Using Technology and Constituting Structures: A Practice Lens for Studying Technology in Organizations

Wanda J. Orlikowski
Sloan School of Management, Massachusetts Institute of Technology, 50 Memorial Drive, Cambridge, Massachusetts 02139, wanda@mit.edu

This essay advances the view that structures are not located in organizations or in technology, but are enacted by users. It offers a fluid view of structure that builds on and extends earlier work on structuration.

M. Scott Poole

Abstract

As both technologies and organizations undergo dramatic changes in form and function, organizational researchers are increasingly turning to concepts of innovation, emergence, and improvisation to help explain the new ways of organizing and using technology evident in practice. With a similar intent, I propose an extension to the structurational perspective on technology that develops a practice lens to examine how people, as they interact with a technology in their ongoing practices, enact structures which shape their emergent and situated use of that technology. Viewing the use of technology as a process of enactment enables a deeper understanding of the constitutive role of social practices in the ongoing use and change of technologies in the workplace. After developing this lens, I offer an example of its use in research, and then suggest some implications for the study of technology in organizations.
(*Information Technology*; *Organization*; *Structuration Theory*; *Work Practices*)

Technology—and its relationship to organizational structures, processes, and outcomes—has long been of interest to organizational researchers. Over the years, different research perspectives on technology have developed in parallel with research perspectives on organizations—for example, contingency theory (Woodward 1965, Galbraith 1977, Carter 1984, Daft and Lengel 1986), strategic choice models (Child 1972, Buchanan and Boddy 1983, Davis and Taylor 1986, Zuboff 1988), Marxist studies (Braverman 1974, Edwards 1979, Shaiken 1985, Perrolle 1986), symbolic interactionist approaches (Kling 1991, Prasad 1993), transaction-cost economics (Malone et al. 1987, Ciborra 1993); network analyses (Barley 1990, Burkhardt and Brass 1990, Rice and Aydin 1991), practice theories (Suchman 1987, Button 1993, Hutchins 1995, Orr 1996), and structurational models (Barley 1986, Orlikowski 1992, DeSanctis and Poole 1994).[1]

Today, both technologies and organizations are undergoing dramatic changes in form and function, and new and unprecedented forms and functions are becoming evident. In response, organizational researchers have applied notions of innovation, learning, and improvisation to account for such dynamic and emerging patterns of organizing (Brown and Duguid 1991, Weick 1993, Hutchins 1991, Brown and Eisenhardt 1997, Hedberg et al. 1997, Barrett 1998, Hatch 1998, Lant 1999). Similarly, researchers of technology have also begun to use the notions of innovation, learning, and improvisation to understand the organizational implications of new technologies (Ciborra 1996, Cook and Brown 1999, Orlikowski 1996, Tushman et al. 1997). This paper continues the development of concepts that address the role of emergence and improvisation in technology and technology use, and in particular, seeks to extend the structurational perspective in this direction.

The past decade has seen the development of a number of structurational models of technology which have generated numerous insights into the role and influence of technologies in organizations (Barley 1986, Poole and

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DeSanctis 1990, 1992, Orlikowski and Robey 1991, Walsham and Han 1991, Orlikowski 1992, Walsham 1993, DeSanctis and Poole 1994). These models posit technology as embodying structures (built in by designers during technology development), which are then appropriated by users during their use of the technology. Human action is a central aspect of these models, in particular, the actions associated with embedding structures within a technology during its development, and the actions associated with appropriating those structures during use of technology.

A number of commentators have urged further theoretical development of a structurational perspective on technology, suggesting that it may have considerable analytic advantages in explaining the consequences associated with the use of new and reconfigurable information technologies (Sproull and Goodman 1990, Weick 1990, Roberts and Grabowski 1995). Because a structurational perspective is inherently dynamic and grounded in ongoing human action, it indeed has the potential to explain emergence and change in technologies and use. However, realizing this potential will require augmenting the current structurational perspective on technology—specifically the notions of embodied structure and user appropriation. While these notions have been extremely valuable in explaining the various outcomes associated with the use of given technologies in different contexts, they are less able to account effectively for ongoing changes in both technologies and their use. This insufficiency is particularly acute in the context of internetworked and reconfigurable technology (such as groupware and the Web), the use of which is becoming increasingly prevalent in organizations today.

In this paper, I extend the structurational perspective on technology by proposing a practice-oriented understanding of the recursive interaction between people, technologies, and social action. I believe such a practice orientation can better explain emergence and change in both technologies and their use. It does so by complementing the notion of embodied structure with that of emergent structure, and the notion of appropriation with that of enactment.

Embodied and Emergent Structures

In their understanding of technologies, structurational models of technology have been strongly influenced by the intellectual tradition of social constructivism (MacKenzie and Wajcman 1985, Bijker et al. 1987, Woolgar 1991, Bijker and Law 1992). Using rich case studies of technological invention and development, social constructivist research examines how interpretations, social interests, and disciplinary conflicts shape the production of a technology through shaping its cultural meanings and the social interactions among relevant social groups. This research also examines how the produced technology achieves "stabilization" through processes of negotiation, persuasion, and debate aimed at achieving rhetorical closure and community consensus. Further work in this tradition focuses more specifically on how dominant interests are reflected in the form and functioning of the technology, a process referred to as "inscription" (Latour 1992). Akrich (1992, p. 208), for example, writes:

> Designers thus define actors with specific tastes, competences, motives, aspirations, political prejudices, and the rest, and they assume that morality, technology, science, and economy will evolve in particular ways, A large part of the work of innovators is that of *"inscribing"* this vision of (or prediction about) the world in the technical content of the new object.

Drawing on the ideas of social shaping and inscription, structurational models have posited that technology is developed through a social-political process which results in structures (rules and resources) being embedded within the technology. For example, Orlikowski (1992, p. 410) writes:

> [H]uman agents build into technology certain interpretive schemes (rules reflecting knowledge of the work being automated), certain facilities (resources to accomplish that work), and certain norms (rules that define the organizationally sanctioned way of executing that work).

Similarly, "adaptive structuration theory" (DeSanctis and Poole 1994, Poole et al. 1998) focuses on the structures built into such technologies as group decision support systems. For example, DeSanctis and Poole (1994, p.125) note:

> [S]tructures are found in institutions such as reporting hierarchies, organizational knowledge, and standard operating procedures. Designers incorporate some of these structures into the technology . . . Once complete, the technology presents an array of social structures for possible use in interpersonal interaction, including rules (e.g., voting procedures) and resources (e.g., stored data, public display screens).

The development of a structurational perspective on technology has benefited considerably from social constructivist ideas, particularly in the absence of any explicit treatment of technology in Giddens' (1984) theory of structuration. However, the adoption of social constructivist conceptions has also created some difficulties, primarily with respect to two propositions: that technologies become "stabilized" after development; and that they "embody" structures which (re)present various social rules and political interests.

The first proposition—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. As Woolgar and Grint (1991, p.370) argue, the proposition of stabilization admits social construction only during development, and "[t]hereafter, technological determinism is allowed, on the basis that beyond the point of stabilization there is little disagreement about what the technology can do." Existing structurational models of technology, because they posit flexibility in how structures are appropriated, avoid such strong technological determinism. However, their presumption that technologies embody specific stable structures is nevertheless problematic because it depicts technologies as static and settled artifacts with built-in arrays of fixed and determinate structures that are (always and readily) available to users. Such assumptions of technological stability, completeness, and predictability break down in the face of empirical research that shows people modifying technologies and their conceptions of technology long after design and development (Rice and Rogers 1980, von Hippel 1988, Ciborra and Lanzara 1991). Such assumptions are also inappropriate in the context of the dynamically reconfigurable, user-programmable, and highly internetworked technologies being developed and used today.

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' (1984) view of structures as having only a virtual existence, that is, as having "no reality except as they are instantiated in activity" (Whittington 1992, p.696). Seeing structures as embodied in artifacts thus ascribes a material existence to structures which Giddens explicitly denies (1989, p.256):

> . . . a position I want to avoid, in terms of which structure appears as something 'outside' or 'external' to human action. In my usage, structure is what gives *form* and *shape* to social life, but is not *itself* that form and shape—nor should 'give' be understood in an active sense here, because structure only exists in and through the activities of human agents.

Structure is here understood as the set of rules and resources instantiated in recurrent social practice. Elements of technology (such as voting procedures, stored data, and public display screens), once they have been built into a technology, are external to human action. As inscribed properties of a technology, they constitute neither rules nor resources, and thus cannot be seen to be structures. It is only when such technological elements as voting procedures, stored data, and public display screens are routinely mobilized in use that we can say that they "structure" human action, and in this way they become implicated as rules and resources in the constitution of a particular recurrent social practice. For example, consider the myriad software packages, network tools, and data files installed on countless desktop computers and corporate mainframes worldwide. Until such time as these are actually used in some ongoing human action—and thus become part of a process of structuring—they are, at best, potential structuring elements, and at worst, unexplored, forgotten, or rejected bits of program code and data cluttering up hard drives everywhere.

We are unaccustomed to conceiving of rules and resources as only existing "in and through the activities of human agents," largely because of our conventional views of them as either external entities (e.g., corporate policy, traffic regulations, land, factories, money) or internal schemas (e.g., rules of thumb, expertise, judgment). From a structurational perspective, however, external entities and internal schemas are only constituted as rules and resources when they are implicated in recurrent social action (*pace* Sewell 1992). Our conventional view of rules and resources as external entities suffers from what Taylor (1993) refers to as an "objectivist reification," while the view of rules and resources as internal schemas suffers from a "subjectivist reduction." Commenting on rules, Taylor (1993, pp.57–58, emphasis added) writes:

> In its operation, the rule exists in the practice it "guides." . . . the practice not only fulfills the rules, but also gives it concrete shape in particular situations. . . . In fact, what this reciprocity shows is that the "rule" lies essentially *in* the practice. The rule is what is animating the practice at any given time, not some formulation behind it, inscribed in our thoughts or our brains or our genes or whatever. That is why *the rule is, at any given time, what the practice has made it.*

Similarly, Giddens (1979, p. 65) writes that "rules and practices only exist in conjunction with one another." In the same way, resources too, are inextricably linked to practice. Giddens observes (1984, p. 33, emphasis added):

> Some forms of allocative resources (e.g. land, raw materials etc.) might seem to have a real existence. In the sense of having a "time-space" presence this is obviously the case. But their "materiality" does not affect the fact that such phenomena become resources . . . *only when incorporated within processes of structuration.*

While a technology can be seen to embody particular symbol and material properties, it does not embody structures because those are only instantiated in practice. When humans interact regularly with a technology, they engage with (some or all of) the material and symbol properties of the technology. Through such repeated interaction, certain of the technology's properties become implicated in an ongoing process of structuration. The resulting recurrent social practice produces and reproduces a particular structure of technology use. Thus, structures of technology use are constituted recursively as humans regularly interact with certain properties of a technology and thus shape the set of rules and resources that serve to shape their interaction. Seen through a practice lens, technology structures are emergent, not embodied.

A practice lens more easily accommodates people's situated use of dynamic technologies because it makes no assumptions about the stability, predictability, or relative completeness of the technologies. Instead, the focus is on what structures emerge as people interact recurrently with whatever properties of the technology are at hand, whether these were built in, added on, modified, or invented on the fly.

Appropriation and Enactment of Structures

Existing structurational models of technology examine what people do with technologies in use, positing such use as an appropriation of the "structures" inscribed in the technologies. Such appropriation occurs when "people actively select how technology structures are used" (DeSanctis and Poole 1994, p.129). DeSanctis and Poole (1994, p. 130) distinguish between "faithful" and "unfaithful" appropriations of the technology structures, highlighting the degree to which use of technology corresponds to the structures embedded in the technology, and then relating such correspondence to expected outcomes. Their analysis identifies different types of appropriation moves which preserve, substitute for, combine, enlarge, contrast, constrain, affirm, or negate the structures provided by the technology (1994, p. 135).

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 and 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 (as I have suggested above), 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*.[2] 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. Focusing attention on how structures are constituted and reconstituted in recurrent social practices acknowledges that while users can and do use technologies as they were designed, they also can and do circumvent inscribed ways of using the technologies—either ignoring certain properties of the technology, working around them, or inventing new ones that may go beyond or even contradict designers' expectations and inscriptions. For example, many of us use such powerful software tools as word processing, spreadsheets, and presentation graphics in our daily lives. In our regular use of these tools, most of us typically utilize, at best, 25 percent of these tools' functionality, focusing on those elements we need to get our task done and ignoring the rest. Or consider the World Wide Web technology which was developed in 1989 as a hypertext networked system for sharing research in the European high-energy physics community. No one, least of all its inventor (Berners-Lee 1996), anticipated the explosion of innovation and reinvention that has accompanied use of this technology since then and that continues to transform it into an extensive global infrastructure for business, government, entertainment, and all manner of social, political, professional, and personal communities.

Together, the notions of emergent structure and enactment afford a practice-based extension to existing structurational models of technology. This practice lens posits humans as constituting structures in their recurrent use of technology. Through their regularized engagement with a particular technology (and some or all of its inscribed properties) in particular ways in particular conditions, users repeatedly enact a set of rules and resources which structures their ongoing interactions with that technology. Users' interaction with a technology is thus recursive—in their recurrent practices, users shape the technology structure that shapes their use. Technology structures are thus not external or independent of human agency; they are not "out there," embodied in technologies simply waiting to be appropriated. Rather they are virtual, emerging from people's repeated and situated interaction with particular technologies. These enacted structures of technology use, which I term *technologies-in-practice,* are the sets of rules and resources that are (re)constituted in people's recurrent engagement with the technologies at hand.

After developing this practice lens further, I provide an example of its application by drawing on some empirical studies of the use of a particular technology in different organizations. I end by discussing some of the research implications entailed by adopting a practice lens to study technology and its use in organizations.

A Practice Lens for Studying Use of Technology

Lave (1988) has argued for the value of focusing on ''cognition in practice'' rather than ''cognition in the head.'' Similarly, the practice lens I am proposing here focuses on emergent technology structures enacted in practice rather than embodied structures fixed in technologies. This practice lens further recognizes that in both research and practice we often conflate two aspects of technology: the technology as *artifact*[3] (the bundle of material and symbol properties packaged in some socially recognizable form, e.g., hardware, software, techniques); and the *use* of technology, or what people actually do with the technological artifact in their recurrent, situated practices.

Artifact and Use

The distinction between the use of a technology and its artifactual character is an analytic, not an ontological one.[4] This distinction may be elaborated by considering a discussion offered by Lave (1988, pp.150–151) in her study of arithmetic problem-solving within supermarkets:

> The supermarket, for instance, is in some respects a public and durable entity. It is a physically, economically, politically, and socially organized space-in-time. In this aspect it may be called an ''arena'' within which activity takes place. . . . At the same time, for individual shoppers, the supermarket is a repeatedly experienced, personally ordered and edited version of the arena. In this aspect it may be termed a ''setting'' for activity. Some aisles in the supermarket do not exist for a given shopper as part of her setting, while other aisles are rich in detailed possibilities.

Lave's point may be similarly made for technologies, that is: technology is, on the one hand, an identifiable, relatively durable entity, a physically, economically, politically, and socially organized phenomenon in space-time. It has material and cultural properties that transcend the experience of individuals and particular settings. In this aspect, it is what we may call a *technological artifact,* which appears in our lives as a specific machine, technique, appliance, device, or gadget. At the same time, use of the technology involves a repeatedly experienced, personally ordered and edited version of the technological artifact, being experienced differently by different individuals and differently by the same individuals depending on the time or circumstance. In this aspect it may be termed a *technology-in-practice,* to refer to the specific structure routinely enacted as we use the specific machine, technique, appliance, device, or gadget in recurrent ways in our everyday situated activities. Some properties provided by the artifact do not exist for us as part of our technology-in-practice, while other properties are rich in detailed possibilities.

While a technology[5] can be seen to have been constructed with particular materials and inscribed with developers' assumptions and knowledge about the world at a point in time (Noble 1984, Perrow 1983, Winner 1986, Thomas 1994), it is only when this technology is used in recurrent social practices that it can be said to structure users' actions. That is, it is only when repeatedly drawn on in use that technological properties become constituted by users as particular rules and resources that shape their action. For example, thousands of Americans annually use tax preparation software to complete their tax returns. Knowledge of computers, the U.S. federal tax code, arithmetic, and the content and layout of various tax forms informed the design of this technology, as did the software programming language and database structures used to construct it. When people routinely use the tax preparation software, they draw on its inscribed properties and embedded information content, their own experiences with technology, as well as their understanding of their rights and obligations as tax payers, to enact a set of tax reporting rules and resources with the software.[6] For example, interaction with the ''1040 Form'' enables the entry of particular kinds of information and facilitates the calculation of various totals, while also prohibiting the creation of alternative tax reporting representations (say a ''999 Form''), or figuring the totals in a more ''creative'' way.

When users choose to use a technology, they are also choosing how to interact with that technology. Thus they may, deliberately or inadvertently, use it in ways not anticipated by the developers. For example, users may use the tax preparation software to print out blank forms and then complete the tax return manually, or they may use the software incorrectly, or they may use it to learn about the current tax code, or to study the software's interface design. Users may also choose not to use a technology even if it is available, as happens, for example, with tax preparation software which is typically ignored for most of the year. In this case, even though the technology exists (typically installed on users' computer desktops), it is not implicated in any recurrent social practice, and thus no rules and resources (i.e., no technology-in-practice) are enacted with the tax preparation technology, because it is not used. Of course, this scenario typically changes quite dramatically a few weeks before April 15, when users are motivated by the tax filing deadline to use their tax preparation software in a flurry of repeated activity and anxiety, and thereby enact a particular technology-in-practice.

From the point of view of users, technologies come with a set of properties crafted by designers and developers. These technological properties may be examined to identify the typical or expected range of activities commonly associated with use of the technology. However, how these properties will actually be used in any instance is not inherent or predetermined; rather it depends on what people actually do with them in particular instances. And as numerous studies have shown, users can, and do, choose to use technologies in ways unanticipated by inventors and designers. Whether through error (misperception, lack of understanding, slippage) or intent (sabotage, inertia, innovation), users often ignore, alter, or work around the inscribed technological properties (Gasser 1986, Kraut et al. 1986, Mackay 1988, Grudin 1989, Bullen and Bennett 1991, Ciborra and Lanzara 1991, Button 1993, Clement 1993, Markus 1994, Suchman 1996). Furthermore, users often add to or modify the technological properties on hand (e.g., installing new software, peripherals, or adding data, etc.), thus, actively shaping or crafting the artifact to fit their particular requirements or interests.

The identification of technological properties and common activities associated with our conventional understanding of a technological artifact, its inscriptions, or the intentions of its designers, cannot circumscribe the ways in which people may use it.[7] Use of technology is not a choice among a closed set of predefined possibilities, but a situated and recursive process of constitution, which—while it may often invoke intended activities or replicate familiar uses—may also and at any time ignore such conventional uses or invent new ones. As Bazerman (1994, p.88) reminds us:

> . . . no matter how rigorous the typifications that guide the enactment at any single moment may be, the dynamics of the moment grant new meaning and life to the typifications, and we must look to the dynamics of the moment to understand what is happening.

Having recognized this, however, it is important to keep in mind that the recurrent use of a technology is not infinitely malleable. Saying that use is situated and not confined to predefined options does not mean that it is totally open to any and all possibilities. The physical properties of artifacts ensure that there are always boundary conditions on how we use them. Conceptual artifacts (such as techniques or methodologies expressed in language) are more likely to be associated with a wider range of uses than software-based artifacts, which, in turn, are more likely to be associated with a wider range of uses than hard-wired machines. Similarly, the more a particular technological artifact is integrated into a larger system, network, or technological configuration, the narrower the range of alternative uses that may be crafted with it. Thus, the use of a stand-alone personal computer in my home is likely to be more malleable than the use of a workstation by an air traffic controller. While it is expected that more and more of the artifacts deployed in future workplaces will be software-based, user-programmable, even user-configurable (and hence, their use may be more malleable), it is also likely that the increased complexity and internetworking accompanying the growth in global infrastructures will require these artifacts to be more standardized, interconnected, and interdependent (and hence, their use may be less malleable).

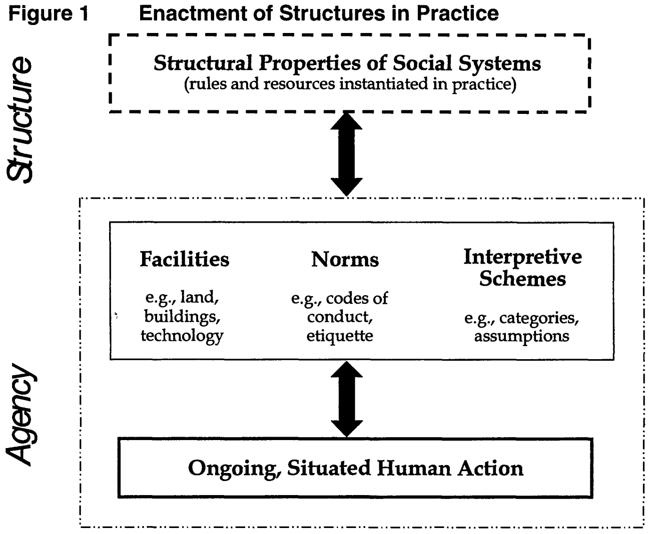
Use of technology is strongly influenced by users' understandings of the properties and functionality of a technology, and these are strongly influenced by the images, descriptions, rhetorics, ideologies, and demonstrations presented by intermediaries such as vendors, journalists, consultants, champions, trainers, managers, and "power" users (Orlikowski et al. 1995). As Woolgar (1996, p.92) notes, such intermediaries "intervene in the interpretation ('reading') of the technology by the user through their comments on the product's nature, capacity, use, and value." Because some of the claims made in these commentaries are quite persuasive, they tend to be believed without concrete evidence to support them. Kling, for example, has found that the powerful narratives constructed during attempts to advocate computerization often continue to shape users' perceptions even "when computer systems are built, installed, and used in ways that differ significantly from early expectations" (1992, p.352).

Structuring of Technologies-in-Practice

Giddens (1979, 1984) proposed the notion of structure (or structural properties of social systems) as the set of enacted rules and resources that mediate social action through three dimensions or modalities: facilities, norms, and interpretive schemes. In social life, actors do not enact structures in a vacuum. In their recurrent social practices, they draw on their (tacit and explicit) knowledge of their prior action and the situation at hand, the facilities available to them (e.g., land, buildings, technology), and the norms that inform their ongoing practices, and in this way, apply such knowledge, facilities, and habits of the mind and body to "structure" their current action (see Figure 1). In doing so, they recursively instantiate and thus reconstitute the rules and resources that structure their social action.

Because technology-in-practice is a kind of structure,

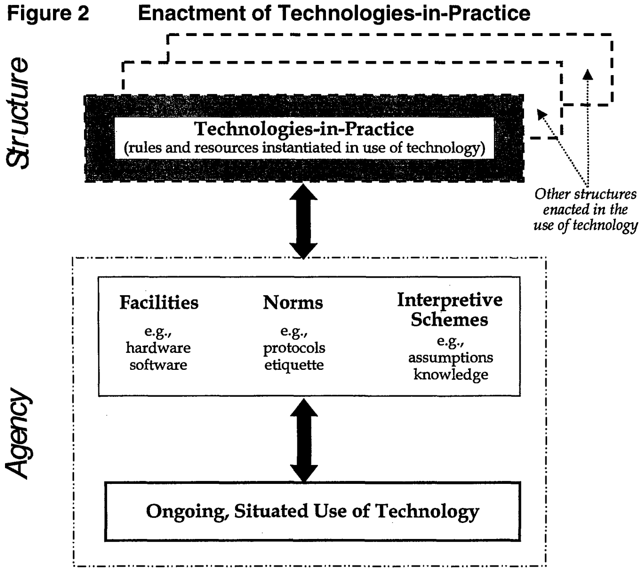
Figure 1 **Enactment of Structures in Practice**



(Adapted from Giddens 1984)

the same recursive constitution applies here too (see Figure 2). When people use a technology, they draw on the properties comprising the technological artifact—those provided by its constituent materiality, those inscribed by the designers, and those added on by users through previous interactions (e.g., specific data content, customized features, or expanded software/hardware accessories). People also draw on their skills, power, knowledge, assumptions, and expectations about the technology and its use, influenced typically by training, communication, and previous experiences (Orlikowski and Gash 1994). These

Figure 2 **Enactment of Technologies-in-Practice**



include the meanings and attachments—emotional and intellectual—that users associate with particular technologies and their uses, shaped by their experiences with various technologies and their participation in a range of social and political communities.[8] Users also draw on their knowledge of and experiences with the institutional contexts in which they live and work, and the social and cultural conventions associated with participating in such contexts. In this way, people's use of technology becomes structured by these experiences, knowledge, meanings, habits, power relations, norms, and the technological artifacts at hand. Such structuring enacts a specific set of rules and resources in practice that then serves to structure future use as people continue to interact with the technology in their recurrent practices. Thus, over time, people constitute and reconstitute a structure of technology use, that is, they enact a distinctive technology-in-practice.

Human interaction with technologies is typically recurrent, so that even as users constitute a technology-in-practice through their present use of a technology, their actions are at the same time shaped by the previous technologies-in-practice they have enacted in the past. Ongoing enactment of a technology-in-practice reinforces it, so that it becomes regularized and routinized, an expedient and habitual response to repeated use of a technology within the daily exigencies of organizational life. That is, a technology-in-practice serves essentially as a ''behavioral and interpretive template'' (Barley 1988, p. 49) for people's situated use of the technology. Continued habitual use of a technology will tend to reenact the same technology-in-practice, thus further reinforcing it over time so that it becomes taken for granted. For example, most of us who drive cars have developed a familiar pattern of interacting with automobiles on the roads—repeatedly enacting a particular and typically shared technology-in-practice that we now take for granted.

While regular interactions with the same technology tend to reproduce the technology-in-practice being enacted, such reinforcement is not assured. Consider the automobile example again. We happily take our (and our fellow drivers') customary enactment of a routine technology-in-practice for granted—that is, until we travel abroad and encounter different artifacts (foreign automobile models, cars with drivers' seats on different sides, road signs in foreign languages, different measuring units for indicating distance or gas (a.k.a. petrol) consumption), and different driving conventions and habits (including driving on the opposite side of the road). All of a sudden, the set of rules and resources we had so habitually enacted with our own automobiles on well-known roads in familiar contexts is no longer effective, and we have think and act differently, thus enacting a somewhat different set of rules and resources to guide our interaction with different automobiles on different roads. On our return home, we will (hopefully) revert to enacting our previously effective technology-in-practice.

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. For example, in a study of process technologies, Tyre and Orlikowski (1994) found that initial patterns of using the technologies congealed quickly, becoming resistant to change despite ongoing operational problems in the use and performance of the technologies. This rapid establishment of relatively fixed technologies-in-practice was influenced by corporate pressure to improve productivity, unavailability of technical support staff, and users' expectations of and preferences for stable and predictable technologies.

Because the enactment of a technology-in-practice is situated within a number of nested and overlapping social systems, people's interaction with technology will always enact other social structures along with the technology-in-practice, for example, a hierarchical authority structure within a large bureaucracy, a cooperative culture within a participative workgroup, the normative structure of a religious or professional community, or the dominant status of English as the primary language of the Internet. Figure 2 shows that people's situated and recurrent use of technology simultaneously enacts multiple structures along with a technology-in-practice. In this paper, I elaborate the notion of *technologies-in-practice*—the particular structures of technology use that users enact when engaging recurrently with a technology. Consequently, the other structures enacted at the same time will not be as central here. In any structurational analysis, one must foreground some structures and background others (Giddens, 1979). My limited discussion of the other structures here should not be taken to mean that they are less important or more fixed than technologies-in-practice. All structures are virtual, and continually enacted through actors' recurrent practices. However, in this discussion, I have chosen to focus on the particular structures of technology use which I have labeled technologies-in-practice.

In their recurrent and situated action, actors thus draw on structures that have been previously enacted (both technologies-in-practice and other structures), and in such action reconstitute those structures. Such reconstitution may be either deliberate, or, as is more usual, inadvertent. Also, it may occur in one of two forms: *reinforcement,* where actors enact essentially the same structures with no noticeable changes; or *transformation,* where actors enact changed structures, where the changes may range from the modest to the substantial.

Changes in Technologies-in-Practice

Users always have the potential to change their habits of use, and in this way change the structures they enact in their recurrent practices. As Cassell (1993, p.13), writing about rules, puts it:

> Because agents draw on rules in the enactment of social practices, the capacity to modify the 'rule' that is drawn on in any action is an ever-present possibility. Men and women may, for example, transform the traditional 'rules' which have structured their past interaction by eschewing sexist norms. At each point of structural reproduction there is also the potential for change.

Technologies-in-practice can be and are changed as actors experience changes in awareness, knowledge, power, motivations, time, circumstances, and the technology. They are changed through the same process that all social structures are changed—through human action. People may change their technologies-in-practice by deliberately modifying the properties of their technology and thus how they interact with it. For example, people may download software ''plug-ins'' to improve the performance of their Web browser tools, or they may override the parameters of a new scheduling system to replicate the operation of a previous system (Saetnan 1991). Even when a technology appears to have stabilized, with the discourse around its properties and functionality apparently having reached ''closure'' (Bijker 1995, Pinch and Bijker 1984), or some industry-wide ''dominant design'' (Tushman et al. 1997) has been established, the stability of the technology and its applications is only provisional. It is provisional because different elements continue to be developed, existing functions fail and are fixed, new materials are invented, new standards are set, and users modify the artifact and/or its content for new and different uses. Technologies are thus never fully stabilized or ''complete,'' even though we may choose to treat them as fixed, black boxes for a period of time. By temporarily bracketing the dynamic nature of technology, we assign a ''stabilized-for-now'' status (Schryer 1993) to our technological artifacts. This is an analytic and practical convenience only, because technologies continue to evolve, are tinkered with (e.g., by users, designers, regulators, and hackers), modified, improved, damaged, rebuilt, etc. Typically, such change is not predetermined or predictable, but implemented by people influenced by competitive, technological, political, cultural, and environmental influences (e.g., feature wars with competitors, technological innovations, safety improvements, security violations, privacy legislation, climatic conditions, earthquakes, poor maintenance, etc.).

Users may also choose to enact different technologies-in-practice because they have become more knowledgeable about using their technology (through attending a training class or watching a colleague's use) or because they have changed jobs and now need to use technology differently in their new work community (say, to share files with coworkers). People may adjust their technologies-in-practice intentionally, as when users respond to new safety regulations by beginning to engage safety mechanisms during machine operation, or when they respond to the unreliability of computer networks by backing up their files at the end of every session or executing system maintenance utilities. Modifications to patterns of use may also result from inadvertent slippage or breakdown, when, either through inattention or error, users fall into a different form of use, such as forgetting to attach safety guards, or discontinuing use of a faulty or complicated element. People may also change their technologies-in-practice by improvising, that is, generating situated innovations in response to unexpected opportunities or challenges, such as when a temporary machine workaround becomes the preferred practice because it turns out to be more effective than the original practice (Tyre and Orlikowski 1994).

As people enact modified technologies-in-practice they also change the facilities, norms, and interpretive schemes used in their use of the technology (as shown with the two-way arrows in Figure 2). For example, through adding downloaded "plug-ins" to a personal computer, or customizing the parameters of a software application, or adding new data to the databases, the technological artifact is altered. At the same time, users' knowledge of what technological properties are available to them may be updated or made obsolete, as with the meanings, expectations, associations, and conventions they attach to the technology and its use. For example, users of electronic mail within a community may evolve a set of communication norms about effective or sanctioned electronic mail use (Yates et al. 1999). Similarly, a company's new policy for use of machine safety features is likely to alter people's views and understandings of the appropriate ways of using technology in that company.

To the extent that people enact a multiplicity of structures (including other technologies-in-practice as well as other normative and authoritative structures) in their recurrent practices, they increase the likelihood that they will enact altered or alternative technologies-in-practice associated with their use of particular technologies. That is, by enacting various interpenetrating (and perhaps even contradictory) structures, actors experience a range of rules and resources that may generate knowledge of different structures and awareness of the possibilities for structural change (Sewell 1992, Tenkasi and Boland 1993). For example, participation in professional or industry conferences often allows people to exchange ideas and stories about their work practices, including how they use technology in their everyday practices. Such awareness of alternative ways of using technology may motivate people to make changes in their technology and/or their use of it. It may also prompt them to make changes in the other structures that they constitute in their work practices—for example, using electronic mail to enact a less hierarchical communication structure which bypasses conventional channels for interacting with senior executives. If this change is sustained over time and shared by other users within their community who similarly begin to use e-mail technology to bypass hierarchical communication channels, then a significant shift in organizational communication structure may be possible.

The practice lens elaborated here recognizes that even as technologies-in-practice may become institutionalized over time, this is only a stabilization for now. Every engagement with a technology is temporally and contextually provisional, and thus there is, in every use, always the possibility of a different structure being enacted. In acknowledging this open-endedness, the practice lens augments existing structurational lenses that have tended to focus on a stable technology (with its fixed array of embodied structures) and the various situated ways in which it is appropriated. The practice lens proposed here focuses on human agency and the open-ended set of emergent structures that may be enacted through recurrent use of a technology. Such a practice lens recognizes that emergence and impermanence are inherent in social structures—that while habitual, routinized, and institutionalized patterns of using a technology may be evident, these are always ongoing accomplishments, and thus there can be no single, invariant, or final technology-in-practice, just multiple, recurrent, and situated enactments. Users have the option, at any moment and within existing conditions and materials, to "choose to do otherwise" (Giddens 1993) with the technology at hand. In such possibilities to do otherwise lies the potential for innovation, learning, and change.

Enacting Technologies-in-Practice: Empirical Examples

The use of a practice lens to study technology use in organizations focuses attention on what people actually do with particular technologies in their ongoing and situated activity. This can be illustrated with some empirical examples,[9] which highlight how a number of user groups enacted different technologies-in-practice with a particular kind of technology. The technologies-in-practice discussed for each of the three sites below should not be seen as exhaustively characterizing what people did with the technology in those sites. These are just the technologies-in-practice I identified with the exposure I had to certain people at certain times and using particular research tools. Given the situated and emergent nature of technologies-in-practice, we can be sure that other technologies-in-practice were being enacted in these sites at the same time, and that, over time, the technologies-in-practice identified here will have evolved and changed, and new ones will have emerged. Before turning to these examples, a brief description of the technological artifact I studied may be helpful.

Background: The *Notes* Technology

The technology considered here is the *Notes* software product, released to the market in 1989 by Lotus Development Corporation, and subsequently sold to thousands of companies worldwide. *Notes* represents a class of software programs known as ''groupware,'' which are designed to facilitate the working together of individuals by providing support for distributed electronic interaction over time. This group-oriented type of computing is grounded in research that was started by computer and social scientists in the mid-1980s, and which became known as ''computer-supported cooperative work'' (Greif 1988).

As represented by its manufacturer, the *Notes* technology consists of software modules to support communication via electronic mail and shared discussion databases, as well as programming tools to build new applications within the *Notes* system (see Table 1). Physically, *Notes* consists of both ''clients''—the software installed on users' personal computers, which mediates interaction with the *Notes* system—and ''servers''— the software installed on network computers which facilitates communication among the users and supports their access to shared databases maintained locally and remotely within the *Notes* system (DeJean and DeJean 1991, Chalstrom 1993).

While there is some general ''rhetorical closure'' (Pinch and Bijker 1984) on the properties represented by the *Notes* product, such ''closure'' refers only to the *Notes* technological artifact and its descriptions in training manuals, marketing ads, and press reports. The technologies-in-practice enacted with *Notes,* because they are constituted in use, cannot attain such closure. And as we will see below, multiple, different technologies-in-practice were enacted by different user groups—one by Iris developers, three within Alpha, and two by Zeta customer support staff.

Example of Enactment: Collaborative Technology-in-Practice Within *Iris*

While the *Notes* technology is currently manufactured by the Lotus Development Corporation (now owned by IBM), it was conceived and designed by Ray Ozzie, founder of Iris Associates. Ozzie traces his vision for *Notes* to the Plato system, a mainframe-based computing environment at the University of Illinois in Urbana-Champaign. Ozzie used this system as a computer science student in the seventies, and observed ''people who had no knowledge of computers using this tool to collaborate on projects.'' This left such a big impression on Ozzie that after working in the software industry for a number of years, he returned to these early experiences:

> In the early eighties I was working in spreadsheets, but spreadsheets didn't turn me on. So my mind turned to Plato and what I had experienced there—collaboration and communication. I wanted to start my own company to develop those things.

With financing from the Lotus Development Corporation, Ozzie founded Iris Associates in 1984 and hired four former colleagues. The five Iris developers spent the next four years designing, building, and testing the *Notes* product. The knowledge and techniques used to construct the *Notes* technology came from Ozzie's Plato-inspired vision of collaborative computing and the various personal computing and networking environments the five developers had been exposed to over the years, such as client server architecture, graphic user interface, and public key cryptography. Additional influences on the construction of *Notes* were the ideals about work shared by the developers:

> As a group of individuals we share the same beliefs about how we'd like to see people work—the Iris values. [And so], we implemented a very different software development methodology here that relies on distributed management, distributed security, and distributed development. . . . Distribution is a value that pervades our philosophy. So technically and architecturally the product embraced distribution.

As a result, the *Notes* technology has a highly distributed architecture which supports collaboration among a variety of distributed users. In addition, it allows users to

Table 1 Properties of the *Notes* Technological Artifact

ELEMENTS	TECHNOLOGICAL PROPERTIES
Electronic Communication	Electronic messaging to geographically dispersed community via e-mail
	Announcements and responses on widely distributed electronic bulletin boards
	Importing of newsfeeds from external services
	Electronic mail gateways to transfer Notes e-mail messages to other systems
Text Editing	Creation and editing of documents that include multiple field types and formats with an emphasis on free-form textual information
	Importing of text, tables, spreadsheets, graphics, images, and sound from other programs
Document Management	Creation and management of databases of documents in a variety of views
	Search and retrieval of individual or groups of documents based on indexes or free text searches
Customization	Direct manipulation of user interface
	Modification of default views and database templates
Integration	Connection between various features: communication, text editing, and document management
Replication	Periodic, scheduled duplication of designated databases across Notes servers in a network
	Support for stand-alone computers through dial-up into a Notes server
Security	Provision of password protection and ID verification to control access to databases
	Support for data encryption at level of e-mail messages, databases, documents, and particular fields
Application Development	Programming of unique database applications via Notes Application Programming Interface
	Computation of totals, averages, and other statistics on any field

(from DeJean and DeJean 1991)

customize their interface with the technology and provides them with the tools to develop their own applications within the *Notes* system. Ozzie explained that the capability to ''build'' applications was extended to all users in conformance with the Iris philosophy of decentralized control:

> A design debate we had a lot was: Does every copy of *Notes* have the ability to design applications or do we have a ''developer's copy'' and ''user copies''? In practice, while it is a nightmare for the MIS person to have this [design] capability on every copy of *Notes,* it makes the product more exciting for the users because anyone can turn from a user to a developer overnight. We wanted individuals to have independence over their work.

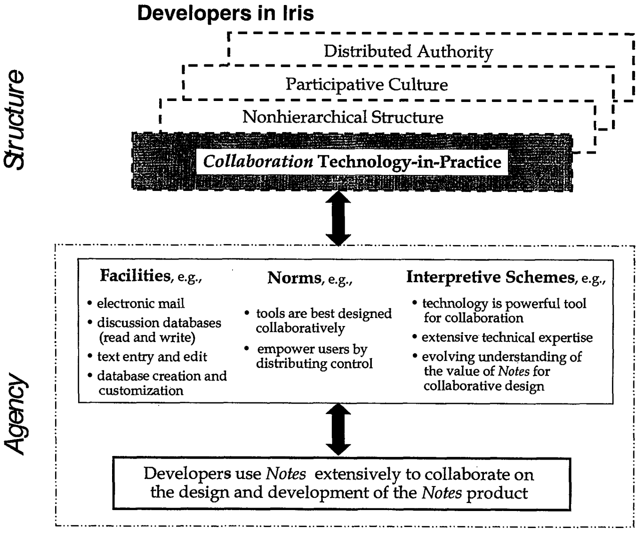
As is common in many software development projects, the Iris developers used the technology they were building to support their own development activities, using its features of electronic mail, discussion databases, text entry, text edit, text search, and tool design to create and share repositories of software documentation and modules. So, the first technology-in-practice to be constituted with the *Notes* technology was the one enacted recurrently by members of the Iris development team. It was a structure of collaboration, which both shaped and was shaped by the ongoing Iris software development process. It was influenced by the Iris developers' strong views about distributed control and individual empowerment, their participative culture and limited hierarchy, their energy and motivation to create a computer tool to support collaboration, as well as the properties of the emerging *Notes* technology that Iris developers were inscribing into the artifact. Their enactment of a collaborative technology-in-practice thus modified aspects of the technology itself (through the addition or improvement of various properties), strengthened the Iris developers' belief in the value (both for themselves and more generally) of computer-supported collaboration, and reinforced their distributed and collegial work practices and norms (see Figure 3). Different technologies-in-practice with the *Notes* technology were enacted in other settings.

Example of Enactment: Three Technologies-in-Practice Within *Alpha*

Alpha (a pseudonym) is a large, multinational consulting firm with offices in hundreds of cities around the world, employing thousands of consultants who work on project engagements to deliver professional services to clients. While consultants work in engagement teams, their work relations and practices are strongly influenced by the ''up or out'' career structure which regulates progress of all consultants via four primary career milestones: junior consultant, senior consultant, manager, and partner.

In the late eighties, a chief information officer (CIO) position was created with responsibility for Alpha's global use of information technology. Having recently

Figure 3 Collaboration Technology-in-Practice Enacted by Developers in Iris



been exposed to *Notes,* the CIO was persuaded that it offered the functionality not only to provide corporate-wide electronic mail support, but also to facilitate broad knowledge sharing. These properties, he believed, would address the considerable "reinvention of the wheel" which occurred when Alpha consultants in different offices worked on similar client problems without sharing ideas, approaches, or solutions, thus duplicating effort and not "leveraging the existing expertise and experience of the firm." The CIO purchased thousands of copies of *Notes* for Alpha's consultants, and ordered his technology staff to install it (and the supporting infrastructure of hardware and networks) rapidly in all offices, so as to establish a critical mass of users as quickly as possible.

I studied the use of *Notes* by both consultants and technologists. As the latter were the first to encounter *Notes* within Alpha, I will begin with their experiences of using *Notes.*

Collective Problem-Solving Technology-in-Practice. Alpha's technology group consisted of some 40 technology staff who reported to the CIO. The group was responsible for setting corporate technology standards and supporting the firm's technological infrastructure. Most of the group members had technical backgrounds, having worked as programmers and computer support staff for most of their careers. While providing support to the firm's consultants, these technologists were not regarded as consultants. As a result, they were not required to bill their time to clients, and were not subject to the rigid timing and high risk associated with Alpha's hierarchical consulting career path.

In addition to implementing *Notes* throughout the firm, these technologists used the *Notes* technology extensively in their work. They used electronic mail for coordinating and scheduling their activities, and they maintained a variety of electronic discussions within *Notes* databases. Most of the technologists frequently accessed and contributed to these discussion databases, exchanging information about technical problems, solutions, and new or upgraded products. Some had also created their own database designs, using the feature within *Notes* that allows customization of database templates. Not subject to the competitive culture, "up-or-out" career tension, and "billable hours" pressures faced by the consultants, and supported by the cooperative norms of technical support, the technologists used many of the properties of *Notes* to promote their collective technical work, and to cooperate with each other. They also modified the technology over time as they added data to the databases and created or customized databases.

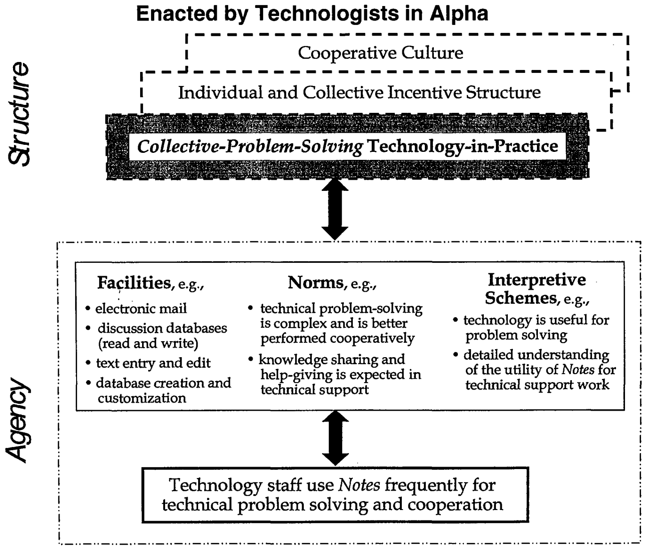
In this recurrent practice of technology use, technologists drew on their detailed knowledge of *Notes* and their technical support work practices and norms to interact with such properties of *Notes* as electronic mail, text entry and editing, discussion databases, and database design. This recurrent action enacted a set of rules and resources which structured their work in terms of cooperative troubleshooting and technical knowledge sharing, while modifying the technology itself (by adding content, creating new databases, and customizing templates). In turn, this technology-in-practice of collective problem-solving reaffirmed the value of cooperation within Alpha's technology group and reinforced their established cooperative work practices and norms, further encouraging the technologists to keep using *Notes* to support their work of maintaining Alpha's technological infrastructure (see Figure 4).

In contrast to this pattern of *Notes* use, the consultants I studied within Alpha engaged with *Notes* quite differently and enacted two distinct technologies-in-practice.

Limited-Use Technology-in-Practice. The most common technology-in-practice I observed in the consulting group involved limited use of *Notes,* and was enacted by consultants at all levels of the firm. Such use of *Notes* was minimal, even perfunctory, and involved opening electronic mail folders a few times a week, rarely, if ever, sending a message, and only occasionally accessing a discussion database to examine activity in it. My data suggest that this technology-in-practice was enacted for at least three different reasons.

First, some consultants had doubts about the value of *Notes* for their own and the firm's performance. Some of these consultants based their skepticism on the view that *Notes* primarily facilitated information transfer while

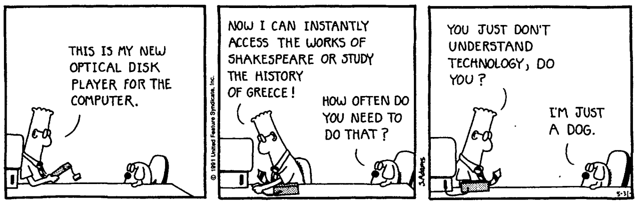
Figure 4 Collective Problem-Solving Technology-in-Practice Enacted by Technologists in Alpha



their work as Alpha consultants was to manage client relationships. Other consultants were skeptical about technologies in general and applied this same skepticism to *Notes*. A vivid illustration of such skepticism was provided by a manager who handed me a cartoon clipped from the morning's newspaper, commenting: ''You asked me what I thought of *Notes*. Well, here's your answer'' (see Figure 5).

The skepticism felt by these consultants was exacerbated by their limited knowledge of *Notes'* functionality. The training sessions conducted about *Notes* dealt with the mechanics of using the software and were technical and abstract. The collaborative aspects of *Notes* were not highlighted and there was little illustration of how *Notes* could be used in Alpha's consulting practice. Most consultants found the training condescending and unhelpful, and many had not referred to the *Notes* documentation which they had all been issued. These often lay, still shrink-wrapped, in the corners of offices or on the tops of bookshelves. Thus, despite training and access to *Notes,* consultants remained skeptical and unmotivated to

Figure 5 Example of Skepticism Towards Technology



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spend much time using the technology. I shadowed half a dozen managers and partners for a few days after they had received *Notes* training, and found that they accessed *Notes* for an average of two minutes a day—usually just to check if they had received any electronic mail.

In this recurrent practice of technology use, consultants drew on their firm's orientation to relationship management, their limited knowledge of *Notes,* their view of it as ''simply a solution in search of a problem,'' their prior experiences with and assumptions about computers as inappropriate or ineffective, and their perfunctory use of *Notes'* electronic mail and discussion database properties, to enact a set of minimal rules and resources which barely influenced their existing consulting work practices and did not alter the technology. In turn, this limited-use technology-in-practice, because it provided them with little value, strengthened the consultants' assumptions and experiences of *Notes* as less than useful for their consulting work practices, and reinforced the firm's orientation to relationship management.

The second reason why consultants enacted a limited-use technology-in-practice with *Notes* was rooted in their ongoing enactment of Alpha's time-based billing structure. For all consultants except partners, there was an expectation that most if not all hours should be ''chargeable,'' that is, billed to clients and hence revenue-producing. Consultants were held accountable for any ''below the line'' (nonchargeable) hours they incurred and most consultants studiously avoided having any.[10] One consultant noted: ''Seniors and managers never have nonchargeable hours. It's just not done. It doesn't happen.'' Because many consultants did not see using *Notes* as an activity that could be billed to clients, they were unwilling to spend time learning or using it, as this would have required them to incur ''nonchargeable hours'' or to give up some of their personal time.

In this recurrent practice of technology use, consultants drew on their knowledge of Alpha's institutional practices (in particular, the corporate norm against ''nonchargeable'' hours), their perception of *Notes* as not useful for client work, and their limited use of *Notes'* electronic mail and discussion database properties, to enact a set of minimal rules and resources which had little influence on their existing consulting work practices or their technology. In turn, such a limited-use technology-in-practice, because it provided minimal value to the consultants, bolstered their assumptions about *Notes* as not valuable in client work, and as not worth the cost of either nonchargeable hours or their own personal time. It also reinforced the legitimacy and importance of the firm's time-based billing structure.

The third reason consultants enacted a limited-use technology-in-practice with *Notes* arose from their fear that use of its collaborative properties would threaten their status within Alpha. The competitive culture at Alpha, strongly reinforced by the ''up-or-out'' career path, was seen by many consultants as encouraging the development of individually distinctive competence. As one manager put it:

> In Alpha we have a lot of problems getting people to share expertise and information. That is not in the culture . . . People hide information because it gives them an edge.

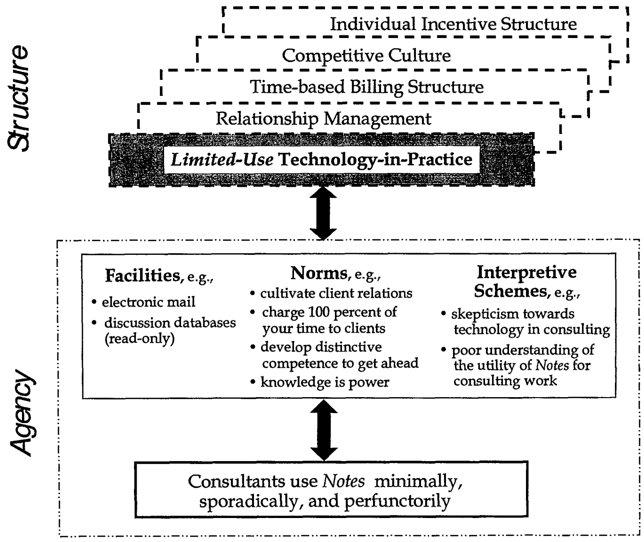
In an environment where ''knowledge is power,'' many consultants believed that any sharing of expertise—particularly via the global and relatively anonymous network provided by Alpha's *Notes* infrastructure—would hurt, not help, their chances of generating some unique expertise and consequently of securing the sought-after promotions. Thus, use of *Notes* was perceived by consultants to be countercultural and incompatible with their individual advancement and success in the firm.

In this recurrent practice of technology use, consultants drew on their understanding of *Notes* as a tool for broad distribution of expertise, their knowledge of Alpha's culture as competitive and individualistic, and their perfunctory use of *Notes'* electronic mail and discussion database properties to enact a set of minimal rules and resources which did little to alter their existing consulting work practices or their technology. In turn, such a limited-use technology-in-practice, because it offered no counterevidence to the consultants' fears, further increased their reluctance to use *Notes* to share expertise, and reinforced their firm's practice of rewarding individual effort and distinctive competence rather than cooperation and knowledge sharing.

While the limited-use technology-in-practice was predominant among the Alpha consultants I studied (see Figure 6), another technology-in-practice emphasizing individual productivity was also evident in the practices of a different set of consultants.

Individual Productivity Technology-in-Practice. Another (smaller) set of consultants in Alpha did not view *Notes* as either irrelevant or threatening; instead, they saw it as an opportunity to enhance their own individual effectiveness by speeding up existing ways of doing things. Thus, a few managers and senior consultants began to use *Notes* regularly to perform activities previously conducted on paper or with other media. For example, they began distributing memos via *Notes* rather than on paper, sending electronic rather than voice mail messages, and transferring files electronically to other offices rather than using the fax machine or express mail services. Some managers also used *Notes* to obtain electronic newsfeeds

Figure 6 Limited-Use Technology-in-Practice Enacted by Consultants in Alpha

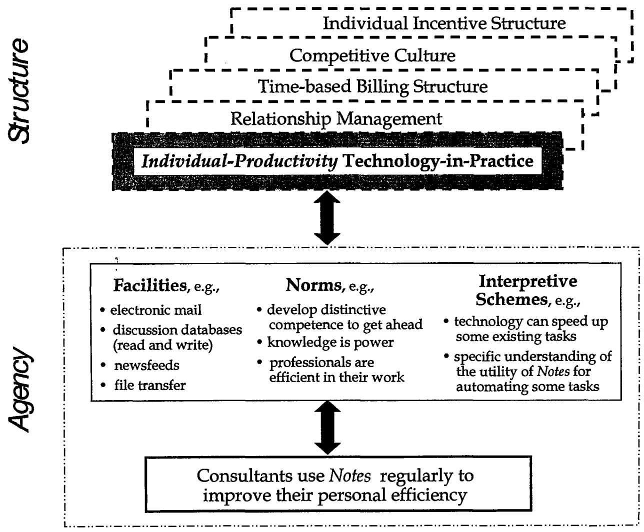


from Reuters or to access Alpha publications, previously available on paper or from a centralized computer system in Alpha's library.

Applying a new technology to existing tasks is a common response to encountering unfamiliar technologies, as Barley (1988, p. 50) notes, ''[workers] often attempt to assimilate new technologies under previous patterns of practice and interpretation.'' Because these consultants' use of *Notes* automated established practices and increased efficiency, it did not violate institutional norms, and thus did not undermine their professional standing within the firm. Indeed, these consultants believed their use of *Notes* would give them a competitive edge in the firm by enhancing their personal productivity. In this recurrent practice of technology use, consultants drew on their knowledge of Alpha's culture, their moderate knowledge of some of the functionality of *Notes,* and engaged specific properties of *Notes* (electronic mail, newsfeeds, databases, and file transfer) to enact a set of rules and resources which increased their work productivity and incrementally modified the technology (via customizations to the desktop and content added to databases). In turn, such a technology-in-practice of individual productivity, because it provided demonstrable improvements in efficiency, supported these consultants' view of *Notes* as an effective tool for personal productivity gains, while reinforcing the individualistic and efficiency orientation of the firm (see Figure 7).

Members of Alpha from the consulting and technology support communities thus used the *Notes* technology to enact three different technologies-in-practice. Members

Figure 7 **Individual Productivity Technology-in-Practice Enacted by Consultants in Alpha**



of another user community—this one within the Zeta organization—used *Notes* in still different ways.

Example of Enactment: Two Technologies-in-Practice Within *Zeta*

Zeta (a pseudonym) is a Top 50 U.S. software company, producing and selling a range of powerful marketing analysis products. In 1994, Zeta earned $100 million in revenues and employed about 1000 employees in its Midwest headquarters and regional sales offices around the world. My colleagues and I examined the implementation and use of *Notes* in Zeta's customer support department (CSD). Customer support at Zeta involved providing technical consultation via telephone to clients, client service representatives in the field, and other Zeta employees. The technical consultation provided by customer support specialists was a complex activity, typically involving several hours or even days of research including searches of reference material, attempts to replicate the problem, and review of program source code. The CSD employed fifty specialists, and was headed by a director and two managers.

In early 1992, the CSD purchased *Notes* and developed a customized application within it, the Incident Tracking Support System *(ITSS),* to help keep track of customer calls. The acquisition of *Notes* was motivated by a realization that the existing call tracking system was inefficient and poorly used, and the anticipation of increased calls due to a growing client base and an expanding product range. Following a successful pilot in the latter half of 1992, the CSD deployed *Notes* and *ITSS* throughout the department. We studied the use of *Notes* in the CSD from 1992 to 1994 and found that over time the support specialists enacted two distinct, but complementary, technologies-in-practice with *Notes*.

Process-Support Technology-in-Practice. Specialists' initial use of *Notes* enacted a technology-in-practice of process support. Such a recurrent practice of technology use involved two primary activities: work documentation and information search. In documenting their work process, specialists used the online input and text-editing properties of *Notes* to enter every customer call they received as an incident in the *ITSS* database, to maintain a complete trace for each incident as they worked on it, and to record the final problem resolution when they closed the incident. The work documentation generated by specialists began to accumulate in the *ITSS* database, growing from about 4,000 entries in December 1992 to 35,000 in December 1994. This information became increasingly valuable as specialists started to search the database to try to find existing solutions for new problems. By December 1994, specialists reported being able to resolve up to 50 percent of new incidents simply by using the *Notes* search function to probe the *ITSS* database. Searching *ITSS* was seen by the specialists to be helpful not just because prior entries revealed potentially reusable problem resolutions, but also because they provided a detailed trace of the work process followed to resolve different types of incidents.

The specialists' engagement with *Notes* for their support work utilized many of its properties—electronic text entry and editing, as well as database searching and document management. As technical support specialists, the CSD members were knowledgeable about technology in general, as well as *Notes* in particular. This latter knowledge was acquired through a series of official training sessions (referred to as "*Notes* jam sessions") which included intensive hands-on use of *Notes* during which specialists simulated their production work in the *Notes* environment, taking "fake calls" from colleagues and then documenting these in the *ITSS* database.

Specialists' use of *Notes* to record and reuse problem resolution knowledge was in direct contrast to the action of many of the Alpha consultants, who had felt inhibited by their competitive culture to create and share knowledge within *Notes.* In comparison, Zeta specialists reported that the CSD's cooperative culture and its team orientation encouraged such behavior:

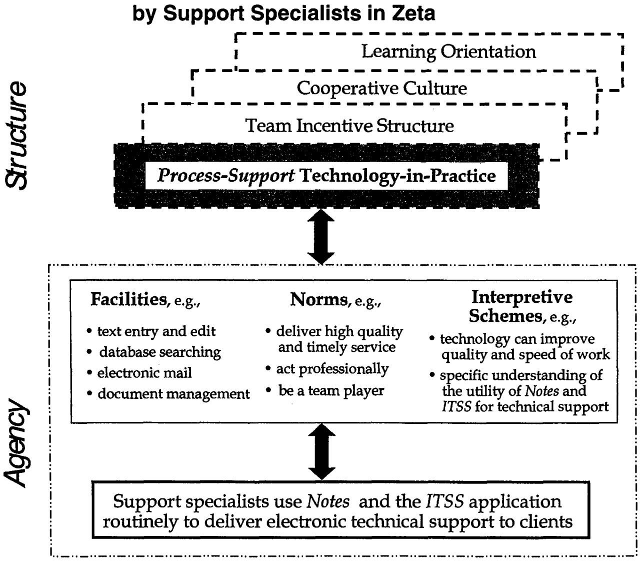
> I don't care who grabs credit for my work. . . . This support department does well because we're a team, not because we're all individuals.

Specialists' ongoing enactment of a process-support technology-in-practice was further reinforced by managerial action which redefined the evaluation criteria used to assess specialists' performance. Managers modified these criteria to include use of *Notes* for entry and documentation of customer calls, and rewarded specialists for creating high quality process documentation and for reusing existing solutions in the database.

In this recurrent practice of technology use, specialists drew on their knowledge of the CSD's norms of cooperation and collegiality, its team incentive structure and expectations of effective client service, their familiarity and experience with computer technology in general, their detailed technical knowledge of *Notes,* and used the text entry, editing, searching, and documentation properties of *Notes* to enact a set of rules and resources which provided electronic process support to their technical support work. They also modified aspects of their technology through such use by generating document templates and adding content to the database. In turn, this process-support technology-in-practice, because it provided immediate and tangible benefits to the CSD specialists served to amplify their view that using *Notes* facilitated customer support work, and reinforced their cooperative and team oriented department structure (see Figure 8). Many of these support specialists also enacted another pattern of using *Notes.*

Improvisation Technology-in-Practice. A subsequent technology-in-practice enacted by the CSD specialists involved their use of *Notes* to respond artfully to unanticipated problems and unexpected opportunities that arose in their work. Such improvisational action went beyond

Figure 8 Process-Support Technology-in-Practice Enacted by Support Specialists in Zeta



the process-support technology-in-practice, and typically generated workarounds or new processes for conducting technical support work. For example, one such process concerned the expectation, set by the CSD managers and provided for in the design of *ITSS,* that specialists would directly enter calls into the *ITSS* database as they received them, so as to produce an up-to-the-minute trace of all incoming calls. However, many specialists found the process of entering calls into *ITSS* while on the phone too difficult, and so they developed a workaround by writing down call details on paper, and then entering these into the *ITSS* database just after the phone call finished. Specialists' rationale for this practice was grounded in their concerns about typing skills and the importance of fully understanding their customers' technical problems before entering them into the *ITSS* database.

Further improvisational use of *Notes* arose when specialists began to use it to collaborate on incidents. Before the implementation of *Notes,* specialists helped each other only when asked to do so. Specialists tended to work on their own incidents in private until they felt stuck, at which point they would approach a colleague—either by phone or face-to-face—and solicit help. In this interaction with colleagues, they would also learn new skills and knowledge. As specialists used *Notes* for process support, they gained access to the entire *ITSS* database, which included all calls, past and present, worked on by members of the CSD. Specialists got into the habit of browsing through each others' calls, and using these to engage in an ad hoc learning process:

> If it is quiet I will check on my fellow colleagues to see ... what kind of calls they get, so I might learn something from them.

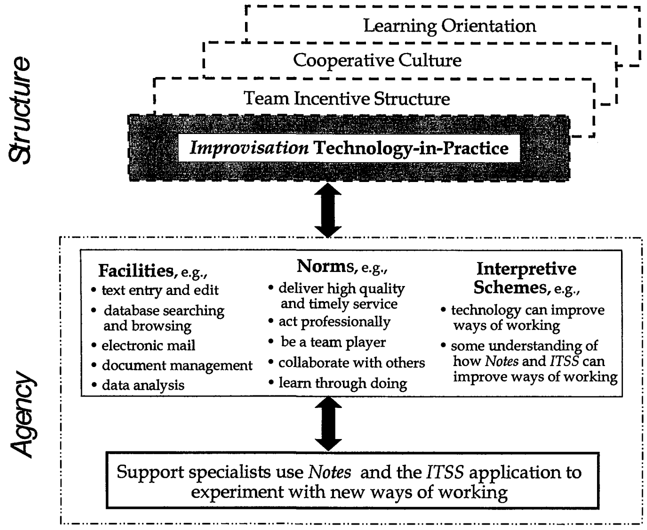
There were two consequences of such browsing. One was that specialists realized the potential for using the *ITSS* database to train newly-hired specialists. Thus, a few senior specialists extracted sample problems from the *ITSS* database and created a "training database" within *Notes* which new hires worked with to learn the process of problem resolution. Their interaction with this training database was then monitored by a designated mentor, and in this way new recruits received guidance and practice in the techniques of online technical support work.

The second consequence of browsing the database was that specialists got to see still-open calls where they might have some expertise to help. This created an opportunity for specialists to offer each other proactive help, in contrast to the reactive mode which had operated previously. Rather than waiting to be approached to give assistance on specific incidents, specialists now took the initiative as they browsed the *ITSS* database to offer unsolicited help on calls where they believed they had some particular knowledge:

> Sometimes, if I see something that's open on somebody's calls which I've seen before, I may put a note in the incident and say "Hey, I think I've seen this before, this might be this and this."

While the enactment of the improvisation technology-in-practice was initiated by specialists, it was supported by the "learning" orientation emphasized by departmental managers who actively encouraged specialists to explore alternative ways of working and offer suggestions for improving processes in the CSD. While managers recommended a particular use of *ITSS,* they did not rigidly enforce it, accepting workarounds and variations if these produced valued results. In this recurrent practice of technology use, specialists drew on their knowledge of their CSD environment (in particular norms of cooperation and expectations of learning and experimentation), their familiarity and experience with computer technology in general, and their detailed technical knowledge of *Notes,* to use multiple properties of *Notes* (text entry and editing, database browsing, electronic mail, and data analysis), and modify them (e.g., by adding content and creating a new training database). Such recurrent use enacted a set of rules and resources which supported specialists' improvisation beyond their process-support technology-in-practice and helped them to overcome practical difficulties and to innovate additional ways of working and learning. In turn, this improvisation technology-in-practice, because it provided value to the specialists' work, affirmed their view that using *Notes* could enhance their work through ongoing experimentation and change, and reinforced the cooperative culture and learning-oriented structure of their department (see Figure 9).

Figure 9 Improvisation Technology-in-Practice Enacted by Support Specialists in Zeta



Examples of Enactment: Summary

Taken together, these empirical illustrations show that people enact different technologies-in-practice with the same type of technology across various contexts and practices. We have seen that they do so in response to various technological visions, skills, fears, and opportunities, influenced by specific interpretations and particular institutional contexts, and shaped by a diversity of intentions and practices to collaborate, solve problems, preserve status, improve efficiency, support work processes, learn, and improvise. These technologies-in-practice are structures enacted through the recurrent use of a technology. They are not embodied within the technology; rather, they emerge from the ongoing and situated interactions that users have with the technology at hand.

Thus, in the case of Iris Associates we see that developers drew on their earlier experiences of different technologies, their visions about collaborative use of technology, their knowledge of software design, and their start-up environment to recurrently enact a collaborative technology-in-practice that both created and engaged the collaborative and distributed design properties of *Notes* as rules and resources for their software development efforts. Technology members of Alpha, influenced by an institutional context that supported and rewarded cooperation in technical support work, recurrently enacted a technology-in-practice that engaged many of the collaborative and design properties of *Notes* as rules and resources for collective problem solving. Consultant members of Alpha, influenced by their firm's hierarchical career path, individual criteria for evaluation and promotion, time-based billing system, and their personal skepticism and apprehensions, recurrently enacted technologies-in-practice that engaged very few of the properties of *Notes* as rules and resources for either limited use or individual productivity gains. Finally, Zeta support specialists, influenced by a collegial environment which encouraged experimentation and learning, and motivated by a personal interest to be cooperative and deliver more effective service, recurrently enacted technologies-in-practice that engaged many of the collaborative and design properties of *Notes* as rules and resources for process support and improvisation of customer service work.

These examples further illustrate how a practice lens allows us to see what, when, where, how, and why different groups enact different structures (technologies-in-practice) through their recurrent interaction with a particular set of technological properties, in similar and different contexts, at the same time, and over time. In addition, such a practice lens allows us to examine the institutional, interpretive, and technological conditions which shape the ongoing constitution of different structures, and how such constitution in turn reinforces or modifies those institutional, interpretive, and technological elements. I turn now to some of the implications of a practice lens for studying technologies in organizations.

Implications of the Practice Lens for Studying Technology

In this paper, I have sought to augment the existing structurational perspective on technology by proposing a view of technology structures, not as embodied in given technological artifacts, but as enacted by the recurrent social practices of a community of users. This view directs researchers' attention to what people do with technology in their everyday practices, and how such use is structured by the rules and resources implicated in their ongoing action. Rather than trying to understand why and how a given technology is more or less likely to be appropriated in various circumstances, a practice lens focuses on knowledgeable human action and how its recurrent engagement with a given technology constitutes and reconstitutes particular emergent structures of using the technology (technologies-in-practice). Thus, the research orientation is inverted—from a focus on given technologies, embodied structures, and their influence on use—to a focus on human agency and the enactment of emergent structures in the recurrent use of technologies.

While a practice lens recognizes that technology use is always situated and emergent, it does not imply that such use is completely unique. On the contrary, because regular use of the same technology tends to be recurrent, people tend to enact the same or similar technologies-in-practice over time. In this way, enacted technology structures become routine, taken for granted, and even institutionalized within certain circumstances. Such stabilization for now of technologies-in-practice allows researchers to seek bounded generalizations about the types of technologies-in-practice likely to be enacted by particular types of users with specific technologies in various contexts and times. As Giddens (1984) notes, generalizations about human social conduct are of two types: those that "hold because actors themselves know them—in some guise—and apply them in the enactment of what they do" (p. xix); and those that refer to the unintended consequences of agents' patterns of action (p. 347). Both of these generalizations hold only in historically and contextually-specific circumstances.

Table 2 suggests some provisional generalizations of both types based on comparisons across the conditions and consequences associated with the six technologies-in-practice enacted by members of Iris, Alpha, and Zeta with essentially the same technology (a customizable groupware tool, *Notes* installed on networked personal computers). Three kinds of conditions (acknowledged or unacknowledged) are salient here: interpretive, technological, and institutional. Interpretive conditions refer to the conventional understandings and shared meanings that members of a community construct to make sense of their world (including the technology they use). Technological conditions refer to the technological properties (both tool and data) available to the users in their work practices. Institutional conditions refer to the social structures (normative, authoritative) that constitute part of the larger social system within which users work. Three kinds of consequences (intended or unintended) are relevant here: processual, technological, and structural. Processual consequences refer to changes (if any) in the execution and outcome of users' work practices. Technological consequences refer to changes (if any) in the technological properties available to the users. Structural consequences refer to changes (if any) in structures that users enact as part of the larger social system in which they are participating.

The comparison of the conditions and consequences associated with whether and how humans use the technology to enact different technologies-in-practice suggests that three clusters or types of enactment can be discerned. These are associated with three distinct kinds of consequences: consequences that represent no evident change in process, technology, or structure; consequences that represent some change in one or more of process, technology, and structure; and consequences that represent significant change in one or more of process, technology, and structure. Whether or not the technology or the work practices are changed is often an intended outcome of people's knowledgeable actions; the structural consequences are much more likely to be unintended consequences of actions.

The first type of enactment may be characterized in terms of *inertia,* where users choose to use technology to retain their existing way of doing things (see first row of Table 2). It results in the reinforcement and preservation of the structural status quo, with no discernable changes in work practices or the technological artifact. Inertia is represented in my data with the limited-use technology-in-practice, where users choose to use their new tool rarely and perfunctorily, and show little or no interest in integrating its use into their ongoing work practices. In the one case where this enactment was evident in my data, it was associated with interpretive conditions that included users having limited understanding and/or being

Table 2 Types of Enactment—Conditions, Actions, and Consequences

Type of Enactment	Interest in using the Technology	Interpretive Conditions	Technological Conditions	Institutional Conditions	Technology-in-Practice	Processual Consequences	Technological Consequences	Structural Consequences
Inertia	Low	Limited technical knowledge	•Networked personal computer •Customizable groupware tool	•Hierarchical •Individualistic •Competitive	*Limited-Use*	•None	•None	Reinforce and preserve status quo
Application	Very High	Extensive technical knowledge	•Networked personal computer •Customizable groupware tool	•Nonhierarchical •Collaborative •Participative	*Collaboration*	•Increased effectiveness in development •Improved collaboration	•Changes to the tool •Changes to the data	Reinforce and enhance status quo
	Moderate	Moderate technical knowledge	•Networked personal computer •Customizable groupware tool	•Hierarchical •Individualistic •Competitive	*Individual-Productivity*	•Increased efficiency in communication	•Changes to the data	Reinforce and enhance status quo
	High	Detailed technical knowledge	•Networked personal computer •Customizable groupware tool	•Communal •Cooperative	*Collective-Problem-Solving*	•Increased effectiveness in problem solving •Increased cooperation	•Adaptations to the tool •Changes to the data	Reinforce and enhance status quo
	Very High	Competent technical knowledge	•Networked personal computer •Customizable groupware tool •Call tracking tool	•Team-focused •Cooperative •Learning-oriented	*Process-Support*	•Increased effectiveness in customer service •Increased efficiency in communication	•Adjustments in the tool •Changes to the data	Reinforce and enhance status quo
Change	High	Competent technical knowledge	•Networked personal computer •Customizable groupware tool •Call tracking tool	•Team-focused •Cooperative •Learning-oriented	*Improvisation*	•Redefined work distribution •Shift in type of collaboration •Change in ways of learning	•Adaptations to the tool •Changes to the data	Transform status quo

skeptical of the technological properties available to them, and institutional conditions that included a rigid career hierarchy, individualistic incentives and task assignments, and a competitive culture. Thus, as a type of enactment, inertia involves drawing on and not changing existing interpretive, technological, and institutional conditions, and, in this way, reproducing and reinforcing them over time.

The second type of enactment may be characterized in terms of *application,* where people choose to use the new technology to augment or refine their existing ways of doing things (see next four rows of Table 2). Such enactment results in the reinforcement and enhancement of the structural status quo, noticeable changes to the data and/or tool aspects of the technological artifact, as well as noticeable improvements to work processes.

Application is represented in my data by four technologies-in-practice—collaboration, individual productivity, collective problem-solving, and process-support—which were enacted in all three of the research sites I examined. Looking across the rows of Table 2, it is evident that this enactment occurred with users having moderate, competent, or extensive understanding of their technology at hand, and being either moderately or highly motivated to use it to enhance their work practices. These users worked within and drew on a range of institutional conditions (from hierarchical and competitive to collaborative and participative). While the interpretive and institutional conditions associated with these sites are diverse, commonality lies in the users' intentions and actions. That is, all of the users in these four cases used the technology with the intention of improving or enhancing their existing work processes.

Thus, as a type of enactment, application involves users drawing on existing institutional, interpretive, and technological conditions over time and reproducing them in an enhanced or improved form. For example, where the institutional conditions are hierarchical and individualistic, enactment in the form of application results in action that increases such hierarchy and individualism, as when the individual productivity technology-in-practice was used to further individual rather than collaborative efforts within Alpha. Similarly, when the institutional conditions are nonhierarchical and participative, as in the case of Iris, the enactment of the collaboration technology-in-practice helped to improve the shared and collaborative design efforts of the developers.

The third type of enactment may be characterized in terms of *change,* where people choose to use the new technology to substantially alter their existing way of doing things (see last row of Table 2). Such enactment results in transformation of the structural status quo, and significant modifications to users' work practices as well as the technological artifact. Enactment of change is represented here with the improvisation technology-in-practice, where specialists use the technology to experiment with and implement new ways of working and organizing, and to adapt/customize aspects of their tool and its data content. In the one case where this enactment was evident in my data, it was associated with interpretive conditions that included users being very knowledgeable about technology and highly motivated to use it in their work practices, and institutional conditions that included a strong team focus, a cooperative culture, and a strong commitment to ongoing learning. Thus, as a type of enactment, change involves drawing on and transforming existing institutional, interpretive, and technological conditions over time, and, in this way, significantly changing the organizational status quo.

Like the six technologies-in-practice, the three types of enactment characterized here are not comprehensive or exhaustive, but suggestive of the kinds of comparisons that may be made across the conditions and consequences associated with people's use of technologies. In this way, and through further research, a typology of enactment types may be identified that associates recurrent human action with clusters of technologies-in-practice enacted by using specific properties of technologies in specific interpretive and institutional contexts. The types of enactments discussed here all involved the use of the same kind of technology. Examining other kinds of technologies offering different properties to those of *Notes* would generate further opportunities to study how users draw on different technological conditions to enact particular types of technologies-in-practice with particular social consequences. Similarly, exploring different cultural (e.g., non-U.S.) and institutional (e.g., governmental, educational) contexts to those studied here would also expand our understanding of how users recurrently structure their use of technologies in different circumstances. Additionally, future research could benefit from attending more carefully to the meanings and emotional attachments that users develop for the technologies they use. Beyond the skepticism displayed by some of the consultants within Alpha, my empirical data did not capture the richness of users' affective connections with technology. Understanding these attachments and meanings could offer richer explanations for the range of structural responses enacted by users as they engage with technologies in practice.

Identifying types of structures of technology use should help both researchers and practitioners better understand how and why people are likely to use their technologies and with what (intended and unintended) consequences in different conditions. Of course, the types identified through such research can never exhaust the technologies-in-practice which users may enact in practice. A practice lens assumes that people are purposive, knowledgeable, adaptive, and inventive agents who engage with technology in a multiplicity of ways to accomplish various and dynamic ends. When the technology does not help them achieve those ends, they abandon it, or work around it, or change it, or think about changing their ends. A practice lens thus recognizes that users may always choose to do otherwise, and any typology of enactment types and technologies-in-practice must always remain an open set, as users will continue to modify their technologies and continue to change their uses of technology over time. Recognizing that the possibility to change technology structures is inherent in every use of technology allows us to understand when, where, how, and why people choose to reinforce, ignore, enhance, undermine, change, work around, or replace their existing structures of technology use.

The focus on technologies-in-practice also allows an examination of the extent to which users realize designers' intentions for a technology. That is, it can help us identify and analyze how the technological properties designed into and available in artifacts deployed on shop floors, installed on desktops, or downloadable from Web servers, are used in situated and emergent ways by people attempting to get something done in their daily activities. It has long been recognized that technologies are often not used as designed or intended (Bijker 1995, von Hippel 1988), but generating an adequate understanding of how, where, and why the slippage between design and use occurs in practice has been difficult. By distinguishing between technologies as artifacts and technologies-in-practice, we have a way to explore and explain this process. For example, the examination of the *Notes* technology and its properties, as well as its designers' intentions, provides a profile of potential use that may be compared to the technologies-in-practice realized in a range of recurrent practices. It suggests, for example, that where users' social practices are compatible with designers' intentions and the properties inscribed within a technology, a technology-in-practice may be enacted that more closely realizes those designers' intentions and their technology's properties. We saw this in the case of the Alpha technologists and Zeta specialists whose work practices of technical support and peer collaboration corresponded with the *Notes* designers' visions and norms of supporting collaboration through technology. Not surprisingly, the technologies-in-practice they enacted (collective problem-solving, process-support, and improvisation) were relatively compatible with the collaborative use envisioned by the Iris developers and provided for in their technology. In contrast, the work practices of the Alpha consultants (individual tasks, competition, knowledge hoarding, client-oriented time-keeping, limited technology experience) were incompatible with the *Notes* designers' visions of supporting collaboration through technology. Not surprisingly, the technologies-in-practice enacted by the Alpha consultants (limited-use and individual productivity) did not come close to realizing the collaborative use envisioned by the Iris developers and provided for in their *Notes* technology.

But even as we can explore compatibilities between users' recurrent social practices, designers' intentions, and technological properties, the practice lens reminds us that use of technology is always situated and emergent, and hence that users in their recurrent interaction with technologies may always choose to depart from designers' a priori intentions and the inscribed properties of the technology. Indeed, the correspondence between use and properties is expected to become, on the one hand, more loosely coupled, as newer reconfigurable technologies become increasingly available in organizations, and on the other hand, more integrated, as the rise of internetworking connects more and more artifacts together in new and complex configurations.

With respect to the former trend, what are sometimes referred to as "radically tailorable tools" (Malone et al. 1992) tend to be less fixed-function than prior computing technologies, serving as general purpose platforms on which users may build local applications which convert the generic delivered technology into a customized and situated work tool. Sproull and Goodman (1990, p. 257) note: "[P]rogrammable technology allows for the possibility of continuous redesign." Reconfigurable technologies will provide users with the opportunity of defining a wider array of local properties with which they may be able to enact an even wider variety of technologies-in-practice. Of course, whether and how they do so depends not just on the properties of the technology, but as we saw above, on their social practices and the intentions, interpretations, and institutional contexts shaping those practices over time. Given such open-ended properties of new technologies, the ability to examine what people do with them in practice will be helped by being able to distinguish between the technological properties and the situated technologies-in-practice enacted with them.

With respect to the latter integrating trend, the increased use of the Internet for conducting business requires more interconnections among more players than before (Iacono and Kling, in press). Organizations wishing to link to other businesses or to the Internet will need to provide standard interfaces and consistency of performance across a range of technological platforms to ensure the interoperability of multiple artifacts. Providing for such interconnections increases interdependence and complexity, coupling the artifacts more tightly together in larger technological systems or infrastructures. Such integration is likely to reduce the degrees of freedom available to users to experiment with and modify their technological artifacts in use. As users become more dependent on using integrated technologies, the variety of technologies-in-practice that they will enact may decrease. Of course, whether such restriction in malleability actually occurs in any situation is an empirical question, and will depend on people's practices and how these are affected by such influences as intentions, interpretations, and institutions.

The distinction between technologies and technologies-in-practice further suggests that researchers and managers measuring technological investment or deployment to predict performance impacts may get more meaningful results if they look for returns on the *use* of technology rather than only at returns on the *technology*. Technology per se can't increase or decrease the productivity of workers' performance, only use of it can. This may sound like semantic hair-splitting, but how people talk has profound implications for how they think and act in the world. By emphasizing technology in their talk, people tend to emphasize the technology (not its use) in their allocation of funds, attention, and measures. Such an emphasis, as the examples within Alpha showed, typically leads to a neglect of recurrent and situated technology use (i.e., technologies-in-practice). By not examining or understanding what actually happens during use of technology, researchers and managers miss the crucial point, that it is whether and how people interact with technology in their day-to-day activities—not the mere presence of the technology on the desktop or factory floor—that influences performance outcomes and consequences. Knowing what we know about the different technologies-in-practice enacted within Alpha and Zeta, there is no difficulty in understanding why these firms should have experienced significantly different outcomes from their investments in the same type of technology. The distinction between technologies and technologies-in-practice thus reminds us that measures of technology investment or deployment are not sufficient indicators of organizational change or effectiveness. Such change or effectiveness depends not on technologies alone, but on whether, how, and what technologies-in-practice are enacted with them.

In this paper, I have proposed that the existing structurational perspective on technology be augmented with a practice orientation which focuses specifically on how people's recurrent interaction with technologies enacts distinctive structures of technology use. These structures of technology use (technologies-in-practice) are not fixed or given, but constituted and reconstituted through the everyday, situated practices of particular users using particular technologies in particular circumstances. By attending to such ongoing (re)constitution, a practice lens entails the examination of emergence, improvisation, and change over time as people reconfigure their technologies or alter their habits of use, and thereby enact different technologies-in-practice. A practice lens thus allows us to deepen the focus on human agency and recognize ''the essentially transformational character of all human action, even in its most utterly routinized forms'' (Giddens, 1984, p.117).

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Endnotes

[1]A number of extensive discussions of this technology literature are available, for example, Kling (1980), Barley (1988), Powell (1987), Scott (1990), Scarbrough and Corbett (1992), and Marx and Smith (1994).

[2]The notion of *enactment* used here is related to but broader than that given currency by Weick (1979). It is intended here in the conventional sense of ''to constitute, actuate, perform'' (Oxford English Dictionary) or ''to represent in or translate into action'' (Merriam-Webster Dictionary).

[3]I use the term *artifact* here in the sense of ''anything made by human art and workmanship'' (Oxford English Dictionary) or ''a product of artificial character due usually to human agency'' (Merriam-Webster Dictionary).

[4]As Grint and Woolgar (1995, p.289) remind us "[Technology] exists only in and through our descriptions and practices, and hence it is never available in a raw, untainted state.'' Thus, even the description and observation of ''technologies'' and their ''properties,'' including their designation as artifacts, is a kind of *use* of that technology. These reflexive complications notwithstanding, I believe that the analytic distinction between technologies as artifacts and the use of such artifacts is an especially useful one in both empirical research and everyday usage.

[5]In what follows, I will conform to common usage and use the term ''technology'' to refer to ''technological artifact.''

[6]It is interesting to note that what is actually enacted here as tax rules is not the tax code as legislated, but the tax code as encoded in the software, which reflects developers' understanding of the tax legislation and their ability to translate it into executable software code.

[7]One of the anonymous reviewers observed that a gun is a gun even if no one pulls the trigger. Yes and no. While it is the case that most of us can recognize a particular object as a gun through its inscribed shape, physical properties, and functions, such recognition is culturally-specific. No such recognition would be forthcoming from the members of a remote tribe in the Kalahari Desert who have never encountered the object we refer to as a ''gun.'' Furthermore, if our knowledge of a gun comes primarily from its use, then we cannot assume that a gun ''is a gun'' without knowing how that object is being used. While guns are designed and built for a particular purpose, and their possession has important implications for social policy, gun possession is not sufficient grounds for presuming that a gun will be used in a particular way. People can and do choose not to pull the trigger, and that makes all the difference.

[8]I wish to thank one of the anonymous reviewers for highlighting the importance of emotional connections in people's use of technologies.

[9]See Orlikowski (1993, 1996) and Orlikowski and Gash (1994) for more details of the research studies which generated these examples.
[10]My research study had been ''officially sanctioned'' and participants had been told to charge the time they spent with me to a professional activities code. Yet, many confided they would ''swallow the time'' so as to avoid any dreaded ''below the line'' hours, even apparently legitimate ones.

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