engage issues central to organizational theory if grappled with materiality and power, which they have heretofore downplayed in an attempt to counteract the field's earlier tendency toward technological determinism.

Like other people, scholars become stuck in the webs of culture. In fact, they may be more vulnerable than anyone else, because scholars make their living with ideas, and it is with ideas that the trouble begins. Especially pesky are the opposing ideas, or antinomies, that structural anthropologists say lie at the core of all cultures and with whose resolution a significant portion of a culture wrestles. Core antinomies suffuse a culture's dominant symbols, validate cleavages in social structure, and often fuel everyday talk (Eisenstadt, 1989). The problem is that cultural antinomies usually define dilemmas that are ontologically difficult, if not impossible, to resolve. In preindustrial societies, cultural antinomies usually encode naturalistic and religious enigmas: life versus death, good versus evil, and so on (Levi-Strauss, 1963, 1976; Needham, 1973). Anthropologists argue that even though industrial cultures are less dualistic than preindustrial ones, oppositions nevertheless continue to play a crucial role (Eisenstadt, 1989; Maybury-Lewis, 1989). In Anglo-American culture, for example, key dualisms include the contrast between communalism and individualism, which lie at the core of most debates over proper social and economic policy, and the philosophical bugaboo that dogs social science: determinism versus volunteerism, or the question of whether we are the pawns or the authors of society.

A sign that scholars have become tangled in an unwinnable cultural argument is a literature that swings pendulum-like over time between one point of view and its converse. In fact, after examining the anthropological literature on cultural dualisms, Maybury-Lewis (1989) concluded that "alternation" or "temporal segregation" is one of a small set of strategies that societies use to manage antinomies. In organization theory, for example, we have seen repeated alternations in the literature on rational versus normative systems of control (Barley & Kunda, 1992) and the relative importance of adaptation and selection (Baum, 1996). The problem with alternation as a strategy is that it brings no synthesis, no rising above, and no moving beyond. Those who first push the pendulum toward its swing in the opposite direction will usually have notable careers, but, in the end, we wind up back where we once tried to escape. Fortunately, there are other ways to manage cultural antinomies, including what Maybury-Lewis called "integration." Cultures integrate by devising ideologies or theories that embrace both poles of an opposition

simultaneously, as in the Taoist notion of yin and yang. While integration may not bring resolution, it can bring transcendence.

The thesis of this paper is that research on technology and organizing has been sidetracked by an attempt to resolve the debate between determinism and voluntarism by shifting from the former to the latter under the banner of "social constructivism." Although we have learned much in the process of the pendulum's swing, we have, ironically, taken our eye off one of the most critically important questions for students of organizing: how is the shift to a computational infrastructure shaping the way people work and organize? By computational infrastructure, we mean to suggest that work done in organizations is increasingly accomplished via computer-based technologies that store, transmit, and transform information. To grasp the importance of this question, one need only recall that a fundamental shift to a mechanical infrastructure occasioned the industrial revolution and the myriad of social changes that arose in its wake, including the rise of corporations, a total revamping of the occupational structure, and the urbanization of what were predominantly rural, agrarian societies.

Our agenda in this article is to persuade students of organizing that the swing away from technological determinism toward social constructivism, which began in the 1980s, has gone too far, and that our current challenge is to forge an approach that integrates, rather than alternates between, the horns of determinism and voluntarism. We begin by outlining the history of research on technology and organizing before the 1980s, when researchers essentially jettisoned prior conceptions of technological change to embrace social-constructivist visions. We then offer an analysis of the variants of constructivism (whose differences have largely gone unrecognized) while pointing to the strengths and limitations of each. We turn then to untangling a fundamental philosophical confusion that has made it difficult for constructivists to investigate simultaneously the material and social dynamics of technologically occasioned change. We conclude by arguing that transcending the dualisms that have haunted the study of technology will require a pragmatic vision of sociomaterial reality, a concern for the dynamics of power, attention to the role that institutions play in shaping technological trajectories and an appreciation of how social dynamics can vary across levels of analysis.

A Brief History of Research on Technology and Organizing

For more than half a century, organizational theorists have pondered how technologies shape organizations. The pondering began with Joan Woodward (1958). Having discovered that different types of production systems explained considerable variance in her data on the structure of British manufacturing firms, Woodward (p. 16) proclaimed that "different technologies imposed different kinds of demands on individuals and organizations and that these demands had to be met through an appropriate organization form."

Perrow (1967, p. 195) advocated a similar vision in his classic study of U.S. hospitals, where he penned the well-cited dictum: "technology is an independent variable, and structure … a dependent variable." In general, Woodward, Perrow, and other contingency theorists equated technology with what industrial engineers call a production system, which is comprised of people, processes, and machines, all of which must be coordinated to transform inputs into outputs. Theirs was a strongly determinist vision of technology that gave materiality a strong causal role: different production systems spawn different forms of organizing.

Trist and Bamforth (1951), Rice (1953), Emery (1959), and other socio-technical-systems theorists posited an alternative view. They rejected determinism in favor of an image of a mutual relationship between technology and social structure. The key principle of socio-technical theory was that social and technical systems influenced each other, and that, to be effective, organizations needed to optimize both jointly. In practice, however, socio-technical-systems research resembled contingency theory, in that researchers wrote primarily about altering the social to fit the technical. Thus early writings on the relationship between technology and structure usually depicted technology as a causal agent of organizational change, while overlooking the way social systems shaped technologies and their use.

During the 1970s, research on technology and organizations stagnated. As socio-technical-systems theorists became increasingly interested in general system theory (for discussion, see Barley, 1990) and the promulgation of autonomous work teams (Cummings, 1978), their research on technology came to a halt. Contingency theory, therefore, became the dominant approach to studying technology, and organizational scholars turned to testing and elaborating contingency theory's predictions (Aldrich, 1972; Blau, Falbe, McKinley, & Tracy, 1976; Davis & Taylor, 1976; Mohr, 1971). For the remainder of the decade, organization studies bore few new insights on technological change.†

During the late 1970s and early 1980s, interest in the social dynamics of computerization was growing in the management information systems and computer science communities, where researchers had begun to explore why people and organizations responded differently to computers. Here, research focused on how individuals' attitudes about and interpretations of technology

† In 1974, Harry Braverman published *Monopoly and Labor Capital*, which altered and reinvigorated studies of technology and work. However, Braverman's deskilling thesis had little impact on organization studies (especially in the U.S.) and that which it did have occurred much later. Braverman was not cited in a paper published in *Administrative Science Quarterly* until 1980 (Morgan, 1980). Initial cites in other management journals occurred even later: *MIS Quarterly* in 1987 (Millman & Hartwick, 1987), *Academy of Management Review* in 1988 (Green & Welsh, 1988), *Organization Science* in 1990 (Martin, 1990) and the *Academy of Management Journal* in 1992 (Snell & Dean, 1992).

shaped patterns of adoption and use (Lucas, 1975; Robey, 1979). Some researchers, however, pushed past an individual level of analysis. Markus (1983), for example, explored how organizational politics drove the dynamics of implementations. At U. C. Irvine's Center for Computers, Organizations, Policy and Society (CORPS), Kling and his colleagues developed a program of research on how computers became enmeshed in webs of social relationships, and how these relationships, in turn, shaped a computer system's meaning and use (Kling, 1980; Kling & Scacchi, 1982).

During the 1980s, similar interests began to filter into organization studies, and new approaches to studying technology emerged (Barley, 1986; Fulk, Steinfield, Schmitz, & Power, 1987; Rice, 1987; Zuboff, 1988). Researchers began to advocate principles that broke radically from contingency-theory's assumptions. First, they treated technology as a concrete object instead of a production process. Second, they rejected hard forms of technological determinism, even when they acknowledged that a technology's material properties could affect work practices. Third, they argued that social dynamics shaped the adoption, implementation, use, and meaning of a technology, and claimed that previous theories had overlooked this fact. Finally, these studies demonstrated that identical technologies could trigger different dynamics and outcomes in different organizations. This new scholarship claimed that one could not explain how a technology affected an organization without taking into account the intricacies of the social context.

The perspective that these studies brought to research on technology and organizing blossomed during the 1990s under the banner of "social constructivism." Today, constructivism is associated with technology in two complementary areas of inquiry. The first, an approach based in the sociology of scientific knowledge (SSK), examines the social processes that contribute to the *development* of new technologies (e.g., Callon, 1986; Klein & Kleinman, 2002; Latour, 1987; Pinch & Bijker, 1984). The second, an organizations-oriented approach, focuses on the *implementation* of new computer-based technologies in established organizational contexts. Although the first program of research has finally begun to filter into organization studies, its influence on the field remains small. Hence, we shall focus on notions of how the effects of computer-based technologies (e.g., e-mail, productivity tools, medical imaging devices, groupware, decision support systems, digital simulation tools, and others of this kind) are socially constructed as they are implemented and used in organizations.

Social constructivists who study technology implementation generally hold that organizational change emerges out of an ongoing stream of social action in which people respond to the technology's constraints and affordances, as well as to each other. Because their agenda has been to challenge technological determinism and to make an empirical case for a more agentic or voluntarist ontology, most of these researchers have emphasized the

underlying similarities among constructivist studies, while paying less attention to their differences. But because the constructivist perspective has now become widely accepted, it no longer seems necessary to continue to demonstrate that social construction occurs. Instead, what would most advance scholarship at this point in time would be theory and research that demonstrates how various social construction processes come into play and entwine with the technology's material properties, as well as with the existing social structure of the context in which it is used (Leonardi & Barley, 2008). In doing so, it would be useful to recognize and leverage the subtle differences that permeate the constructivist literature on the implementation of technology. Understanding these differences, their strengths, and their limitations should help researchers design studies that will lead to more comprehensive theories of the relationship between technology and organizing.

Others (e.g., Jones & Karsten, 2008; Pozzebon & Pinsonneault, 2005) have observed that researchers who offer constructivist accounts of technology and organizing have disproportionately employed structuration theory, Anthony Giddens' (1984) attempt to reconcile theoretical sociological dichotomies, including debates over agency and structure, subjective and objective realities, and micro and macro perspectives. Although structuration theory does figure prominently in this literature, scholars have also made use of social information processing theory, actor-network theory, negotiated order theory, critical realism, and symbolic interactionism. Although all of this research shares a similar ontology, as we shall show, authors differ with respect to: (1) the phase of implementation on which they focus; (2) the social phenomenon they claim is being constructed; and (3) the process by which construction occurs. Thus, rather than organize the literature by the theoretical frameworks that authors have employed, we have found it useful to cluster papers according to their stance on these three issues. Our analysis indicates that authors' stances on these issues define five distinct constructivist perspectives, which we shall call perception, interpretation, appropriation, enactment, and alignment.[‡]

The *perception* perspective focuses on adoption, the earliest phase of implementation. Researchers in this camp seek to explain why users come to share similar perceptions of a technology's usefulness, and to demonstrate that these perceptions largely determine whether people will use a technology. They contend that social construction occurs through the convergence of attitudes, values, and beliefs among the potential users of a technology. Contagion and other social influence processes are seen as the primary cause of convergence.

The *interpretation* perspective asks how people use the technology rather than why they adopt it. Advocates contend that users draw on familiar schemas or frames to make sense of a new technology. Thus the interpretation perspective is the most cognitively oriented of the five. Construction involves transferring interpretations from one domain to another, for example from

past practice to present practice or from experiences with mechanical devices to encounters with computer-based technologies.

Researchers who write from the *appropriation* perspective are also interested in how people use technologies, but unlike researchers who operate from the interpretation perspective, they are interested in whether people conform to or deviate from designers' perceptions of how the technology should be used. Social construction unfolds through intra-group interaction, as members negotiate how they will use features of a technology to accomplish a task.

Like the previous two approaches, the *enactment* perspective focuses on how people use a technology. It differs in that scholars who adopt this perspective study the evolution of work practices rather than cognitions or norms. Researchers who study enactment argue that social construction emerges during the course of people's encounters with a technology as they use it in the conduct of their everyday work. Thus social construction proceeds through pragmatic action and situated improvisations.

Finally, the *alignment* perspective examines how the structure of an organization adapts to a new technology. Researchers who have promoted this perspective are interested in how work systems become organized around a technology as patterns of use begin to form. More specifically, they examine how roles and relationships change as representatives of two or more functional or occupational groups interact in the process of using new technology. Thus inter-group interactions, which often have political overtones, are the engine of the social construction process.

‡ To develop the analysis in this paper, we reviewed constructivist studies of implementation that have appeared in major organization studies, information systems, and communication journals that published work on technology and organization through 2008. The journals included *Academy of Management Journal, Academy of Management Review*, *Accounting Management and Information Technology*, *Administrative Science Quarterly*, *American Journal of Sociology*, *American Sociological Review*, *Communication Monographs*, *Communication Research*, *Human Communication Research*, *Human Relations*, *Information and Organization*, *Information Systems Research*, *Journal of Management*, *Journal of Management Studies*, *Management Science*, *MIS Quarterly*, *Organization Science*, *Organization Studies*, *Technology Work and Employment*, and *Work, Employment and Society*. We then turned to papers that the authors of the first set of studies referenced as seminal contributions. We selected papers based on three criteria. First, each paper had to treat technology as a material artifact, such as hardware or software. This criterion excluded papers that operationalized technology as a type of knowledge or as a production process. Second, each paper had to discuss the organizational implications of the technology's implementation. This criterion excluded papers that talked generally about the relationship between technology and social dynamics, without specifically discussing its role in organizations. Finally, each paper had to explore explicitly the relationship between social action and a technology's organizational effects. This criterion excluded papers that spoke solely about a technology's material features or treated it as an abstract material cause.

Table 1 summarizes the critical differences among these five perspectives, and lists the papers that comprise each group. To sharpen the distinctions between perspectives, let us turn to the details of the papers that define each cluster to elaborate its perspective, summarize its findings, and acknowledge its strengths and weaknesses.

Social Constructivist Perspectives on Technology Implementation

Perception

The perception perspective consists of studies that examine how exposure to others' attitudes through membership in a group or communication network shapes peoples' perceptions of a new technology. Researchers use "perception" as a cover term for attitudes, beliefs, and values. They are interested in how members of an organization come to share common perceptions of a technology, and how those perceptions determine whether people will or will not use the technology. Members of this camp have typically used large-scale surveys to study either information or communication technologies.

Early work by Fulk et al. employed a social-information-processing model to explain how individuals form perceptions of new technologies (Fulk, 1993; Fulk & Boyd, 1991; Fulk, Schmitz, & Ryu, 1995; Fulk et al., 1987; Schmitz & Fulk, 1991). Social information processing theory argues that those with whom a person interacts significantly influence what he or she thinks. Fulk et al. (1987, p. 537) proposed that an individual's perceptions of a technology's constraints and affordances were formed "to a substantial degree by the attitudes, statements, and behaviors of coworkers." They reasoned that if this were true, individuals' perceptions of a technology would more closely resemble the perceptions of people in their work group than the perceptions of those outside it. Moreover, they argued that these social forces would be more important than the technology's physical attributes in determining use. To test this theory, Fulk et al. collected data on how engineers in a petrochemical company perceived the richness of their e-mail system, how often they used the system, how attracted they were to their workgroups, and how much information they exchanged about the technology with various members of the organization. These studies yielded several key findings. First, social influence processes shaped how engineers perceived e-mail's affordances. Second, engineers' perceptions of the e-mail system were correlated with the perceptions of members of their work groups but were uncorrelated with the perceptions of their communication partners outside the work group. Third, co-workers' opinions were also more influential than the opinions and exhortations of management.

Whereas Fulk et al. could infer that social influence determined one's likelihood of using a technology, they did not study the actual flow of communication in a network. Rice and Aydin (1991) were the firszt to combine social

Table 1 Summary of Perspectives on the Social Construction of Technology Implementation

	Perception	Interpretation	Appropriation	Enactment	Alignment
Phase of implementation	Adoption	Use	Use	Use	Adaptation
The social phenomenon constructed	Attitudes, beliefs, and values	Schemas and frames	Patterns of deviation and conformity	Work practices	Roles and relationships
Construction process	Social influence Fulk, Steinfield, Schmitz, and Power (1987) Fulk et al. (1990) Fulk and Boyd (1991) Rice and Aydin (1991) Schmitz and Fulk (1991) Fulk (1993) Fulk, Schmitz, and Ryu (1995) Griffith and Northcraft (1996)	Transference Barley (1988) Prasad (1993) Markus (1994) Prasad and Prasad (1994) Orlikowski and Gash (1994) Walsham and Sahay (1999) Gopal and Prasad (2000) Walsham (2002) Jian (2007)	Intra-group interaction Watson, DeSanctis, and Poole (1988) Poole and DeSanctis (1990) Orlikowski and Robey (1991) Orlikowski (1992) Poole and DeSanctis (1992) DeSanctis and Poole (1994) Scott et al. (1998)	Situated improvisations Yates and Orlikowski (1992) Orlikowski and Yates (1994) Orlikowski, Yates, Okamura, and Fujimoto (1995) Boczkowski (1999) Yates, Orlikowski, and Okamura (1999) Orlikowski (2000) Boczkowski (2004) Boczkowski and Orlikowski (2004)	Inter-group interaction Barley (1986) Zuboff (1988) Barley (1990) Zack and McKenney (1995) Orlikowski (1996) Robey and Sahay (1996) Majchrzak, Rice, Malhotra, King, and Ba (2000) Edmonson, Bohmer, and Pisano (2001) Schultze and Orlikowski (2004)

Table 1 Summary of Perspectives on the Social Construction of Technology Implementation (Continued)

Perception	Interpretation	Appropriation	Enactment	Alignment
Kraut, Rice, Cool, and Fish (1998)	Hsiao, Wu, and Hou (2008)		Boudreau and Robey (2005)	Black, Carlile, and Repenning (2004)
Karahanna, Straub, and Chervany (1999)			Vast and Walsham (2005)	Davidson and Chismar (2007)
Yuan et al. (2005)			Constantinides and Barrett (2006)	Leonardi (2007)
Vishwanath (2006)			Dery, Hall, and Wailes (2006)	
Yuan, Fulk, and Monge (2007)			Volkoff, Strong, and Elmes (2007)	

influence and network theories to explore how spatial, positional, and relational proximity affects an individual's perception of a new technology.[§] The authors used a questionnaire to assess how 104 users of a medical information system perceived the system, how frequently they used the system, and with whom they communicated. They gathered additional data on job titles, seating charts, and organizational charts. These data allowed the researchers to map networks based on different relationships. The data revealed that direct communication ties and managers' perceptions of the technology significantly influenced respondents' perceived worth of the system, but that their actual use of the system had no affect on their attitudes. This led the authors to conclude that "usage of the system, by itself, does not apparently influence one's attitudes toward the system" (p. 238). What matters are one's relations to others. Griffith and Northcraft (1996) showed that in addition to the information's source, the content of what is communicated (e.g., is the information about the technology positive or negative?) also apparently influences the effectiveness of the social influence process.

These studies established that social influence was a primary mechanism by which perceptions of a technology are socially constructed. Other studies have assessed the relative strength of social influence as a reason to adopt. Kraut, Rice, Cool, and Fish (1998) studied competing video telephony (desktop videoconferencing) systems in a large R&D company to assess the relative affects of social influence and the technology's practical utility on the probability of use. They collected data on 135 individuals' use of two systems through observation, questionnaires, organizational records, and interviews. The authors found that the technologies were used most frequently by people whose work required extensive communication, but that social influence was nevertheless important in two ways. Early in the use of the new systems, social influence processes led to the development of a critical mass of users that ultimately determined which of the two systems they adopted. Once use was established, social influence began to shape how people used the technology.

Karahanna, Straub, and Chervany (1999) asked not just whether but when social influence was more important than other forces favoring the adoption and use of a technology. The researchers studied the adoption and use of Microsoft Windows V3.1. in a Midwestern financial institution. The firm allowed employees to decide for themselves whether to adopt the new operating system. Consequently, Karahanna et al. were able to study intentions to adopt among 107 users who had not yet adopted Windows, and the decision

§ Relational proximity refers to how close two people in a social network are, where closeness is conceptualized as path distance. Positional proximity refers to similarity in the structural positions or roles of two actors in a network and is measured as structural equivalence. People may occupy the same position but not have any direct connection. Spatial proximity refers to closeness in physical space.

to continue to use Windows among 161 people who had already tried the software. The authors showed that social influence was important only when users were making the initial decision to use Windows. In contrast, the decision to continue using the software rested entirely on the user's evaluation of its performance and utility. Following this work, the most recent studies in the perception stream aim to place scope conditions upon the theory by explaining under what conditions social influence and peoples' competency with the technology are stronger predictors of its use (Vishwanath, 2006; Yuan et al., 2005; Yuan, Fulk, & Monge, 2007).

Summary and Limitations

In sum, perception researchers argue than an organization's decision to deploy a new technology is no guarantee that individuals will adopt it. Instead, adoption depends on peoples' attitudes and beliefs about the technology. This is precisely because people do not directly perceive the utility of a technology's features before they have actually used it. Instead, they fashion their perceptions of a technology's usefulness through conversations with co-workers and others whose opinions matter. Moreover, the researchers are careful to show that perceptions are a social rather than an individual phenomenon. Because perceptions are constructed through information exchanges, attitudes and beliefs about a technology become shared. Thus adoption is a collective rather than an individual process that stands apart and may sometimes be divorced from the technology's physical capabilities.

Despite the importance of these insights, perception research suffers from several shortcomings. First, in focusing so intently on how people perceive a new technology, these studies often ignore how the technology is used. In the perception literature, one senses that social construction ceases once users have decided to adopt the technology. From that point on, the technology's constraints and affordances determine patterns of use. Second, perception researchers clearly show that membership in a work group determines whether a person will adopt a technology, but they do not explore how consensus about a technology emerges. Researchers assume that communication practices play an important role, but we do not know whether some people's attitudes and opinions matter more than others', whether some forms of communication are more influential than others, or even whether communication is more important than mandates or role modeling. Nevertheless, recognizing that social influence plays a role in shaping perceptions of a technology's utility is an important step in explaining why some people adopt a technology and others do not.

Interpretation

The interpretation perspective focuses on use rather than adoption. Proponents hold that how people interpret a technology strongly affects the way they will

use it. Although most students of social construction would agree that interpretations are important, scholars in this camp make the substance of shared interpretations an explicit object of study, which they normally pursue through field studies of a technology's use. They also claim that people make sense of new technologies by drawing on frames imported from other domains, such as technologies they may have worked with in the past, the subculture of their occupation, or their organization's culture.** In other words, social construction involves the transfer or modification of a previously existing cognitive framework to a new situation.

Researchers suggest that users can draw on a variety of domains when making sense of a new technology. Several studies have shown that users interpret a new technology by drawing on their experience with technologies they have used in the past. Barley (1988) studied technicians in two radiology departments that had just acquired their first computerized tomography (CT) scanner. Although all of the technicians had previously used x-ray machines, most had never worked with a computer, much less a computerized imaging device. Over a period of nine months, Barley documented 65 instances of technicians attempting to correct scanner malfunctions. When technicians did not understand why the malfunction occurred, they often resorted to framing the problem in terms of mechanical technologies with which they were more familiar. For example, upon encountering the error message, "open file failure," a technician drew on her experience with record players. She explained that the disk's heads had probably hit a scratch on the surface of the hard disk and that caused a skip.†† This interpretation absolved her from having to fix the problem, since it would have been impossible to remove a scratch. She simply rebooted the computer and rescanned the patient.

Orlikowski and Gash (1994) made a similar observation in their study of a consulting firm that was implementing Lotus Notes. The technologists who had brought Notes into the organization interpreted the software as a group productivity tool and anticipated that consultants would use Notes for group collaboration. But the technologists did not share their frame with the

** By frame, we mean the assumptions, expectations, understandings, concepts, and models that people use to make sense of a phenomenon; in this case, a technology. Frames act as filters through which people interpret the world. Not all authors whom we include in the interpretation perspective speak explicitly of frames, but all propose that people make sense of technologies using a shared cognitive structure. Barley (1988) and Orlikowski and Gash (1994) call these cognitive structures "frames." Other authors use synonymous terms: "symbols" and "meaning" (Prasad, 1993), "social definitions" (Markus, 1994), "structure in the mind" (Walsham, 2002), and "realities" (Gopal & Prasad, 2000). We use "frame" throughout our discussion to reduce ambiguity.

†† The message actually indicated that the computer had failed to write an end-of-file statement to close the file containing an image. The problem occurred because of a bug in the software that was activated only under certain conditions.

consultants prior to distributing the software. Consequently, the consultants interpreted Notes in light of applications that they were currently using, for example e-mail and spreadsheets. As a result, consultants generally used Notes for individual tasks such as sending e-mail, but not for group tasks or collaboration. Orlikowski and Gash (1994, p. 191) concluded:

> Research in cognitive sociology and organizational studies 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.

Researchers have also recognized that organizational and occupational subcultures provide frames for interpreting technologies (Gopal & Prasad, 2000; Jian, 2007; Markus, 1994; Prasad, 1993, 1995; Yeow & Sia, 2008). As one example, Prasad spent 18 months studying the adoption of an administrative database by a health-maintenance organization whose goal was to integrate records across a range of functions (Prasad, 1993; Prasad & Prasad, 1994). She found that nurses who used the new technology made sense of the computer by drawing on nursing's rhetoric of professionalism. Nurses have long felt unappreciated by physicians and hospital administrators, who perceive them as underlings and functionaries (Freidson, 1970). As sociologists of work and occupations have repeatedly shown, nursing has long tried to bolster its authority within medicine by asserting its professional status. Often, this has involved extending nursing's jurisdiction over tasks and bodies of knowledge that allow nurses to claim unique and esoteric expertise (Abbott, 1988). The nurses that Prasad studied framed the computer system in precisely this way. They quickly embraced the system, arguing that it enhanced their stature within the hospital and would lead others to see them as professionals.

Gopal and Prasad (2000) studied a group of teachers who were learning to use a group decision support system (GDSS) to aid them in arriving at a consensus about how to shape their school's culture. The researchers observed two GDSS sessions, and, after each session, they interviewed twelve participants about their experience. They discovered that teachers drew on the vocabulary of the classroom to frame their experience of the technology; they referred to the GDSS facilitator as "the instructor" and to their own activities as "assignments." Orlikowski and Gash (1994) also argued that conflicts between groups over the use of a technology may reflect occupational and organizational backgrounds. Specifically, they claimed that technologists and consultants viewed Lotus Notes differently, in part because each group approached the technology from the vantage point of their occupation and their functional area. Similarly, Markus (1994) argued that the culture of a risk-management firm shaped how managers interpreted a new e-mail system, as well as the norms they developed

for using it. Hsiao, Wu, and Hou (2008) suggested that different needs faced by varying classes of taxi-cab drivers (e.g., those who served as semi-permanent drivers for regular clients vs. those who worked on-call or at taxi stands) shaped their interpretation and subsequent use of new GPS technologies, as well as the way they organized their workforce.

Walsham (2002) and Walsham and Sahay (1999) showed that even frames that originate far outside the context of work may affect how people interpret new technologies. The authors examined how Indian foresters and land-management experts responded to maps created by a Geographical Information System (GIS) that central-government officials had adopted. Americans originally developed the GIS system for use at home and then brought it to India at the request of scientists working for the Ministry of Environments and Forests. Although American and European foresters routinely employ maps created by GIS systems, their Indian counterparts refused to use them. Walsham and Sahay (1999) argued that the Indians rejected the maps because they conceptualize space differently than Westerners. Whereas space is an abstract and objective concept for most of the Western world, it is an experiential or subjective concept in India. Unlike Westerners, Indians do not separate space from place. Moreover, in India, maps are not common cultural artifacts as they are in the West. In fact, Indians do not generally use maps when they travel. Thus Walsham and Sahay (1999, p. 50) conclude:

> The map-based culture of Western societies is taken for granted by the Western developers of GIS technology, and the assumption that users will be comfortable with maps is inscribed into the technology. When GIS technology is transferred to India, these implicit cultural assumptions embedded in the technology can prove highly problematic.

In short, even overarching cultures may provide people with frames for making sense of a new technology.

Summary and Limitations

Interpretation researchers make clear that users do not approach technologies with a blank slate on which technologists and managers can write at will. Instead, people come to a technology with a host of potential frameworks on which they can draw to construct their response. By transferring ideas and concepts from familiar domains, users may override interpretations that officials and designers wish to impose. An upshot of such transfers is that technologies are likely to serve symbolic as well as instrumental purposes. Interpretations of a technology are potentially limitless and can only be understood *in situ*. For example, a technology that may signify an opportunity for power or freedom to one group may represent oppression to another. For this reason, interpretations can lead to widespread variance in how technologies are used and may even trigger political conflict.

Despite these contributions, the interpretation perspective has several limitations. Researchers who adopt this perspective usually assume that the members of a work group, an occupation, or a culture interpret a technology similarly by virtue of their common membership. While this may be true, researchers provide little evidence on how the consistency of framing arises. Instead, they take the existence of shared interpretations as evidence that a social process has occurred. The question that begs answering is how members of a group transfer meaning from the same domain despite their individual differences. In short, researchers need to go beyond showing evidence that a collective interpretation exists to examining how old meanings are transferred to new situations and how those meanings become shared.

The interpretation perspective also fails to explain why groups draw meaning from one domain instead of another. For example, why did Prasad's nurses make sense of their computer system by transferring a concern with professionalization, and why did Barley's technicians use mechanical technologies to explain how computers operate? Like the technicians, the nurses were certainly familiar with mechanical technologies. Conversely, like the nurses, the radiological technicians also had a history of contesting their professional status. Thus one issue that awaits exploration is why participants who have access to the same domains draw on different domains to interpret new technologies.

Third, by associating meaning with interpretations drawn from ready-made cultural reservoirs, researchers in this tradition have largely ignored the role of situated action and interaction. People certainly draw on the familiar to make sense of the new. Yet, some of their understanding of a technology must inevitably emerge as they encounter its constraints and affordances in the here and now. Conceivably, studies in this camp have glossed over emerging meanings because they focus only on an early stage of use. One would expect meanings to change as people become more familiar with a technology. Understanding the processes by which interpretations arise over time in the course of everyday action is crucial for developing a more complete view of how technologies are socially constructed. Charting such changes would require researchers in the interpretive camp to collect longitudinal in addition to cross-sectional or comparative data. That said, the interpretation perspective has shown us that meanings that people bring from the past are integral to the question of how and why technologies are used in the present.

Appropriation

Like the interpretation perspective, the appropriation perspective attends to technologies after people have decided to adopt them. But rather than ask how people make sense of a technology, appropriation researchers investigate whether people use the technology as its designers or adopters intended. In fact, the appropriation perspective is the only constructivist approach that

recognizes that those who design technologies have images of how the technology will or should be used. Because adherents look to these intentions to establish a point of comparison, they use the term "appropriation" to signal that people are free to use a technology's features in anticipated or unanticipated ways. Thus social construction occurs as the members of a group interact around a new technology to produce patterns of deviation from and conformity to an expected mode of use.

Appropriation research began as a response to Watson, DeSanctis, and Poole's (1988) study of college students using group-decision support systems (GDSS). Students in this laboratory study participated in a task designed to simulate decision making when conflicting personal preferences are involved. Some groups used the GDSS, while others either used paper and pencil aids or made decisions without any support. Because the technology was specifically designed to enhance communication and equalize participation, the researchers expected the groups using GDSS to exhibit more consensus, greater equality of participation, and more confidence in their decision. The authors were disappointed to discover that none of their hypotheses held. In fact, on several dimensions, the results were precisely the reverse of what they anticipated.

Although Poole and DeSanctis (1990) could have attributed the experiment's negative results to methodological flaws, they observed that the entire body of research on group-decision support systems was marked by contradictory and ambivalent findings. This, in turn, led them to reject their formerly determinist stance in favor of a constructivist explanation. The authors explained the change as follows:

> Traditionally, technology has been thought of as something independent of the user, as an object or tool. But an important school of thought … claims otherwise … Social processes create the conditions for the evolution of technology … No matter what features are designed into a system, users mediate technological effects, adapting systems to their needs, resisting them, or refusing to use them at all. The operative technology is determined by patterns of appropriation and use by human beings. (Poole & DeSanctis, 1990, pp. 176–177)

Poole and DeSanctis proposed Adaptive Structuration Theory (AST) to embrace the unanticipated effects found in previous studies. AST drew heavily on Giddens' (1984) theory of the relationship between structure and action to propose that "advanced technologies bring social structures which enable and constrain interaction to the workplace" (DeSanctis & Poole, 1994, p. 125). According to Poole and DeSanctis, one can describe a new technology not only in terms of its "structural features" but also by its "spirit":

> …we have distinguished two aspects of technological structures: their *spirit*, the general goals and attitudes the technology aims to promote

> (such as democratic decision making), and the specific *structural features* built into the system (such as anonymous input of ideas, or one vote per group member). A *structural feature* is a specific rule or resource that operates in a group, whereas the *spirit* is the principle of coherence that holds the rules and resources together. Obviously the features of a GDSS are designed to promote its spirit. However, features are functionally independent of spirit and may be used in ways contrary to it… (Poole & DeSanctis, 1990, p. 179)

In short, designers build physical affordances and constraints into a technology to encourage certain patterns of use and behavior. Users appropriate these features in ways that are either consistent or inconsistent with designers' intentions. Poole and DeSanctis refer to consistency as *faithful appropriation* and to deviation from intended use as *ironic appropriation*. By repeatedly using a new technology in a certain way, patterns begin to stabilize, which either reflect the designer's intentions or not.

Poole and DeSanctis (1992) first employed AST in a study of how 18 student groups appropriated the features of a group-decision support system. The system captured all comments that the students entered into their computer terminals, thereby creating a transcript of their interactions. The authors then analyzed the speech acts contained in the transcript using a complex coding system designed to distinguish among nine types of appropriations (see DeSanctis & Poole, 1994; Poole & DeSanctis, 1992). The data indicated that 11 of the 18 groups faithfully appropriated the technology, and that these groups exhibited more consensus than those that appropriated the system ironically. Further research (DeSanctis & Poole, 1994; Sambamurthy & Poole, 1992) confirmed that a group's propensity to appropriate faithfully the features of the GDSS was directly tied to *how* the group integrated the technology into its ongoing stream of interaction.

At approximately the same time, Orlikowski also turned to Giddens' theory of structuration to unravel the material and social aspects of technological change (Orlikowski, 1992; Orlikowski & Robey, 1991). Like Poole and DeSanctis, Orlikowski distinguished between the intentions of those who design and commission technologies and the intentions and behaviors of those who use them. She called the former the "design mode" and the latter the "use mode," choosing her terminology to emphasize that human action occurs both before and after the adoption of a technology (Orlikowski, 1992, p. 408). Also like Poole and DeSanctis, Orlikowski invoked the notion of appropriation to signify that users may or may not employ a technology's features as they were intended. Highlighting this point, Orlikowski and Robey (1991, p. 153) wrote, "For information technology to be utilized, it has to be appropriated by humans, and in this exercise of human agency there is always the possibility that humans may

choose not to use the technology or use it in ways that undermine its 'normal' operation."

Nevertheless, Orlikowski's vision of appropriation differed from Poole and DeSanctis's in crucial ways. Poole and DeSanctis came to technology studies from group communication research where there is a long-standing tradition of developing models for more effective decision making and consensus building. In fact, GDSS systems were explicitly built to foster these objectives. Understandably, Poole and DeSanctis took a normative stance toward appropriation. They saw faithful appropriation as better than unfaithful appropriation. "In general," they wrote, "we would expect desired decision processes to be more likely to result when … appropriations are faithful to the system's spirit, rather than unfaithful" (DeSanctis & Poole, 1994, p. 131). Orlikowski came to technology studies with a different and less normative agenda: to highlight technology's role in the production and reproduction of institutions. Orlikowski (1992) developed her stance on appropriation during an eight-month ethnographic study of the implementation of Computer Aided Software Engineering (CASE) tools in a large consulting company. CASE tools create software-development environments that standardize programming practices. Orlikowski documented how the tools reinforced the organization's structure and imposed discipline on the consultants whose job was to customize databases and design interfaces for clients. By appropriating the technology's features, the consultants reproduced the existing organizational structure.

Rather than frame appropriations as faithful and unfaithful, Orlikowski employed the more neutral language of constraints and affordances to explain how technologies shape actions and, hence, social structures. As Orlikowski observed, technology is

> …both an enabler of, and a constraint on, human action. On the one hand, tools allow the consultants to design screens more quickly than before, relieving them of the monotonous task of formatting fields, and further assisting modifications as these are required. On the other hand, the tools constrain the consultants in that they are limited to the formatting options available in the tools' repertoire. (Orlikowski, 1992, p. 416)

This language allowed Orlikowski to move beyond treating intended use as a dependent variable and to focus on how technologies reflect and affect the social system in which they are embedded.

Although subsequent researchers have drawn on the theory and concepts articulated in these seminal papers, they have departed significantly from the original visions. With few exceptions (e.g., Maznevski & Chudoba, 2000), those who drew on AST normally did not treat social construction as a process in its own right; instead, researchers used the insights of AST as evidence of

unexamined moderating variables.[‡‡] Consequently, most subsequent studies test for moderating variables that might lead to more faithful appropriations (Anson, Bostrom, & Wynne, 1995; Chin, Gopal, & Salisbury, 1997; Contractor & Seibold, 1993). For example, Anson et al. (1995, pp. 191–192) wrote: "It is not our intent to test these frameworks [i.e., AST] *per se*. They will be used to suggest hypotheses regarding treatment effects and to propose supplemental questions for exploring potential moderating factors."[§§]

Although Orlikowski's application of structuration theory to technical change has been very influential, her articulation of appropriation has been largely forgotten because she later rejected it. Referring explicitly to DeSanctis and Poole (1994) and her own work (Orlikowski, 1992), Orlikowski wrote eight years later:

> The first proposition [of the appropriation perspective]—that technologies become "stabilized"—neglects the empirical evidence that people can (and do) redefine and modify the meaning, properties and applications of technology after development … The second proposition—that technologies "embody" social structures—is problematic from a structurational perspective because it situates structures within technological artifacts. This is a departure from Giddens' view of structures as having only a virtual existence, that is, as having "no reality except as they are instantiated in activity." (Orlikowski, 2000, pp. 405–406)

Summary and Limitations

Few researchers presently study the social construction of implementation from within the appropriation perspective. Nevertheless, it made several lasting contributions to our understanding of the social construction process. Perhaps most importantly, appropriation research is the only perspective on social construction to recognize explicitly that technologies are not neutral. Instead, people design and adopt technologies with explicit objectives in mind, and these objectives are encoded in the object itself. Appropriations are the practices that turn material properties into constraints on and affordances for human action. It is precisely for this reason that technologies sometimes liberate, sometime control, and sometimes do both simultaneously.

‡‡ Although a tremendous number of articles have cited the early work of Poole and DeSanctis and Orlikowski, most did not conform to the review criteria that we established earlier in this paper. In other words, most authors who have drawn on adaptive structuration and the duality of technology models do not talk specifically about organizational change or share the same interest in exploring the social construction of a technology's implementation as the authors of these foundational papers.

§§ The studies mentioned in this paragraph all cite and build on AST. However, as described in the text, none actually do an AST analysis. Consequently, we have not included these studies or many others that cite the work of Poole and DeSanctis or Orlikowski in Table 1.

Furthermore, appropriation research represented the first attempt to study explicitly the use of a technology in context. Thus it uncovered the possibility that the intentions of designers and adopters can be at odds with the interaction order in which the technology becomes embedded. By employing the concept of appropriation, researchers could show that people can do more than simply use or resist technologies; they can construct alternative meanings for the technology and use it in unanticipated ways.

Nevertheless, the appropriation perspective exhibits some limitations. Although appropriation researchers cite the importance of social context, they rarely offer explicit and situated accounts of why people appropriate technologies precisely as they do, in part because their papers have heavy theoretical agendas. For this reason, appropriation researchers are silent on whether people appropriate as they do because they are forced to do so by others, because their appropriations are consistent with their interpretations or beliefs, because they bend technologies to fit existing processes and practices, because they seek change, or because of a host of other possible reasons. As a result, the appropriation perspective offers an underspecified image of the social construction process as the product of intra-group interaction.

Moreover, even though appropriation researchers recognize that technologies are designed with certain goals in mind, they overlook the possibility that the process of infusing a technology with intent is itself a process of social construction. In fact, as Pinch and Bijker (1984), Thomas (1994), and others have made clear, the design of a technology arises out of conflict and negotiation among groups with diverse interests in the technology's development. By ignoring the politics of design, appropriation researchers may fail to realize that "correct" or "natural" uses of a technology are themselves constructed. Thus they take "correct" uses of a technology for granted, which runs the risk of subtly reintroducing determinism into a stance intentionally formulated to reject it.

Enactment

The enactment perspective is tightly associated with the work of Wanda Orlikowski, JoAnne Yates, and their colleagues (Orlikowski, 2000; Orlikowski & Yates, 1994; Orlikowski, Yates, Okamura, & Fujimoto, 1995; Yates & Orlikowski, 1992; Yates, Orlikowski, & Okamura, 1999). Through the 1990s, Orlikowski and Yates gradually developed the enactment perspective, which Orlikowski (2000) then systematically articulated in her paper, "Using Technology and Constituting Structures: A Practice Lens for Studying Technology in Organizations." Enactment papers published since Orlikowski's manifesto have extended the framework by exploring the various forces that shape enactments and by refining the perspective's initial claims in light of further empirical evidence (Boczkowski, 2004; Constantinides & Barrett, 2006; Dery, Hall, & Wailes, 2006; Vaast & Walsham, 2005; Volkoff, Strong, & Elmes, 2007).

Karl Weick (1979) is usually credited with introducing the verb "enact" into organization studies as a way of underscoring the idea that organizing is an activity and that humans wittingly and unwittingly craft organizations as they try to make sense of and respond to their environments. "Enact" first entered the constructivist literature on technology use through Barley's (1986, 1988, 1990) studies of computerized imaging in radiology departments. Barley used the term offhandedly to connote that the radiologists and technologists he studied produced the social order of radiology departments as they went about their daily round of activity. Orlikowski also employed the term loosely in the papers that we have discussed under the appropriation perspective. Orlikowski and Yates began using the term more frequently and deliberately in their work on genres of electronic communication (Orlikowski & Yates, 1994; Yates & Orlikowski, 1992). In those papers, genre usually appeared as the verb's direct object, signifying that genres were what were being enacted. Later, Orlikowski associated enactment with the social production of "technologies-in-practice" (Orlikowski, 2000). Orlikowski and her colleagues did not offer an explicit definition or extended discussion of enactment until her conceptual paper on the practice perspective published in 2000, where she positioned enactment as an alternative to appropriation:

> While the notion of appropriation captures well the importance of human action in shaping the situated use of technology, it nevertheless frames such human agency in terms of interaction with the structures embedded within technology. Thus, DeSanctis and Poole (1994, p.133) recommend "appropriation analysis [which] tries to document exactly how technology structures are being invoked for use in a specific context" (DeSanctis & Poole, 1994, p. 133), and Orlikowski and Robey (1991, p. 148), while not using the term "appropriation analysis," suggest analyzing how the structure inscribed in information technology "shapes action by facilitating certain outcomes and constraining others." These views start with the structures presumed to be embedded within technology, and then analyze how those structures are used, misused, or not used by people in various contexts. If, however, we focus on emergent rather than embodied structures … an alternative view of technology use becomes possible—a view which allows us to frame what users do with technologies not as appropriation but as *enactment.* Thus, rather than starting with the technology and examining how actors appropriate its embodied structures, this view starts with human action and examines how it enacts emergent structures through recurrent interaction with the technology at hand. (Orlikowski, 2000, p. 407)

Perhaps because Orlikowski (1992) and Orlikowski and Robey (1991) initially worked with the appropriation perspective, enactment and appropriation share important commonalities. Both use structuration theory as their

lens for envisioning how technologies, structures, and agency are entwined. Both are primarily interested in explaining the social organization of a technology's use rather than its adoption, and both highlight the role that human action plays in shaping practices. Nevertheless, the enactment perspective departs from appropriation in critical ways.

First, although developers' purposes do not completely disappear in enactment research, their contributions to the social organization of a technology's use are given no particular privilege or force. The enactment perspective is largely unconcerned with whether people use, reject, or misuse a technology's specific features as someone else may have intended. The enactment perspective recognizes that those who design and implement technologies can influence the social order that people enact as they use the technology (Orlikowski et al., 1995; Yates et al., 1999), but designers and implementers are portrayed as one among the many forces that shape users' behaviors.

Second, whereas authors in the appropriation stream treat structures as though they are relatively fixed and embodied in technological artifacts, authors in the enactment stream treat structures as inherently virtual, as patterned streams of action and interaction. As such, structures are not given but rather emerge over time as forms of use and social relations sediment into place and become institutionalized. The imagery is one of situated "improvisation" (Orlikowski, 2000, p. 404) or "improvised learning" (Boudreau & Robey, 2005). Structures emerge and shift as people go about solving the problems they confront and as they fold the technology into their everyday practice in ways that make sense in light of their current situation.

Third, and accordingly, the enactment perspective focuses not on patterns of deviation and conformity, as do appropriation researchers, but on practices—how people actually employ the technology in the process of accomplishing their work. One can argue that it is this unrelenting focus on the emergence of practices in the here and now that defines enactment as a distinct perspective. Indeed, in recent years, Orlikowski has come to refer to enactment as the "practice perspective."[***] Boczkowski and Orlikowski (2004, p. 366) summarize the foregoing themes in their account of what it means to study the use of technology (in this case, new media) as practice:

> …practices are defined as "embodied, materially mediated arrays of human activity centrally organized around shared practical understandings" (Schatzki, 2001, p. 2). Practices are situated within institutional contexts and enact a multiplicity of social structures. Actors generate them as part of the ongoing structuring processes through which groups, organizations and communities are (re)produced and transformed … a

*** We have chosen to speak of the enactment rather than the practice perspective, largely because the studies that we shall discuss under the alignment perspective also study practices.

> practice lens invites us to focus on different dimensions of discursive activity: its ongoing character; its embodiment within human bodies; its embeddedness in social-political contexts; its relation to the material and symbolic capabilities of artifacts; its dependence on shared practical understandings; its capacity for improvised responses to emergent situations; and its enactment—generation, reinforcement, renewal and transformation—of social structures through everyday action.

Because enactment emphasizes emergence and, hence, the need to study a technology's use as it unfolds, longitudinal research designs are the hallmark of enactment studies. In addition to extended periods of participant observation, enactment researchers have made use of e-mail archives and other databases that enable them to study retrospectively how specific configurations of use arose, changed, and stabilized through time (Boczkowski, 1999; Orlikowski et al., 1995). The perspective's emphasis on longitudinal analysis represents a sharp departure from all preceding perspectives. In fact, Yates and Orlikowski (1992, pp. 322–323) argued that only with longitudinal data can researchers explicate how structuring occurs, because structuring is a process that unfolds over time. Sharply departing from all previous perspectives, Orlikowski et al. also hold that the same group may use the same technology differently at different points in time, thus highlighting that action has ontological priority. From the enactment perspective, a technology's life span ultimately entails a long series of enactments beginning with designers and flowing though the technology's last user. Because practices continually evolve, albeit at different rates, no set of practices represent a clear end state.

The notion of a community is central to the enactment perspective. The practices that concern Orlikowski et al. are not matters of individual habit or technique but rather ways of doing things that have currency in a specific collective. As Orlikowski and Yates (1994, p. 543) put it when discussing genres, "the communicative purpose of a genre is not rooted in a single individual's motive for communicating, but in a purpose that is constructed, recognized, and reinforced within a community." Because of the perspective's emphasis on the emergence of practices within communities, enactment research's central concern can be understood as documenting the micro-social processes of institutionalization. From this vantage point, enactment is not only consistent with structuration theory, it is the first of the perspectives that we have considered that approaches social construction with the same agenda that motivated Berger and Luckmann's (1967) famous monograph. For Orlikowski et al., genres and "technologies-in-practice" are types of institutions and enactment is the engine of institutionalization:

> A community of users engaged in similar work practices typically enacts similar technologies-in-practice, where through common training sessions, shared socialization, comparable on-the-job experiences, and

> mutual coordination and storytelling, users come to engage with a technology in similar ways. Over time, through repeated reinforcement by the community of users, such technologies-in-practice may become reified and institutionalized, at which point they become treated as predetermined and firm prescriptions for social action, and as such, may impede change. (Orlikowski, 2000, p. 411)

Summary and Limitations

The enactment perspective has made a number of important contributions to our understanding of how and why technologies are socially constructed. First and foremost, its advocates have demonstrated the analytic power of grounding accounts of technological change in the study of ongoing action and human agency. Related and second, enactment researchers have made a strong case for the utility, if not the superiority, of longitudinal designs for studying social construction. Third, enactment research drives home the point that social construction is a never-ending process, and that any "technology-in-practice" is potentially no more than a temporarily stable pattern of action. Finally, enactment researchers have taken steps toward integrating other perspectives into a more encompassing framework. In particular, Orlikowski et al. and, more recently, Boudreau and Robey (2005) and Vaast and Walsham (2005) have shown how to treat schemas and frames and the intentions of designers and mangers as elements of the situation out of which patterns of practice emerge in the course of a technology's use.

Nevertheless, like other perspectives, enactment has limitations. Ironically, the enactment perspectives' most serious limitations arise from its greatest strength: an unrelenting focus on the micro-dynamics of use and on users' agency in improvising and shaping their own practices. The upshot has been a tendency to grant relatively equal footing to all actors' contributions to the structuring process. As a result, Orlikowski et al. have struggled to come to terms with power and the idea that some actors have license to dictate how others should and do use technologies.

Orlikowski et al. come closest to dealing with power imbalances in their work on technology mediators (Orlikowski et al., 1995; Yates et al., 1999). They admit that the mediators they studied had greater influence than the average user, but rather than speak of power they spoke instead of "metastructuring": the idea that some actors are able to set premises that structure the structuring of other actors. As Orlikowski et al. (1995, p. 437) put it, "the structuring involved in technology-use mediation shapes users' own structuring of their technologies." Yates et al. (1999) argue that mediators enact an "explicit" process of structuring, while the structuring processes enacted by users are "implicit".

The enactment perspective's unrelenting focus on action in the here and now of practice has also made it difficult for researchers to speak to how

preexisting, entrenched social structures shape how technologies are deployed and used. Orlikowski (2000, p. 411) explicitly recognized that this was an important limitation of the enactment perspective, but chose to set the issue aside to elaborate more fully the emergence of micro-social structure. To handle more coercive forms of power and constraint and to understand how, why, and when technologies alter or reinforce existing social systems requires that researchers employ notions of roles, entrenched interests, rewards, punishments, and ideologies, and that they acknowledge a more stratified social system than other perspectives have allowed. Indeed, it is the alignment perspective's concern with role structures, power, and stratification that makes it distinctive.

Alignment

Social constructivists who write about technological change from the alignment perspective share much in common with those who write from the enactment perspective. Both ground their analyses in the close study of work practices, foreground human agency, and conceptualize technologically occasioned change as an emergent process. Both generally favor longitudinal data, and count visible shifts in situated patterns of behavior as evidence of change. Like enactment researchers, many students of alignment also draw on Giddens' (1984) notion of structuration. In fact, an alignment study was the first to view technological change from the structuration theory's vantage point (Barley, 1986). What separate the two perspectives are the phenomena they attempt to explain and the level of analysis of the research.

Whereas students of enactment ask how and why people employ specific technologies in particular ways, alignment researchers ask how previously existing institutions shape a technology's use and how the use of a technology might alter or confirm an existing social order. In general, the institutions of concern in most alignment research are more macro-social than those examined by students of enactment. They range from employment relations (Zuboff, 1988), or the culture and authority structure of an occupation (Barley, 1986, 1990; Edmondson, Bohmer, & Pisano, 2001), to the balance of power in a market (Schultze & Orlikowski, 2004), or the structure of a work system (Black, Carlile, & Repenning, 2004; Davidson & Chismar, 2007; Robey & Sahay, 1996). Alignment, therefore, refers to the process by which social orders and technologies configure or adjust to each other through emergent patterns of use. In this sense, the alignment perspective harkens back to the intellectual agenda of socio-technical-systems theory (Rice, 1953; Trist & Bamforth, 1951) and the sociology of automation (Walker & Guest, 1952) which were industrial sociology's attempt to grapple with the institutional implications of technological change in the workplace. In fact, Zuboff (1988) and Barley (1986, 1990), who authored early alignment papers, were both interested in work relations and saw themselves as speaking to the same issues

that motivated research on automation by industrial sociologists in the 1950s and 1960s.

The question of stability and change in role relationships lies at the core of alignment research. Whether explicitly stated or implied, the central premise is that technologies change social orders only to the degree that they alter established patterns of interaction among members of a role set. Changes in role relationships rest, in turn, on changes in work practices of the sort studied by enactment researchers. When changes in work practices occasioned by a technology lead to changes in role relationships, then the structure of the social order is also at risk of change. A number of alignment researchers have mapped structural changes emerging from altered role relations as a change in the structure of social networks (Barley, 1990; Leonardi, 2007; Zack & McKenney, 1995). Employing Nadel's (1957) distinction between the nonrelational and relational aspects of a role, Barley (1990, p. 69) showed that computerized imaging technologies had bifurcated the structure of two radiology departments, in part, because technicians needed to interpret the images that computerized technologies created in real time to produce a diagnostically useful study. Not only was interpretive knowledge not required for operating older imaging technologies, but the American College of Radiology had long insured that technologists were not trained to recognize signs of pathology in the images they produced. The need to interpret, coupled with other changes in practice, led to less hierarchically structured work relations between radiologists and technologists who performed sonography, special procedures, and CT scans when compared to the relationships that the same radiologists had with technologists in radiography and fluoroscopy.

Shifts in role relations rooted in technologically occasioned changes in work practices figure prominently in all alignment studies regardless of the technology or setting investigated. Zuboff (1988), for instance, studied how work changed in three pulp paper mills that had adopted integrated digital sensing and control technologies, and in two banks that had implemented integrated databases for managing financial transactions and services. She found that whether these technologies tended to "automate" or "informate" the work of operators and clerks depended on whether work practices emerged to challenge the traditional allocation of tasks between workers and middle managers, thus altering relations of authority and supervision. "The more blurred the distinction between what workers know and what managers know," Zuboff wrote (p. 308), "the more fragile and pointless any traditional relationships of domination and subordination between them will become."

Majchrzak, Rice, Malhotra, King, and Ba (2000) studied how a virtual team composed of eight employees drawn from three aerospace companies came to employ a collaborative tool chosen to facilitate their interaction. The team was charged with designing a new rocket. The team's mandate represented a significant departure from past practice in the aerospace industry where rocket

design had historically been done by a single firm. Majchrzak et al. (p. 508) described how the team's emergent work practices led to significant changes in role relations between the lead engineer and other team members:

> The availability of a common tool and a common analysis model to share knowledge meant that, in principle, the lead engineer's role as information gatekeeper could be bypassed. This was, in fact, what happened; in addition, the lead engineer's role expanded and became more ambiguous. From being the hub in a communication wheel, he now had to get everybody to explain their inputs to others and at the same time negotiate with everyone publicly on which solution to adopt … with this shift from a hierarchical to a participative decision making structure, the role of each team member shifted. While each specialist continued making their independent technical analyses, each member also began to engage in the design process more proactively. This led to questioning what had initially been accepted as management-imposed technical requirements for the design, a process that, in the end, led to a breakthrough solution.

Edmondson et al. (2001) studied the deployment of minimally invasive cardiac surgery at 16 hospitals. Their analysis showed that the most successful implementations occurred in those hospitals where traditional role relations among surgeons, nurses, technicians, and anesthesiologists became less hierarchical and more collaborative. Conversely, unsuccessful implementations occurred in those hospitals where work practices replicated and reinforced traditional roles in the surgical theater. As the authors summarized (p. 691):

> The new technology not only changes individual team members' tasks, it blurs role boundaries and increases team interdependence. Successfully enacting this change affects deeply engrained status relationships in the OR team, as the surgeon's role shifts from that of an order giver to a team member in the more interdependent process.

Schultze and Orlikowski (2004) studied the changes occasioned by an online quoting system deployed by WebGA, a firm that assisted independent insurance agents in determining which carriers offered the best policies and prices for the clients the agents served. The on-line quoting system allowed agents to generate quotes themselves, thereby bypassing WebGA's service representatives, who had historically provided quotes and acted as consultants to agents putting together proposals. By splitting the activities of quoting and consulting and by automating the former, the technology decreased the frequency and altered the tenor of interactions between sales representatives and clients. Drawing on Gould and Fernandez's (1989) typology of broker relationships, Schultze and Orlikowski argued that the online system transformed sales representatives from gatekeepers, who aligned themselves with agents,

into liaisons, who were aligned with neither agents nor carriers. Ironically, the structural change undercut the benefit that agents once gained by working with WebGA.

Although most alignment studies fail to focus on the links between technology use and organizational adaptation, two studies have combined the enactment perspective's emphasis on situated improvisation with the alignment-perspective's interest in changing roles and role relationships. Over a two-year period, Orlikowski (1996) studied how computer specialists and managers employed a new information system that allowed them to track the incidence and resolution of computer problems. She distinguished between and paid close attention to planned changes, changes that emerged from evolving work practices, shifts in the relationships among and between specialists and managers, and changes in coordination between the group on which she focused and other groups in the organization. Leonardi (2007) studied a group of computer-support technicians during the first five months that they also used an incident-tracking tool. He found that a succession of organizational events led the technicians to reevaluate how they used the technology and did their work, and that these cumulating adjustments led, over time, to an inversion of the group's status structure. The theory of information activation that Leonardi inducted from his fieldwork holds that new technologies often enable access to new information, or to information that was previously available but not easily accessible. Having access to new information often brings changes to the kinds of tasks people conduct or provides people with new means to accomplish old tasks, and, in so doing, creates the need for people to communicate about new topics, which, in turn, often leads people to seek new communication partners.

Orlikowski and Leonardi offered similar accounts of how their technicians made situated improvisations in response to planned and emergent changes, and how these, in turn, reconfigured roles and relationships in the settings they studied. Specifically, as technicians adopted the new systems, the demands made upon them, the problems they encountered, and the features of the technology they employed created opportunities for them to approach their tasks in new ways. But by reconfiguring their roles, they generated additional problems and opportunities that triggered a new round of enactment and alignment. In other words, both Orlikowski and Leonardi envisioned the relationship between enactment and alignment as a phased sequence of emergent and cumulative changes. However, Orlikowski and Leonardi conceptualized phases differently. Orlikowski observed that each phase of improvisation moved change up a level of analysis. She showed that emerging work practices led to changes in work roles (or what she called the "distribution of work"), which subsequently triggered shifts in interaction patterns—first within the group she studied and then between the group she studied and other groups. These changes ultimately led the organization to modify its formal procedures

for evaluating support specialists. While Leonardi also showed that new practices changed roles and structures, his imagery was one of repeated sequences of change at the same level of analysis: interaction patterns within the group he studied. The difference may well reflect the fact Orlikowski studied a larger social system over a longer period of time with less frequent observation than Leonardi. From this vantage point, both images of phasing are viable and potentially complementary. Leonardi's level of analysis was simply less molar than Orlikowski's, and for this reason they noticed dynamics of different scope.

Summary and Limitations

The alignment perspective makes several important and unique contributions to our understanding of the social construction of technological change. First, alignment researchers remind us that technological changes have political implications. Although the politics of technology has long been a central theme among social constructivists who study the design and commissioning of new technologies (Berg, 1998; Bijker, 1995; Thomas, 1994), most constructivists who have focused on adoption and use have largely ignored contestation. Alignment studies indicate that power attends technological change in several ways. Groups who have the authority to acquire new technologies and who control the terms of implementation may frame a technology's utility and mandate that it be used in ways that maintain those aspects of the *status quo* that they deem useful and that change those aspects that they believe need changing (Zuboff, 1988). To the degree that power structures have become institutionalized and taken for granted, users may unwittingly mold the technology's use in ways that replicate the *status quo* without the powerful needing to act (Zack & McKenney, 1995). In other cases, technologies may occasion a renegotiation of the relative balance of power in one or more domains of action (Barley, 1986).

Second, alignment research has shown how, even in the presence of powerful actors, technologies may occasion a structuring process that that alters the social order in unanticipated ways. Although radiologists and technologists understood that they had renegotiated their respective roles around the use of specific technologies, no one anticipated or intended that these developments would gradually split the radiology departments into two distinct social systems (Barley, 1990). Similarly, WebGA sought efficiencies and greater revenue by mandating that sales representatives encourage agents to use the online quoting system, but it neither intended nor anticipated that the technology would alter relations between agents and representatives in ways that would decrease WebGA's value to agents and, hence, its income stream (Schultze & Orlikowski, 2004).

Third, and perhaps most importantly, alignment research offers one way to determine when technologies will change or reinforce an existing social order. Technologies will alter social systems to the degree that emergent

work practices lead to a restructuring of role relations. Conversely, when emergent practices demand no reconfiguration of role relations, technologies are unlikely to have a significant effect on and may even strengthen the *status quo*. The alignment perspective's foregrounding of role relationships links the social constructivist agenda to questions that preoccupied an earlier generation of sociologists of work and technology. To the degree that the sociology of automation atrophied because it fell victim to the lure of technological determinism, it is possible that alignment research could breathe new life into the study of how technologies shape organizational structures and work relations.

Alignment researchers have distinguished between and written about how technologies become aligned with an existing social order and how a social order aligns with a technology's features or use. However, with the exception of Zuboff (1988) and Leonardi (2007), they have not sought to determine when a recapitulation or a reconfiguration of role relations is more likely to occur. Zuboff argued the likelihood of significant reconfiguration rested predominately on the ability of managers to reconceptualize their roles,[†††] while Leonardi suggested that such a reconfiguration may occur informally when a technology makes asymmetries in group members' knowledge structures visible for the first time.

Another important limitation of the alignment perspective is the converse of its primary contribution. By attending so closely to institutions and the social dynamics of work relations, detailed accounts of affordances, constraints, and technologies-in-use tend to fade into the background. No alignment study examines patterns of use in the kind of detail that marks research on enactment. To the degree that changes in role relations are contingent on emergent work practices, there is much to be gained from research that carefully links changes in the social order to changes in practice. Such research is likely to be particularly challenging, for it will require longitudinal studies that attend simultaneously to multiple levels of analysis ideally conducted in multiple sites.

Implications for Theory and Research on Technology and Organizing

Our review makes clear that students of technology and organizing agree on a fundamental ontological point: technologies do not directly determine organizational structures and dynamics. Instead, the changes that technologies occasion are intimately tied to social dynamics that are likely to vary across contexts. Beyond this common ontological stance, however, there is

††† Although Zuboff was initially optimistic that a reconceptualization might occur, in the intervening years, she has concluded that managers are unlikely to jettison an ideology of authority and control (http://www.drfd.hbs.edu/fit/public/facultyInfo.do?facInfo=bio&facEmId=szuboff).

considerable diversity in what scholars mean when they say that the organizational outcomes of technology implementation are socially constructed. Scholars have approached the topic from at least five coherent perspectives—what we have called perception, interpretation, appropriation, enactment, and alignment. As summarized in Table 1, these perspectives examine different phases of implementation, concern themselves with the construction of different social phenomenon, and concentrate on different social processes.

Specifically, researchers who have studied perceptions have written almost exclusively about how social influence shapes attitudes, beliefs, and values during the period of adoption. In these studies, concern with social construction ends when people decide to use or reject a technology. Proponents of interpretation, appropriation, and enactment have examined how transference, intragroup interactions, and situated improvisations respectively shape schemas, patterns of deviation, and work practices only after people begin to use a technology. In these papers, attention to social construction ceases once common and routine patterns of use emerge. Alignment research typically follows routine patterns of use until inter-group interactions spur significant changes in roles and role relationships that alter the organization of work. Combined, this body of literature also seems to imply a change in relevant units of social organization as technologies move from being adopted to becoming well entrenched in an organization. To the degree that social influence operates through contagion, dyadic encounters are the primary mechanisms of social change at the time of adoption. As people begin to use the technology in their work, the relevant social unit shifts from the dyad to the work group. As practices of work groups solidify, relations between occupations, departments, and other types of groups become the loci of social construction.

These latent patterns in the literature have gone unrecognized by students of the social construction of implementation. Accordingly, we simply do not know whether the associations that comprise the latent patterns describe empirical reality or whether they are epiphenomenonal, reflecting theoretical choices that researchers have made about when to study what social dynamics over the course of implementation. We speculate that the patterns may reflect a bit of both. For instance, few would seriously dispute the claim that people must adopt a technology before they can use it or that people must use a technology before it can affect patterns of organizing. Similarly, it is difficult to believe that roles and role relationships would change before work practices become solidified. Work practices and schemas also seem more likely to cluster at the group level of analysis, while organizational changes are more likely to involve the division of labor and, hence, shifts in roles and relationships between members of different groups.

What is less clear is whether the implicit sequencing of phenomena and processes is accurate and whether construction processes are actually confined to specific phases of implementation. For example, we question whether

attitudes, values, and beliefs usually affect construction prior to the engagement of schemas and frames, the making of appropriations, and the development of work practices. Nor is it clear whether frames, appropriations, and practices precondition the solidification of roles and role relationships. We are also skeptical of the implication that particular processes of construction are linked to a particular class of outcomes. For example, in addition to shaping attitudes and beliefs, social influence processes may play a role in shaping the schemas and frames that people use to make sense of a technology, as well as the work practices they evolve.

In short, our review reveals that the literature suggests an implicit sequence of processes, phenomena, and levels of analysis in the social construction of a technology's implementation, but assessing the veracity of this latent pattern awaits study. To do so, researchers would need to track implementations over longer periods of time than is typically the case while paying attention to all of the social processes and types of outcomes identified in Table 1. No study currently examines all of these processes simultaneously, and the studies we have reviewed at best cover a period of 24 months. In addition, researchers would need to collect data at multiple levels of analysis, ranging from dyads to relations between occupations and functions. While a few studies have explored social changes across two levels of analysis, such as dyads and groups (e.g., Barley, 1990; Leonardi, 2007; Orlikowski, 1996), researchers have yet to follow change across all three.

Although we have emphasized the diversity of the five perspectives, it is critical to recognize that they nevertheless share two remarkable similarities, both of which have contributed to constructivism's inability to address the larger question of how computer-based technologies, like those that most constructivists have studied, are affecting the social order. First and ironically, all downplay the role of technology in the social construction process. While researchers often describe the technologies they have studied, in the stories that scholars tell, technologies have little discernable influence on the social dynamics that emerge. At best, technologies activate social processes that, in turn, construct social phenomena. A cynic might argue that constructivist studies of technology and organizing are more about social influence, interpretation, conformity, work practices, and role relations than they are about technology. Second, all of the perspectives sidestep the role powerful actors play in shaping technologically occasioned organizational change. By and large, authors assume that users have the ability to determine how they will use the technology and that they shape the changes that emerge from ongoing encounters with the technology. This stance undercuts one's ability to deal adequately with questions of power because it implies that the micro-institutions that emerge in the wake of technological change can be divorced from an examination of the macro-institutions in which they are embedded. Consider each of these omissions in turn.

Materiality

To understand why social constructivists have allowed technology to fade into the background, recall that they were primarily committed to refuting the determinism of earlier research that emphasized the technical over the social by framing technology as a cause of organizational structure and change. To achieve this objective, the constructivists brought the social to the fore. Although both determinists and constructivists sometimes acknowledge that social and material factors are equally important in changing organizations, most have tilted toward theoretical and empirical accounts that emphasize one or the other (Jackson, Poole, & Kuhn, 2002). One reason for tilting may be social scientists' tendency to conflate two philosophical distinctions (or as we put it at the beginning of this essay, cultural antinomies): the difference between determinism and voluntarism, on one hand, and the distinction between materialism and idealism, on the other. Determinism holds that our actions are caused by technological, cultural, and other forces prior to, external to, and independent of our behavior. Voluntarism takes the opposite stance, arguing that humans have agency, the ability to shape their environments to achieve their goals. Materialists hold that human action stems from physical causes and contexts such as geography, biology, climate, and technology. Conversely, idealists argue that shared ideas, norms, values, and beliefs drive human action.

The distinction between determinism and voluntarism is orthogonal to the distinction between materialism and idealism; yet, social scientists frequently write as if materialism implies determinism and idealism implies voluntarism. Although scholars often write either as materialistic determinists or voluntaristic idealists, as Table 2 indicates, the two combinations do not exhaust the universe of viable visions. One could also be an idealistic determinist, as were the deskilling theorists (Braverman, 1974; Noble, 1979) who argued that using technology to separate the conception of work from its execution was the *inevitable* outcome of a dominant managerial ideology rooted in Scientific Management. Similarly, one could also approach technological change like a materialistic voluntarist, as do most ergonomists (Bullinger, Kern, & Muntzinger, 1987) who believe that technologies directly shape behavior, but because designers can alter technologies at any time, humans can also intend as well as change the social effects of a technology.

Social constructivists have taken their stand in the bottom-right quadrant of Table 2 to maximally distance themselves from early contingency theorists who championed materialistic determinism. As a result, even the most influential constructivist studies of technology and organizing tilt toward explaining how people interact with each other around the technology, rather than providing evidence of what specific material features people use, why they use them, and how their use constrains and enables users' actions. One need not,

Table 2 Examples of Ontological Orientations on Technologically Induced Organizational Change

	Determinism	**Voluntarism**
Materialism	Contingency theory	Sociomateriality
Idealism	Deskilling theory	Social constructivism

however, operate from the lower-right quadrant of Table 2 to rescue technology studies from materialistic determinism.

Sociologists of science have shown that attending to agency and social dynamics is not incompatible with an appreciation for material constraints and affordances (Latour & Woolgar, 1986; Lynch, 1985). Like research on technology and organizing, the sociology of science turned toward social construction in the 1980s. The turn led some researchers to favor explanations of change that privileged social over material practices (Knorr-Cetina & Mulkay, 1983; Woolgar, 1988). Eventually, however, scholars began to caution that such an orientation might be misguided because material phenomena (be they natural or technical) do things that cannot be attributed to social practice (Fujimura, 2006; Hutchby, 2001; Pickering, 2001). Pickering (1995) argues persuasively that physical phenomena resist scientists' efforts to manipulate them and that this resistance is, in fact, part of the conversation between scientist and object that leads scientists to alter their methods and their theories. Technologies also resist, in the sense that they do not allow users to do whatever they want. However, the fact that technologies resist does not mean that users are at the mercy of the technology, only that they must adapt their practices accordingly.

Drawing on this research, Orlikowski (2007) and Orlikowski and Scott (2008) have recently articulated a similar critique of constructivist studies of technology use. Orlikowski advocates that researchers adopt a "sociomaterial" approach akin to materialistic voluntarism. As she defines it:

> [The sociomaterial] view asserts that materiality is integral to organizing, positing that the social and the material are *constitutively entangled* in everyday life. A position of constitutive entanglement does not privilege either humans or technology…Instead, the social and the material are inextricably related—there is no social that is not also material, and no material that is not also social. (2007, p. 1437)

Because Orlikowski's agenda is primarily ontological integration, she argues that students of technology and organization have given unwarranted status to studying implementations. Specifically, she argues that focusing on implementations treats sociomaterial entanglement "as a matter of interest only in certain particular organizational circumstances" (p. 1436). Treating the sociomaterial as a "special case," she continues, "is problematic because it loses sight of how *every* organizational practice is *always* bound with materiality.

Materiality is not an incidental or intermittent aspect of organizational life; it is integral to it."

Although Orlikowski is surely correct in warning us not to treat implementations as ontologically privileged, her agenda underplays the fact that there are tactically important epistemological reasons for studying implementations. As our review underscores, implementation marks a time when an existing sociomaterial fabric is disturbed, offering researchers an opportunity to "see" more clearly how the social and the material become constitutively entangled. Once a sociomaterial fabric has been woven, untangling what influenced what and why is difficult. Especially troublesome is disentangling the relative contributions of the material and the social. Whereas Orlikowski urges us to weave the social and the material together conceptually, we argue for unraveling them empirically in order to study how each contributes to the whole. At the very least, this means that, in addition to studying social processes, researchers need to pay attention to what a technology lets users do, to what it does not let them do, and to the workarounds that users develop to address the latter. With such data, researchers could then identify how and when the material constrains and affords the social, as well as how and when the social shapes the material and its effects (Leonardi, 2009). Ultimately, in a longitudinal study, the goal would be to give a move-by-move account of how the social and the material become constitutively entangled, and under what conditions the material or the social have the upper hand.

The answer to the question of whether the material or the social has the upper hand and just who has how much agency over what may well depend on the level of analysis and the time frame from which researchers choose to work. Historians of science have grappled with this issue. Misa (1994) notes that technological determinists and social constructivists typically draw evidence from different levels of analysis to construct their arguments:

> ….machines make history when historians and other analysts adopt a "macro" perspective, whereas a causal role for the machine is not present and is not possible for analysts who adopt a "micro" perspective … Besides taking a larger unit of analysis, macro studies tend to abstract from individual cases, to impute rationality on actors' behalfs or posit functionality for their actions … Accounts focusing on these "order bestowing principles" lead toward technological, economic or ecological determinism. Conversely, accounts focusing on historical contingency and variety of experience lead away from all determinism. Besides taking a smaller unit of analysis, such micro studies tend to focus solely on case studies, to refute rationality or confute functionality, and to be disorder-respecting (pp. 117–119).

Misa argues that resolving dilemmas of determinism and materialism by privileging one level of analysis over another is not only empirically

dissatisfying; it allows analysts to sidestep important issues. Scholars who champion voluntarism and idealism by insisting on micro-level data are "forced to omit comment on the intriguing question of whether technology has any influence on anything" (p. 138). The claim that technology exerts no socially significant material force on the direction of society is not only inconsistent with everyday experience, but as Misa notes, it "seems especially undesirable in an age of pervasive socio-technical problems" (p. 138). Social constructivists, therefore, risk assigning technology too little a role in making history. Technological determinists, on the other hand, either risk creating the image of an autonomous social process that lies beyond human awareness or imputing motives and intentions without the warrant of evidence. Thus the worldview of a determinist (whether materialistic or idealistic) too easily reduces humans to cultural and social dupes. Misa argues that a more plausible stance lies in the middle ground between determinism and voluntarism, where constraints and affordances both exist. This middle ground, which Misa calls the "meso level," is populated by institutional actors:

> For historians of technology and business this means analyzing the institutions intermediate between the firm and the market or between the individual and the state. A short list of these include manufacturers' organizations (including cartels and interfirm networks), standard setting bodies (including the engineering profession and public agencies), export–import firms specializing in technology transfer, consulting engineering firms and investment banking houses. (p. 139)

Institutions are critical in Misa's view because they represent social mechanisms by which one group's volition can be translated into another group's constraint.

Hughes (1994) offers an alternate approach to bridging the philosophical chasm between determinism and voluntarism and between materialism and idealism. Rather than speak of specific technologies, Hughes posits the notion of a "technological system." By technological system, Hughes means to denote a complex of cultural, organizational, and technological phenomena jointly focused on a particular productive or political goal: for instance, the system for generating, distributing, and using electricity or the system surrounding the production and use of automobiles. As in Misa's resolution, organizations, professions, and other institutions play crucial roles in building technological systems. The image is similar to DiMaggio's (1988) interpretation of an "organizational field." Hughes argues that human choices and ideologies matter a great deal in the early life of such systems when they are being constructed by individuals with specific ideas or agendas. However, Hughes contends that, as such systems grow, they become institutionalized and take on a life of their own, so that they begin to act more like material determinants of social reality.

Hughes refers to the accretion of materialistic and deterministic force as "technological momentum":

> A technological system can be both a cause and an effect: it can shape or be shaped by society. As they grow larger and more complex, systems tend to be more shaping of society and less shaped by it. Therefore, the momentum of technological systems is a concept that can be located somewhere between the poles of technological determinism and social constructivism. The social constructivists have a key to understanding the behavior of young systems; technological determinists come into their own with the mature ones. Technological momentum, however, provides a more flexible mode of interpretation and one that is in accord with the history of large systems. (Hughes, 1994, p. 112)

As we have seen, social constructivists who study implementation have concentrated on dynamics at the micro-social level. As a result, this body of work might lead one to conclude that every implementation results in a unique sociomaterial order. Such a conclusion is problematic because, if taken seriously, social constructivists cannot speak to how the same or similar technologies occasion similar outcomes across organizations. Misa, Hughes, and other historians point to a way out of this dilemma: look at the varying impact of social and material forces at different levels of analysis.

Consider a technology like WebEx, which allows users to meet and collaborate on documents simultaneously from a distance. At an individual level of analysis, one would expect to find considerable variation in how people use WebEx; for example, which features they employ and which features they disregard. At the level of a work group or community, one would expect less variation. Academics, for instance, might use WebEx primarily for collaborative data analysis and writing while working in dyads or triads. Managers, however, might be less likely to see WebEx as a tool for collaborative authoring, but instead deploy it as a medium for holding virtual meetings and for making presentations to large audiences. In other words, how WebEx becomes a technology-in-use should exhibit a strong family resemblance within work groups, occupations, and other social groups. At this level of analysis, it doesn't matter how much variance there is in the use of the technology at the individual level, so long as differential use does not impede a group from achieving a shared objective. One might expect even less variation at the organizational level of analysis. For example, tools like WebEx are widely used by firms to deploy a decentralized and geographically distributed workforce. In fact, there are strong reasons to believe that the trend toward distributed organizing, in general, and offshoring, in particular, would be less prevalent in the absence of such technologies. At this level of analysis, differences between technologies-in-use are largely irrelevant.

This is not to say, however, that using WebEx to facilitate the offshoring of work is technologically determined, for social processes are at work here as well. As Misa points out, the relevant actors are likely to be organizations, including vendors, consultants, and the business press, that comprise the institutional field that surrounds the technology. At this level of analysis, institutional dynamics such as mimetic, coercive, and normative isomorphism could well lead to the kind of consistency that earlier students of technology mistook for technological determinism. We would speculate that, at lower levels of analysis, social actors engender heterogeneous sociomaterial entanglements, while at higher levels of analysis, relevant social actors encourage homogeneity.

Power

In one form or another, the question of whether designers and managers choose technologies to shape relations of production has loomed in the background of organization studies for several decades (Braverman, 1974; Edwards, 1979; Markus, 1983; Thomas, 1994). Yet, with the exception of Zuboff's (1988) work on the distinction between automating and informating and Orlikowski's (1992) analysis of the use of CASE tools by IT consultants, the question of how technology and power relations are entwined has not been substantively addressed by constructivist studies of technology and organizing. In principle, social constructivists should be well situated to contribute to the discussion of power and technology, precisely because they privilege agency, interpretation, and behavior. However, at least three issues appear to have hindered the five perspectives that we have identified from directly grappling with the role of power in technological change.

First, each perspective begins research after adoption, thereby divorcing implementation and use from preceding decisions and events. When studies begin with little insight into why technologies were designed as they were, why one technology was chosen over another, or how the technology was deployed, they essentially left censor the construction process. The tendency to left censor makes it impossible to determine whether patterns of use are shaped in important ways by dynamics of power, control, status, and conflict that set the context of use. Although the particulars of use may be emergent and, hence, unpredictable, it may also be that emergence is constrained to vary within a larger trajectory that is out of the users' control. As constructivist research on technology development has repeatedly shown, technologies emerge out of ongoing negotiations and conflicts between groups with competing interests and visions of what the technology should do (MacKenzie, 1996; Pinch, 1996). Typically users are marginally involved in these conflicts and are thus subject to the constraints of their resolution. With recent exceptions (Mackay, Carne, Beynon-Davies, & Tudhope, 2000; Oudshoorn & Pinch, 2003), sociologists of technology who have studied development ended

their examination of technological change at the point where a technology has been designed and is ready to be adopted. In other words, they have ignored the dynamics of use. To speak to the intentions of the powerful and the relative success of their agendas, constructivists must undertake studies that range from development through organizational change.

Second, constructivists have had difficulty speaking to the entwining of power and technology because most have focused on interaction in the here and now to highlight social construction in its various forms. This strategy enables constructivists to speak to how local political negotiations shape the development of local routines or what one might call micro-institutions (Powell & Colyvas, 2008), but at the cost of allowing more macro-institutions, such as relations of production and distributions of power, to slip into the background. In fact, some constructivists have acknowledged that they have made just such a choice (see the preceding discussion of the enactment perspective). Powerful actors are generally more interested in maintaining or changing the global institutions of a social order and less concerned with the specific routines by which work is accomplished. Consequently, it is plausible that technologies can significantly alter routines and patterns of interaction while posing no challenge to the larger institutional order. For example, although computerized imaging technologies dramatically changed role relations among radiologists and radiological technologists, they left radiology's system of professional dominance largely intact (Barley, 1990). Another way of conceptualizing this paradox is that new technologies may well alter the informal structures of work but only within the bounds set by overarching institutions. Until social constructivists attend to macro-institutions as closely as they currently do to micro-institutions, they are unlikely to unravel the complications of agency and power.

Finally, the tendency to emphasize change over stasis has limited constructivists' ability to speak to the entwining of power and technology. By foregrounding change and tying agency largely to the intentionality of users rather than that of developers, managers and other powerful actors, even constructivists who draw on structuration theory, have underplayed a significant portion of Giddens' agenda. Giddens is quite clear that human action not only changes, but is constrained by systems of domination, legitimation, and signification. The trick is to understand the relative contributions of all actors in shaping the balance of replication and alteration. Such a purview would allow constructivists to move beyond the study of implementation to join conversations on broader issues in organization studies.

For example, institutional theorists have long sought to determine why organizations are so similar. Like students of technology, they have also foregrounded the role that interpretation and symbolism play in the emergence and diffusion of organizational structures and practices. In fact, Zucker (1977), Meyer and Rowan (1977), and DiMaggio and Powell (1991) specifically turned

to Berger and Luckmann's *Social Construction of Reality* for the micro-social foundations of their institutionalist agenda. Berger and Luckmann (1967) were interested in how subjectivity was transformed into objectivity. They rooted the construction process in emergent interactions and interpretations that became habitualized at a local level and then diffused across actors and contexts to become taken-for-granted social forms. Taking Berger and Luckmann's perspective, one can argue that technology studies have concentrated on the early phases, while institutionalists have focused on the later phases of social construction. In other words, while constructivist students of technology implementation have paid most attention to how similar technologies can occasion distinct cognitive, communicative, and network structures, institutionalists have often concentrated on explaining how structures that have already emerged elsewhere diffuse (e.g., DiMaggio, 1991; Jepperson, 1991; Owen-Smith & Powell, 2004; Scott, 2004; Strang & Macy, 2001).

To link these perspectives as Berger and Luckmann might have envisioned would require a theoretically nuanced account of how emergent and heterogeneous uses of technologies in individual organizations become homogeneous, such that they can diffuse across organizational fields. To understand the kind of analysis required, imagine three organizations that implement a new social-networking technology. Based on our five perspectives, people in each organization should form attitudes about the technology's usefulness, develop interpretations of what it is good for, appropriate its features in ways that conform with or deviate from designers' intentions, enact differential work practices, and achieve a new (or reinforce an old) alignment of roles and relationships. In time, one firm begins using the technology to socialize new employees, the second for surveillance, and the third to distribute information about managerial initiatives. Suppose that, at some later date, institutional researchers show that most firms ultimately implemented the technology to socialize their employees and, as a consequence, discontinued new-employee orientation sessions while restructuring their human-resource departments. What would be missing from both the constructivist and institutional stories would be an account of how organizations came to take for granted that social-networking technology should be used to socialize employees and why adoption was accompanied by ritualized change in human-resource departments. Constructivists would have stopped before diffusion began and institutionalists would have begun once diffusion occurred. Thus neither could offer much insight into how organizations arrived at relatively homogenous responses to the technology.

Developing such an account will likely require wrestling with power at two levels of analysis. At a micro level, researchers need to ask how one organization's unique response to a new technology could eventually dominate and subsume others. Studies of inter-organizational relations based on resource dependence or transaction costs have shown that firms controlling

key environmental contingencies can knowingly or unknowingly force other organizations to follow their practices (Haunschild & Beckman, 1998; Pfeffer & Salancik, 1978). Such power relations may also encourage organizations to develop similar attitudes, schemas, work practices, and role structures. Because few constructivists have pursued comparative studies of organizations, they cannot speak to the convergence of adoption, use, or adaptation across settings.

At a more molar level, linking the social construction of implementation to institutional isomorphism will require research on how responses to a technology developed in a few organizations spread throughout an organizational field. Institutionalists have argued that professional associations (Scott, Ruef, Mendel, & Caronna, 2000), consultants (Powell, 1991), and forms of discourse (Phillips, Lawrence, & Hardy, 2004) facilitate the diffusion of organizational forms and practices. In the case of new technologies, the technical literature (Carlson, 2001), technical training (Goodman, Griffith, & Fenner, 1990), and, as we discussed above, the technology's own material constraints and affordances may foster the emergence and spread of institutionalized uses and adaptations. All of these factors are bound up with important power relations. Professional associations, for example, secure their jurisdictions and, hence, their dominance by controlling the training and licensing of the technicians who often operate the profession's new technologies (Abbott, 1988). Managerial discourse privileges the values, goals, and perspectives of those who run organizations, while often marginalizing the values, goals, and perspectives of other stakeholders (Deetz, 1992). Technologies sometimes exhibit particular material constraints and affordances precisely because a group has successfully maneuvered to have its vision of how people work inscribed into the technology's design (Grint & Woolgar, 1997). At present, there is almost no research on how power dynamics or other social mechanisms shape the diffusion of common responses to a new technology across an organizational field.

Studying the interplay between power relations and the homogenization of how organizations implement new technologies at micro as well as macro levels of analysis would bring social constructivists close to the goal of explaining how emergent and inherently indeterminate social phenomena are transformed into the seemingly objective and immutable facticities of organized life. It would also highlight the important role that technological artifacts play in the dynamics of organizing, thereby encouraging organizational theorists to recognize that technologies are more than tools: how they are adopted, implemented, and used shapes how organizations emerge, replicate, and change.

Conclusion

In this article, we have argued that students of technology and organizing no longer need to spend intellectual capital and energy on debunking technological

determinism: social constructivists have shown convincingly that technological determinism does not hold water. The task now at hand is to explain why there is so little variance in how technologies are used or, more precisely, why technologies eventually seem to shift social orders within an institutional field in more or less consistent directions. To do so will require acknowledging that one need not jettison materialism along with determinism, that powerful actors can shape technological momentum through the institutions they inhabit, and that analysts cannot adequately explain the micro-social dynamics of technological change without considering the macro-social processes of technological change (and *vice versa*).

Given the swiftness with which our society is embracing a computational infrastructure, organizational theorists will be unable to engage in dialogue about important workplace concerns if they do not develop a more precise voice with which to speak about the way that technologies enable and constrain social action. Students of technology and organizing have, over the last 50 years, taken important steps toward developing such a voice. However, the current focus on pushing the pendulum back and forth on ontological issues has distracted them from focusing on many of the important empirical realities of organizational technology use. If students of technology and organizing can figure out how to incorporate notions of materiality and power into their voluntaristic ontology, they could conceivably play a larger role in organization studies and perhaps even social science itself, for technology studies is hardly the only area is social science that finds itself unnecessarily stymied by the apparent dilemma between determinism and voluntarism.

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