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Author(s): Richard J. Boland, Jr. and Ramkrishnan V. Tenkasi
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Perspective Making and Perspective Taking in Communities of Knowing

Richard J. Boland, Jr. • Ramkrishnan V. Tenkasi
Weatherhead School of Management, Case Western Reserve University, Cleveland, Ohio 44106-7235
School of Business Administration, University of Southern California, Los Angeles, California 90089-1421

Abstract

Knowledge-intensive firms are composed of multiple communities with specialized expertise, and are often characterized by lateral rather than hierarchical organizational forms. We argue that producing knowledge to create innovative products and processes in such firms requires the ability to make strong perspectives within a community, as well as the ability to take the perspective of another into account.

We present models of language, communication and cognition that can assist in the design of electronic communication systems for perspective making and perspective taking. By appreciating how communication is both like a language game played in a local community and also like a transmission of messages through a conduit, and by appreciating how cognition includes a capacity to narrativize our experience as well as a capacity to process information, we identify some guidelines for designing electronic communication systems to support knowledge work. The communication systems we propose emphasize that narratives can help construct strong perspectives within a community of knowing, and that reflecting upon and representing that perspective can create boundary objects which allow for perspective taking between communities.

We conclude by describing our vision of an idealized knowledge intensive firm with a strong culture of perspective making and perspective taking, and by identifying some elements of the electronic communication systems we would expect to see in such a firm.

(*Knowledge Work*; *Organization Learning*; *Distributed Cognition*; *Communication Systems*)

Introduction

Organizations are developing innovative products and services on faster cycle times (Purser and Pasmore 1992, Lawler 1992), causing an increase in knowledge work (Pava 1983) and a gradual replacement of capital and labor intensive firms by knowledge intensive firms (Starbuck 1992). Knowledge work creates new understandings of nature, organizations or markets and applies them in valued technologies, products, or processes. Knowledge intensive firms are composed of multiple communities with highly specialized technologies and knowledge domains (Purser et al. 1992). In the pharmaceutical industry, for example, developing new products requires integration of knowledge from a broad array of disciplines such as molecular biology, physiology, biochemistry, synthetic chemistry, pharmacology and even esoteric specialties such as molecular kinetics (Henderson, 1994). A similar pattern is observable in other industries. The first generation of cellular telephones used five sub technologies, but their third generation incorporated fourteen distinct sub technologies (Granstrand et al. 1992). The increasing proliferation of specialized and distinct knowledge communities and the need for their integration has also resulted in the emergence of new organizational forms, among them the lateral-flexible form of organization (Galbraith and Lawler 1993, Galbraith 1994). The lateral-flexible organizational form relies on peer-to-peer collaboration (as opposed to a vertical hierarchy) in achieving organizational objectives.

It is our contention that all organizations are becoming more knowledge intensive across the service, industrial and governmental sectors. It is easiest to see the fundamental importance of knowledge work in firms involved with new product development in leading edge technologies, but the relentless pace of change in market expectations means that all organizations will

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increasingly rely on creating new knowledge and adopting lateral organizational forms. The major issue for such firms is to find creative ways for representing and integrating knowledge across their lateral units (Weick and Roberts 1993, Galbraith 1994).

Knowledge production involves communication within and between a firm's multiple communities of knowing. We refer to communication that strengthens the unique knowledge of a community as perspective making, and communication that improves its ability to take the knowledge of other communities into account as perspective taking. In this paper we employ models of language, communication and cognition to propose how electronic communication systems can be designed to support perspective making and perspective taking in knowledge intensive firms.

We argue that perspective making and perspective taking are achieved by narrating our experience as well as by rationally analyzing it. These processes are like playing games with language as well as like transmitting messages through a conduit, and they involve heightened levels of reflexivity. The narrating of experience is a critically important but often overlooked element of knowledge production in knowledge intensive firms, even though it is recognized that scientific reasoning is often conducted through narratives and that scientists' interpretive practices are embodied in their conversation (Knorr-Cetina 1981, Mulkay et al. 1983). Similarly, the importance of playful situated action for strengthening one's own perspective and the importance of reflexivity for appreciating the perspective of another is not sufficiently recognized in communication system design. After analyzing the processes of perspective making and perspective taking, we describe an idealized knowledge-intensive firm to highlight some of the features of an electronic communication system that would support those processes.

We first present the concept of a community of knowing as an open system and provide a brief overview of models of language, communication and cognition that can guide the design of electronic communication systems. The language games model of Wittgenstein (1974) and Bruner's (1986, 1990) model of narration as a cognitive mode are presented as supplements to the dominant organizational models of language as message transmissions and cognition as information processing. Science is used as an example of knowledge work to draw implications for applying these models to the communication requirements in knowledge-intensive firms. We then explore the dynamics of perspective making and perspective taking and some potential breakdowns in the perspective-taking process. This allows us to summarize the strengths and weaknesses of the language game and the conduit models of communication for designing electronic communication systems, and to emphasize the importance of reflexivity and boundary objects in perspective taking. Finally, we present our admittedly utopian vision of some future applications of electronic communication for supporting knowledge work in a hypothetical firm with a lateral-flexible form.

Communities of Knowing as Open Systems

Organizations are characterized by a process of distributed cognition in which multiple communities of specialized knowledge workers, each dealing with a part of an overall organizational problem, interact to create the patterns of sense making and behavior displayed by the organization as a whole (Boland et al. 1994).

Organizations are necessarily characterized by distributed cognition because their critically important processes and the diversity of environments and technologies to be dealt with are "too complex for one person to understand in its entirety" (Brehmer 1991, p. 4; Nersessian 1992). This problem is especially acute in knowledge-intensive firms that rely on multiple specialties and knowledge disciplines to achieve their objectives. Each such community of specialized knowledge workers is what we term a "community of knowing."

A number of scholars such as Fish (1980), Fleck (1979), Barnes (1983) and Brown and Duguid (1991) have commented on the way that communities develop unique social and cognitive repertoires which guide their interpretations of the world. Fleck's (1979) concept of "thought collective" is one such notion that emphasizes the unique interpretive repertoires of a distinct community of knowing. A thought world evolves in a community of knowing as a "readiness for directed perception". Thought worlds with different funds of knowledge and systems of meaning cannot easily share ideas, and may view one another's central issues as esoteric, if not meaningless. Other terms which echo our concept of community of knowing include "interpretive community" (Fish 1980), "context of learning" (Barnes 1983), and "community of practice" (Lave and Wenger 1990, Brown and Duguid 1991, Orr 1990). However, given our focus on knowledge-intensive firms, and our concern with the interaction of different expert knowledge groups in the process of knowledge

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creation, we feel "community of knowing" is the most appropriate label for our purposes.

The multiple communities of knowing in knowledge-intensive firms overlap in complex and shifting ways. There is a rich structural hierarchy (Smith 1981) of communities of knowing within the firm, and between the firm and its environment. Divisions, functional areas, product lines, professional specialties, project teams, issue-based committees, and so on are all possible sites for communities of knowing that interweave with each other across various levels of the organization. Individuals will find themselves as members of several communities of knowing operating within a firm and its environment.

In science, the interaction of communities of knowing has been viewed as an open system by Star (1993) and a similar notion has been expressed by Barnes (1983) and Hesse (1974) who characterize each community as a knowledge net within an institution or culture. Even in settings where communication appears unproblematic and knowledge homogeneous, the nets of individual communities differ. It is through the dynamic interactions between such communities that new configurations of the knowledge net emerge by creating new meanings, new linguistic routines, and new knowledge. Maintenance and refinement of the existing knowledge in a community can be attributed to feedback processes operating within established routines and policies. The creation of new knowledge in an organization, however, is often the result of an open system transformation of that organization's communities of knowing as they question and revise routines and create new processes and relationships among themselves (Wiener 1954; von Bertalanffy 1968, Argyris and Schön 1978). We argue that perspective making and perspective taking are the basis for transformations within and between communities of knowing and thereby the basis for open system control in knowledge work. Our principal contention is that designing electronic communication systems for knowledge intensive firms requires an appreciation of how they can mediate the transformation and changing relationships among communities of knowing by affecting perspective making and perspective taking capabilities.

Assumptions about Language Communication and Cognition in Knowledge Work

The knowledge work of perspective making and perspective taking requires individual cognition and group communication. Our understanding of language, communication and cognition are centrally important in designing electronic communication systems, and below we supplement the dominant model for each with an alternative that we believe necessary for creating more effective designs.

Supplementing a Conduit Model of Communications with a Language Games Model

In considering how electronic communication can be designed to support knowledge work in organizations, two models of language and communication are important to consider. One is the conduit model inspired by the work of Shannon and Weaver (1949), which we see as the dominant model in management literature, the other is the language game model of Wittgenstein (1974). Each of these theoretical orientations is useful for thinking about language and communication in an organization when it is viewed as an open system of communities of knowing. Each is good for certain purposes, but not for all, and we will employ them for different needs in our analysis.

The conduit model is the most familiar in organizational studies, and portrays communication as a message sending and message receiving process through a transmission channel with a limited channel capacity. A conduit model suggests that communication can be improved by reducing noise in the channel, with noise defined as the possibility for error contaminating the message on its route from sender to receiver. Noise can be reduced by increasing the channel capacity; by refining the procedures for encoding and decoding messages; by providing more reliable data storage and retrieval facilities; or by making the channel of communication more universally available. A central limitation of the conduit model is its unproblematic treatment of a message (Redding 1972, Reddy 1979) in which the symbolic or interpretive character of messages in language is not considered. The encoding and decoding activities are treated as discrete selections of messages from a predefined set and the problem of human meaning in language is avoided. In management studies we see this model being used in organization design (Galbraith 1973, Tushman 1978, Allen 1986), as well as research and development and innovation (Davis and Wilkof 1988, Allen et al. 1980, Allen and Cohen 1969). Attempts to expand the conduit model to address ambiguity in language can be seen in studies of media richness (Daft and Lengel 1984) and the interpretation of noise (Ciborra et al. 1984), but they remain within a message transmitting framework.

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As an alternative model we will consider Wittgenstein's image of language and communication as games in forms of life (Wittgenstein 1974, Astley and Zammuto 1992). His image of communication appreciates language as fundamentally and inexorably embedded in the situated action of our immediate communities, or our "forms of life". Action in our immediate communities is the locus for language development and use. Conversations and activity in our forms of life are language games, and through our language games we create the meaning of particular words and forms of speech, and we continuously evolve new ways of talking and acting together.

Wittgenstein spent the first part of his life trying to define the essence of language, searching for a stable, ideal meaning for words and sentences, and the principles of logic that could be relied upon to provide unambiguous and coherent knowledge (Wittgenstein 1961). He later rejected the notion of an ideal language in which words pictured objects, and meaning was uniquely identifiable and stable. Instead, he came to see how language cannot be understood apart from its rootedness in life experience, nor can words stand apart from situated use with unambiguous meaning. Language games in forms of life are the basis for all we know. Through action within communities of knowing we make and remake both our language and our knowledge. Unlike the conduit model, in a language game there is no fixed set of messages or meanings from which to choose in communicating.

> 23. But how many kinds of sentences are there? ... There are *countless kinds*: countless different kinds of use of what we call "symbols", "words", "sentences". And this multiplicity is not something fixed, given once for all; but new types of language, new language-games, as we may say, come into existence, and others become obsolete and become forgotten ... .
>
> Here the "language game" is meant to bring into prominence the fact that the *speaking* of language is part of an activity, or a form of life. (Wittgenstein 1974, p. 11, as in original)

Supplementing an Information Processing Mode of Cognition with a Narrative Mode of Cognition

Bruner (1986, 1990) has proposed that we recognize there are at least two distinct modes of cognition, the information processing (or paradigmatic) mode and the narrative mode. We believe that explicitly recognizing the narrative mode of cognition is important for understanding how perspective making and perspective taking occur. The dominant way of understanding cognition today is to emphasize its paradigmatic mode, as reflected in information processing models of cognition (Simon 1977). Bruner (1986, 1990) has proposed that this information processing view of cognition, emphasizing the rational analysis of data in a mental problem space and the construction of deductive arguments, be supplemented by recognizing that humans also have a narrative cognitive capacity. We narrativize our experience almost continually as we recognize unusual or unexpected events (the noncanonical) and construct stories which make sense of them (restore canonicality). Bruner argues persuasively that the narrative capability of humans is a fundamental cognitive process through which our cultural world and sense of self are constructed and maintained over time.

Good arguments and good stories are equally important for understanding human cognition in knowledge work, but the two modes are judged by different criteria. Whereas an argument is judged to be good if it is logical, coherent, consistent, and noncontradictory, a narrative is judged to be good if it is interesting, plausible, and believable. An argument proves something about the world to be true, but a narrative shows how events or features in the world are sensible and fit within our shared cultural field. It is well recognized that surfacing and challenging the often implicit assumptions that underlie a paradigmatic argument is an important element for innovative knowledge work. Narrative serves an important role in this regard. By bringing the apparently noncanonical into relief alongside the canonical, the narrative mode of cognition provides access to the implicit assumptions and interpretive structures that characterize a community of knowing. We will give an example of such an analysis later in the paper, when we describe some of the electronic communication systems we envision.

There are several points of similarity in the underlying assumptions of these models of communication and cognition, particularly between the conduit and paradigmatic, and between the language game and narrative (see Table 1). Both the conduit model of communication and the paradigmatic mode of cognition are based on information processing images in which words point at things, meanings are not problematic, and the power of deductive logic is emphasized. Similarly, both the language game model of communication and the narrative mode of cognition are based on social constructionist images in which words gain sense only through actual use in a community, meanings are symbolic and inherently ambiguous, and the power of social processes, storytelling and conversation is emphasized. In spite of this family resemblance among the models of communication and

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Table 1

Key assumptions behind conduit model of communication and paradigmatic mode of cognition.

- There is underlying objective knowledge in the world that has universal applicability.
- Language can be a medium for representing objective knowledge and words have fixed meaning.
- Human beings can achieve universality of understanding since fixed meanings of words can be communicated objectively from one person to another.
- Realization of objective knowledge is a rational process. Knowledge evolves and progresses through the systematic application of logic and principles of the scientific method.

Key assumptions behind language games model of communication and narrative mode of cognition.

- Knowledge as well as methods for realizing knowledge are objective only to the extent they are ratified as objective by a specific community's interpretive conventions.
- Words can have consensus of meaning only within a specific community of knowing. However, even within a unique community, the meaning of words change and are never fixed in time or space.
- Language is not a medium for representing our thoughts and objective underlying knowledge but language is thought and knowledge. The limits of our language are the limits of our knowledge since we can explain the world only through language and narrative forms.
- Knowledge evolves by inventing new language and narrative forms. Re-narrativizing the familiar or coming up with narratives that explain the unfamiliar is the primary activity by which new knowledge comes about.

cognition being drawn upon, they will not be combined. Whereas the language games model is philosophical and proposed as a more accurate depiction of human language and communication, the conduit model is technical and proposed as the necessary requirements for a communication system. One focuses on human language, the other focuses on communication technology. The narrative and paradigmatic modes of cognition, on the other hand, are meant by Bruner (1990) as complementary functions of the same whole, each being capacities of the human being. We will not collapse them, and will treat all four as having a separate tradition and use. We will employ each to serve different purposes in understanding the processes of perspective making and perspective taking among communities of knowing.

We will now look to science for insights on how communities of knowing develop and change through communication. We will then draw implications for designing electronic communication systems for knowledge work in organizations, and also consider how multiple communities of knowing interact.

Science as Knowledge Work in Communities of Knowing

Considering science as organized knowledge work has many insights to offer for understanding perspective making and perspective taking in knowledge intensive firms and for speculating on how electronic communication can be designed to support knowledge work in lateral organizational forms. A central source for these insights is provided by Thomas Kuhn (1970) as he describes the historical process of scientific work. Readers are no doubt familiar with Kuhn's argument of how normal science within paradigms leads to crisis and revolution. For Kuhn, a paradigm is a shared sense of what the metaphysical nature of the world is, what problems are important, and what serve as good exemplars for a domain of concern.

There are many difficulties with Kuhn's notion of paradigm. It is often taken to be totalizing, unitary and almost religiously held. As Masterman (1970) has noted, Kuhn (1962) used the term paradigm in many different ways in the first edition of *The Structure of Scientific Revolutions*. In the revised edition Kuhn (1970) acknowledged the concept's ambiguity and added further refinements, but debates about just how a paradigm is to be defined or isolated for further study in its own right will not concern us here. We believe his basic insight is valid, and is in keeping with Polanyi's (1967) idea of "tacit knowledge", Boulding's (1956) discussion of "the image", Pepper's (1942) notion of "world hypotheses" and numerous others who point out that perception is only accomplished through a perspective (Burrell and Morgan 1979, Bartunek 1984).

Kuhn's (1970) insights are particularly relevant for understanding how knowledge is produced in a community of knowing by refining and clarifying the perspective of the community. Development of knowledge in a community is a process of posing and solving puzzles, thereby elaborating and refining the vocabulary, instruments and theories that embody the perspective. Agreement that knowledge is progressing is agreement that the perspective is strengthening. Unexpected events or findings can only be recognized as such from within a perspective. Without a strong perspective the community cannot tell an anomaly from noise; a challenge to their knowledge from an irrelevancy.

Collins (1983) makes some interesting observations on the dynamics of knowledge development and the

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different kinds of competence required of the scientist. Working within a perspective has well established methods for externalizing its objects, and the scientist should be competent in those respects. Collins terms this "native competence". It is the kind of competence that makes meanings, perceptions, and acts of the native member follow naturally as a matter of course. However, changing or overturning the taken for granted rules or replacing them with a completely new set requires "interpretive competence" on part of the scientists. It lies in perspective taking: being able to reflect upon and renarrativize the familiar to open up new insights and understandings.

The stronger and more well developed a community's perspective is, the more useful a conduit model of communication and feedback becomes. As theories, puzzles, measures and accepted results are clarified and institutionalized within the community, the more likely it is that messages can be thought of as selections from a predefined set. The process by which new communities of knowing begin to form, however, and the processes of questioning and changing perspectives is not as well handled by a conduit model. Work that questions a perspective is of a different logic type than work within a perspective, and is primarily controlled by the dynamics of change in an open system rather than simple feedback (Wiener 1954, von Bertalanffy 1968, Bateson 1972). For this second-order knowledge work, the language games communication model is more helpful than the conduit model. Previously accepted understandings, measurements, and logics are in a sense "up for grabs". The perspectives behind ways of knowing of the organizational communities are being made in real time by the communities' members. The language of their communication is changing as their practices in forms of life are changing. Messages cannot be separated from the evolving context of making and using them as in the conduit model.

Two final themes from Kuhn that we will consider before drawing implications for knowledge work in organizations are the incommensurability between perspectives and the emergence of new perspectives. If members of a community create a strong perspective and do distinctive and important knowledge work, it will of necessity approach becoming incommensurable with other perspectives. They may use the same words as other communities of knowing, but they will use them to see things in different ways (Knorr-Cetina 1981). They will look at the same phenomena as another community, but will see different problems, different opportunities, and different challenges (Czarniawska-Joerges 1992). As Kuhn puts it, they will live in a different world from those in other communities of knowing. Data important to one are irrelevant to another, or are used for entirely different purposes. Arguments that persuade convincingly in one community of knowing have little or no weight in another. And the more developed and refined the community of knowing becomes, with an increasingly elaborate and detailed perspective, the more nearly incommensurable it becomes with others (Fleck 1979, Brown and Duguid 1991, Dougherty 1992). If the members' language games within one community of knowing fully understood and appreciated the positions of another, they would not be different communities and would not be doing distinct knowledge work.

Knorr-Cetina (1981) presents some grounded examples of how local communities of knowing develop their unique paradigmatic worlds and are resistant to changing them. In her sociological study of different research units, she found that research laboratories developed local interpretations of methodical rules, or a local know-how with regard to how to make things work best in actual research practice. Criteria for what mattered and what did not matter were neither fully defined nor standardized throughout the research community. Nor were the rules of official science exempt from local interpretations. Many important selections of the research process were locally driven, including questions of ingredients, instrumentation, and duration of experiments.

Implications of Kuhn and Knowledge Work in Science for Understanding Knowledge-intensive Firms

A first implication of Kuhn for thinking about knowledge-intensive firms is that the primary unit of analysis should be the community of knowing. The individual does not think in isolation and is not an autonomous origin of knowledge. A community of knowing is a language game and neither the language nor the knowledge created within it comes from the actor alone.

Secondly, a community of knowing requires perspective making in order to do knowledge work. Without a strong perspective it cannot produce important knowledge. A community's perspective develops by refining its vocabulary, its methods, its theories and values and its accepted logics through language and action within the community of knowing. This means that the community must, of necessity, have a space for conversation and action isolated from the larger organization.

Thirdly, the ability of one community of knowing to work jointly with another requires an ability to overcome the degree of incommensurability between them.

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This, of course, must be done without sacrificing the integrity and distinctiveness of their own perspective. Below we will explore this process of perspective taking in which the perspective of another can be taken into account as part of a community's way of knowing.

Fourthly, the conditions for change in the perspective of a way of knowing come from both the inside and from the outside. Inside the perspective, conditions of change come from the accumulation of anomalies as it is tested and elaborated. From outside the perspective, pressure for change comes from adherents drawn to a promise of the aesthetics, power or excitement of a new perspective. This suggests that memories of errors and anomalies are important to maintain and review openly, and that the isolation of communities necessary for their development should be punctuated by periods of interaction between communities.

Finally, new perspectives need to be nurtured and given protection from strong demands for performance. Of necessity, they will not be able to compete with an established perspective in another community's way of knowing.

For a knowledge-intensive firm, then, we look to its ecology of communities of knowing to understand its possibilities for doing knowledge work. Electronic communication can mediate how the open system of communities emerge, develop, elaborate, suffer crisis, and transform within it. Electronic communication can also mediate how communities of knowing interact and their capacity for perspective taking. It is to these processes of perspective making and perspective taking that we now turn.

Perspective Making and Perspective Taking in Communities of Knowing

The Process of Perspective Making

Perspective making is the process whereby a community of knowing develops and strengthens its own knowledge domain and practices. As a perspective strengthens, it complexifies and becomes better able to do knowledge work. Complexification is achieved cognitively through the use of paradigmatic analysis within a narrative framing of experience. It is a process of developing finer language games, and from a paradigmatic standpoint, more precise causal laws. Complexification signifies a movement from a global, undifferentiated naming to a more precise explication of constructs, where more coherent meaning structures are developed than preceding ones (Waddington 1957, Werner 1957). Knorr-Cetina (1981) proposed that scientific conceptual systems have to progressively complexify themselves over a period of time to successfully solve scientific problems. This implies the ability to respond to shifts and fluctuations in the novelty of the scientific problem domain by modeling the shifts themselves (Rubinstein et al. 1984).

A good example of complexification in perspective making is presented by Bradshaw (1992) in his analysis of the Wright brothers' invention of the airplane. He also illustrates the interweaving of narrative framing and paradigmatic analysis in the perspective making process. Bradshaw asks why were the Wright brothers so successful in conquering the challenge of manned flight, while many of their competitors with better training and resources failed? He answers that first, the Wright brothers narratively framed the phenomenon of flying using a different metaphor than their competitors, and second, they employed finer problem solving procedures. Whereas their competitors narrated flight with a "chauffeurs of the air" metaphor, telling how flying was akin to driving a car into the air, a group that included the Wright brothers narrated flight as being like "flying a kite". Many of the unsuccessful inventors had a propensity to construct complete aircrafts and then to test them by measuring distance and time in flight. To these designers, the airplane as a vehicle to be chauffeured was an assemblage of parts (wings, fuselage, propulsion, etc.) and developing an aircraft meant exploring possible designs for configuring these parts.

However, for the Wright brothers, the major concern was to understand how a kite flew, and to achieve its functions (lateral control, sufficient lift, reduced drag, etc.) in the airplane. They first isolated these functional problems and then proceeded to solve them one at a time. The pattern in their work was to explore solutions to subproblems using directed experiments. For example, a kite was built to explore lateral control and wind tunnel experiments explored lift and thrust. Through extensive testing of models, the Wright brothers "discovered an important error in aerodynamics overlooked by other investigators" (Bradshaw 1992, pp. 246–247). Only when each separate problem was understood and solved did the Wright brothers invest time and energy in building a new craft. The Wright brothers employed both narrative and paradigmatic modes of cognition in their perspective making, as they modeled and developed more complex and finer understandings of the workings of aerodynamic laws. In contrast, their competitors were exploring the possibility of flight with minimal understandings of aerodynamic laws, and relied on trial and error, hoping one of

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their models would fly, without having any conception of why. They lacked the strong perspective necessary to do important knowledge work.

The Importance of Narrative in Perspective Making

Perspective making within communities of knowing is a social practice in a form of life. For insight into how this process takes place in a community of knowing, we will return to Jerome Bruner's work on the role of narrative in constructing knowledge of self and world (Bruner 1986, 1990). Bruner argues that we must look to how actors make meaning of their experience through narrative if we are to understand the process of perspective making. Bruner, synthesizing studies of child development, language acquisition and concept formation, proposes an innate narrative capacity as the engine for our cognitive activity. "The typical form of framing experience (and our memory of it) is in narrative form. What does not get structured narratively is lost in memory." (Bruner 1990, p. 56) Paradigmatic thinking is an important part of our cognitive repertoire, but only a part. Narrativizing our reflexive monitoring and rationalization of conduct is not ruled by an abstracted logic. Within a community of knowing, a narrative explanation works not only because it is logically acceptable, but also because it is lifelike and plausible; it fits the culturally bound demands of a form of life.

In parallel with Giddens' structuration theory (Giddens 1976), Bruner emphasizes that when we narrativize experience, we also construct and validate the self. The narrator's perspective as an essential element in any story assures this. The self is always at stake in the individual's narrativizing of experience, because the self is at least the narrator (recognizing the canonical, indicating and explaining the anti-canonical, determining how the world should be) and often part of the story (being herself delineated as a causal agent with motives, intentions and values).

The importance of narrative has not gone unnoticed in organizational research. Clark (1972) explored the importance of sagas and Mitroff and Kilmann (1976) recognized the importance of myth. Myth and saga are important, but they can distract our attention from the way that human cognition operates almost continuously in a narrative, storytelling mode. We wish to emphasize that narrative is fully equal to paradigmatic analysis in the construction, maintenance and change of perspectives in an organization. We see them in a type of figure-ground relation in which paradigmatic, rational-analytic thought takes place in a context provided by narrative, and narratives are constructed against a backdrop of paradigmatic understandings in a kind of "genuine union" of the two modes (Boland and Pondy 1983). The rational analytic elements of a perspective in a community of knowing are a product of storytelling as much as they are a medium for it.

More recently, the role of stories and storytelling in the day-to-day functioning of organizations has been addressed by Boje (1991). The constructive, changing quality of stories documented by Boje in his focus on situated practice is a major step toward the position we argue for here. He moves beyond the mythic view of the story as an "object", found in Martin and Meyerson (1988), McConkie and Boss (1986), and Gabriel (1991), and turns our attention to the community dependent process of producing the story.

When scientists experience anomalies within a perspective they often turn to narrative in an attempt to make sense of the noncanonical observation. Science, and scientific papers documenting experiments and theories, in retrospect, always seem paradigmatic, linear and certain. This is partly dictated by the social conventions of what good science is (Knorr-Cetina 1981). However, an examination of the informal discourse of scientists presents another picture altogether. Highly variable and inconsistent accounts of action and belief are very much the norm. Actors continually construct and reconstruct the meaning of their scientific world through the formulation of divergent narrative accounts. As Mulkay et al. (1983) summarize: "Unless we understand how actors socially construct their accounts of action and how actors constitute the character of their actions primarily through the use of language, we will continue to fail... to furnish satisfactory answers to the long-standing questions about the nature of action and belief in science" (pp. 195–196).

Others such as Nersessian (1992) and Eysenck and Keane (1990) have also pointed out the important role of narrative in scientific reasoning. Thought experiments are a prevalent form of scientific reasoning in which the scientist imagines a sequence of events and then narrativizes the sequence in order to communicate the experiment to others. Einstein is supposed to have performed thought experiments based on stories about riding on a light beam and traveling in elevators. Rutherford in his investigations of the structure of the atom is reputed to have imagined the electrons as revolving around the nucleus in the same way as planets revolve around the sun (Gentner 1983). Galileo (Galilei 1638; cited in Nersessian 1992) likewise used a thought experiment in arguing against the Aristotelian theory that heavier bodies fall faster than lighter ones.

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The Process of Perspective Taking

In knowledge-intensive firms, competitive advantage and product success are a result of collaboration in which diverse individuals are able to appreciate and synergistically utilize their distinctive knowledge through a process of perspective taking (Dougherty 1992, Purser et al. 1992, Nonaka 1994, Henderson 1994, Brown 1991). Duncan and Weiss (1979, p. 86) summarize this process as one in which: "The overall organizational knowledge base emerges out of the process of exchange, evaluation, and integration of knowledge. Like any other organizational process, ... [i]t is comprised of the interactions of individuals and not their isolated behavior." It requires a process of mutual perspective taking where distinctive individual knowledge is exchanged, evaluated, and integrated with that of others in the organization (Nonaka and Johansson 1985, Shrivastava 1983).

Much of social behavior is predicated upon assumptions an actor makes about the knowledge, beliefs and motives of others. This is the beginning of the process of perspective taking, and is fundamental to communications. In any communication, the knowing of what others know is a necessary component for coordinated action to take place (Bakhtin 1981, Clark 1985, Krauss and Fussell 1991). As Brown (1981) observed, effective communicating requires that the point of view of the other be realistically imagined. Others such as Rommetveit have affirmed this point: "An essential component of communicative competence in a pluralistic social world ... is our capacity to adopt the perspectives of different others" (Rommetveit 1980, p. 126). The fundamental importance of taking the other's point of view into account is seen in Mead (1934) who referred to it as taking the attitude of the other and equated our ability to be fully human with our ability to maintain an inner conversation with a generalized other.

In order for perspective taking to proceed, the diverse knowledge held by individuals in the organization must be represented in its uniqueness, and made available for others to incorporate in a perspective-taking process. Valuing diversity of knowledge by enabling each type of expertise to make unique representations of their understandings, and assisting actors with different expertise to better recognize and accept the different ways of knowing of others, is the foundation for perspective taking. It can be encouraged by communication systems that include an emphasis on supporting the distinctive needs of separate communities of knowing.

The task of taking each other's knowledge and background into account is a complex process, and can frequently break down. For example, Purser et al. (1992) did a comparative study of two knowledge intensive product development projects of equal technical complexity in a high-technology firm. One project succeeded while the other failed. Two essential factors accounted for the differences in results between the two projects. The first was a higher incidence of barriers to knowledge sharing among the members on the failed project team. But behind this first factor was a second, causal factor of failed perspective taking. Team members were unable to surface and reconcile dissimilarities in their knowledge and cognitive frames of reference. Failure to achieve perspective taking through depicting and exchanging representations of their unique understandings dramatically reduced their possibilities for successful team knowledge work.

Perspective taking involves a variety of inferential and judgmental processes. Individuals may utilize an assortment of techniques including stereotypes and inference heuristics to estimate what others know. Such heuristics can induce systematic errors and biases (Kahneman et al. 1982, Nisbett and Ross 1980). The ready availability of the actor's own perspective may lead the actor to overestimate the likelihood that the perspective will be shared by others (Steedman and Johnson-Laird 1980). This false consensus effect, in which subjects assume that others are more similar to themselves than is actually the case (Ross et al. 1977) is a form of bias particularly relevant to the perspective-taking process. This heuristic leads to overestimates of the extent to which a person's knowledge is shared by others, and studies support the existence of such a bias (Dougherty 1992, Krauss and Fussell 1991).

Dougherty (1992) provides an insightful analysis of breakdowns in the perspective-taking process due to actors' inability to surface and examine their differing interpretive schemes. She found that in unsuccessful cases of new product development, the key players interpreted and understood issues around technology-market linking and new products in qualitatively different ways from each other and were not able to reconcile these differences. The differences in interpretation centered around three themes. The first theme was what people see when they look into the future, including which issues are seen as most uncertain. What they saw seemed uncertain, while what they did not see, did not seem particularly uncertain or even noteworthy. The business planner worried about positioning against competition while the field person worried about iden-

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tifying the right potential customers. A second theme characteristic of failed teams involved people's understanding of the development process itself. People not only ignored the activities of others and failed to argue over relative priorities, they glossed over the concerns of others, and tended not to appreciate their complexities. A third theme characteristic of failed teams involved the different "thought worlds" of team members. For new product development, different departmental thought worlds were coherent and consistent within themselves. This reduced the possibility for creative perspective taking, since members of a department thought that they already knew everything (Dougherty 1992). As lucidly worded by Dougherty (1992), "Nor is the problem like the proverbial set of blind men touching a different part of an elephant. It is more like the tales of eye witnesses at an accident, or of individuals in a troubled relationship—each tells us a complete story, but tells a different one" (p. 191).

In summary then, the problem of integration of knowledge in knowledge-intensive firms is not a problem of simply combining, sharing or making data commonly available. It is a problem of perspective taking in which the unique thought worlds of different communities of knowing are made visible and accessible to others. Making explicit representations of one's knowledge and understandings to exchange with others enables one to better appreciate the distinct ways of knowing that those others will attempt to communicate. In order to integrate knowledge through perspective taking, communication systems must first support diversity of knowledge through the differentiation provided by perspective making within communities of knowing. Only after a perspective is differentiated and strengthened can it be reflected upon and represented so the actors in other communities of knowing have something to integrate through a perspective taking communication.

Implications for Electronic Communication Systems and Policies

The design of electronic communication systems affects how organization members are able to engage in perspective making and perspective taking and thus build communities of knowing. In knowledge-intensive firms, the problem of designing systems and policies for electronic communication is a problem of providing an environment in which an ecology of communities of knowing can develop through complexification over time. In perspective making, a community of knowing complexifies by enriching and refining its distinct perspective and way of knowing. Its categories for partitioning the world become more numerous and subtle; the distinctions it makes as to the appropriateness of problem statements, measures, tests and logics for a given situation become more esoteric and precise. In perspective taking, complexification involves an increased capacity for communities of knowing to take each other into account within their own language games, and to construct new language games for their interaction. The development of complexified perspective taking represents the integrative capacity of the ecology of communities.

These two dynamics, perspective making and perspective taking, are instantiated only through speaking and acting in a community. Electronic communication media provide an important part of the physical and symbolic environment available for engaging in the forms of life of the organization's communities of knowing, but only a part. Other concerns such as task, technology, structure, culture, reward systems and leadership style, all play a role in mediating the type of language games that will emerge. Although the entire set of these issues is beyond the scope of this paper we will discuss some of the issues further in the next section when we describe some examples of communication systems that would support these processes. Here, we will concern ourselves with presenting a certain sensibility as a way of thinking about how electronic communication media provide conditions for the two dynamics of perspective making and perspective taking.

A first element in the sensibility we propose is to recognize the strengths and weaknesses of the models of communication and cognition we are drawing upon in designing these systems. The conduit model, with its assumption of messages that carry unambiguous meaning if they are coded and decoded error free, is a good model for thinking about the communication of well established elements in a community of knowing's vocabulary and methods of practice. Communication within established community routines can and should be addressed with a conduit model. The knowledge is semi-fixed and reliably interpretable within the community, so the assumptions of a conduit model match the communication needs well. The organization-wide community where culture and identity are acted out and a sense of institution is developed is also well suited to a conduit model. It is appropriate for questions of broadcast bandwidth and for development of a firm-wide vocabulary. Recent research in corporate

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strategy emphasizing the importance of shared interpretive schemes (Bartunek 1984, Ranson et al. 1980), common visions (Collins and Porras 1991, Bennis and Nanus 1985) or shared strategic image (Hamel and Prahalad 1991, Bertado 1990) are examples of this type of communication at the level of the organization as a whole.

The symbolic quality of this culture-building communication, with its reliance on evocative images rather than precise language is somewhat at odds with the conduit model, but can generally be adequately handled by redundancy or repetition. The conduit model can support activities that broadcast and reinforce important symbols, stories, and exemplars which become commonly available to members of the community as a whole and incorporated in their language games. Very little in the way of distinctive, organizational knowledge work is accomplished at the cultural level of the community as a whole. It is better thought of as a backdrop against which the more esoteric language games of more locally situated forms of life are played out.

The conduit model, however, does have some distinct weaknesses. The perspective-making process requires a nurturing of emergent communities of knowing, and requires a respect for the uniqueness of a local community's distinctive form of life. The conduit model stands in opposition to this requirement with its emphasis on developing data models, decision models and communication formats that are common and shared across the organization. Current research in information technology often reflects this inappropriate use of the conduit model with its emphasis on enterprise modeling and data architecture with a single, unified data structure (Scheer 1992, Deng and Chaudhry 1992, Targowski 1988, Richardson et al. 1990, Chen 1976). Similarly, model management systems concern themselves with unifying the diversity of knowledge in management decision models through a variety of meta-level integrative techniques (Geoffrion 1987, Dolk 1988, Elam and Konsynski 1987). Finally, it seems that a principal concern with end-user computing is the reduction of diversity and the establishment of standards and common structures for data and models (Brown and Bostrom 1989, Munro et al. 1987, Rivard and Huff 1988). We disagree with these calls for commonality in vocabulary and knowledge practices, and call instead for recognizing the importance of strong perspective making and differentiation of knowledge among a firm's communities of knowing.

Electronic media based on the wrong model of communication can hinder perspective making and taking in interactions among communities of knowing. An example from research on new product development processes will illustrate the point. The task for this new product development team was to choose a nonhuman analogue such as a rat, rabbit or primate model with which to conduct tests of a new drug compound they were developing for certain afflictions associated with the human intestine. The team had members representing different disciplines such as life sciences, chemistry, toxicology and biopharmaceutics. There were differences of opinion as to the nonhuman analogue most appropriate for the task. As a result, the team members resorted to a popular groupware product and its voting system to reach a consensus. Based on the voting procedure, a rat analogue was chosen. Unfortunately, the rat was not suitable for the task of representing the human intestine, but the team only found that out at the human clinical trials. The poor choice had by then cost the company considerable expense and three years of development time. The groupware voting system, with its emphasis on finding consensus, hampered the team members from first strengthening and representing their own perspectives and then engaging in a dialogue of perspective taking with each other. The groupware helped reduce noise in the communication and provided an illusion of certainty. What was required, however, was a language games model of communication to complexify the unique understanding of each through dialogue within their community of knowing. Then, they should have employed a technology that would support reflexivity, and creation of a visible representation of their unique knowledge that would have enabled perspective taking among them.

The language games model also has its strengths and weaknesses. One strength is helping us think through issues of perspective making with its insistence on the primacy of speaking and acting in a local community. Electronic communication media may reduce bounds of space and time for such communities (Giddens 1991), but the language games model can help us to recover the importance of enabling and protecting local logics, practices and vocabularies (Jönsson 1992), even within dispersed communities. The language games model is also useful for emphasizing the need for isolation to create identity in a community of knowing. Time for participating in communities is limited, and identified spaces for members to engage the community's language games and develop its perspective are an important condition for its persistence and development.

Schön (1979) provides a vivid example of the need to respect the importance of communication in local com-

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munities from the history of town planning. When town planners saw their task as a need to cure a blighted area, they intervened with all manner of planned renewals to tear down and remake whole sections of a city, often disturbing the patterns of communication within neighborhoods. But their efforts went terribly wrong, again and again, until they came to see such areas of town not as blighted, but as folk communities with a strong network of communication and support that sustained them quite well in the face of substantial difficulty. The problem for the town planners then became how to design systems and policies that would enable that emergent capacity of the local communities of knowing to strengthen and self-organize. We hope to build such an awareness into our approach to thinking about electronic communication from the start.

The language games model is also a good basis for thinking about narrative in a community of knowing. It emphasizes that narrative is experientially grounded and that it is a search for ways to make issues and events of interest to the community sensible within its way of knowing. The causal implications and action sequences in narrative are the source of perspective making for the community, as members reflect upon the underlying logics, values and identities of the community of knowing.

A major limitation of the language games model is the "epistemic inhibitions of its own paradigm" (Rubinstein et al. 1984). The stronger a community of knowing is supported by communication systems reflecting a language game model of communication, the stronger is perspective making complexities, and the less able it may become to allow for other ways of seeing. A vivid example of this dynamic is presented in Dougherty's (1992) field study. The various functions involved in the product development process agreed on the need for the product to be market oriented. However, in the language games of the research and development group, market orientation meant product specifications and technical features: the market is what the product can do. For the manufacturing people, on the other hand, a market-oriented product was a durable and reliable one. Lowering the number of features and specifications would improve its market orientation. Further, the marketing group considered customer needs on a customer by customer approach. For the planning group, to be market oriented meant to position the product in the right market niche. They did not worry about product features, customer needs, or reliable product performance. This is where the reward systems and culture of the organization become important in maintaining a balance between perspective making and perspective taking. One important design element in this regard is the establishment of an issue-specific space for perspective taking between strong communities of knowing to take place. Isaacs (1993) refers to this space as a container for dialogue, and we will think of it as a forum within an electronic communication system.

Table 2 Two Models of Communication and Their Relative Merits for Supporting Electronic Media in Systems of Knowledge Work

CONDUIT MODEL
Strengths
• Reliable and precise channel for communicating well established elements in the vocabulary of a community of knowing and techniques of practice.
• Can facilitate culture building, organization-wide integration activities through shared and common images.
Weaknesses
• Does not value diversity; emphasis on uniform data and decision models and communication format across the organization can hamper the emergence of unique communities of knowing.
• Inappropriate for supporting the narrative forms of cognition that are central to the perspective making process.
• Common vocabulary and set of decision models denies the importance of perspective taking.
LANGUAGE GAME MODEL
Strengths
• Facilitates perspective making by virtue of its insistence on primacy of speaking and action in a community of knowing.
• Underscores the importance of enabling and protecting local logics, local practices and local vocabularies.
• Implicates the importance of narrative in a community of knowing.
• Emphasis on narratives enables reflection on underlying logics, values and identities of the community of knowing.
Weaknesses
• Increasingly specialized language games results in epistemic inhibitions (imposed by each community's unique paradigm) and comes in the way of perspective taking.
• May heighten conflict among communities.

As we have seen, both models have strengths and weaknesses that primarily relate to their role in perspective making, but both models alone have distinct weaknesses with respect to perspective taking (see Table 2). The conduit model, with its emphasis on a commonly available and exhaustive set of messages and coding techniques denies the importance of perspective taking. A common vocabulary and set of decision models presumes that each member of the organization participates in the same way of knowing and needs no

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special support for opening a space within the dialogue of their own local community for taking the perspective of another. The language game model, as we have just seen, also does not help in thinking about perspective taking because of its emphasis on speaking and acting within a form of life and its increasingly specialized language games. Another aspect of communication must be considered for thinking about perspective taking, one that is absent or overlooked in the conduit and language games models. This aspect concerns how the richness of representations and the reflexive capacity of a communication system enables the creation and exchange of boundary objects (Star 1989, 1993), which we will discuss in the next section.

Reflexivity, Boundary Objects and Perspective Taking

In our discussion of perspective making in communities of knowing, we saw the individual speaking and acting within the community's form of life. For perspective taking we need a shift in emphasis, to focus on the individual's ability to make his or her own understanding visible for self-reflection. Once a visible representation of an individual's knowledge is made available for analysis and communication, it becomes a boundary object and provides a basis for perspective taking.

Representations of ways of knowing from members in one community can then be exchanged with members of another, who, having themselves engaged in an effort to make rich representations of their understandings, can now engage in communication about the perspectives of another. This taking of the other into account, in light of a reflexive knowledge of one's own perspective, is the perspective-taking process.

Perspective taking is never a one-to-one mapping of meanings. Members of the same community of knowing will not have full consensus, and members of different communities cannot simply adopt the meanings of another. But as Star (1989, 1993) has observed, scientists within and between communities do find a way of bringing their distinctive perspectives into dialogue through the construction and discussion of boundary objects. An indexed collection of items, a map, an idealized image, or a label can all serve as boundary objects around which sense making can take place. Such boundary objects do not convey unambiguous meaning, but have instead a kind of symbolic adequacy that enables conversation without enforcing commonly shared meanings. Boundary objects can, of course, be a center of intense conflict as easily as one of cooperative effort. Creating and reshaping boundary objects is an exercise of power that can be collaborative or unilateral. Nonetheless, in the absence of boundary objects, the possibility of perspective taking is limited and the opportunity for knowledge work in the firm is reduced.

Reflection on our own perspectives is difficult and often not attempted. As Rubinstein et al. comment, "If practicing scientists were more conscious of the processes of science, it would go a long way toward circumventing the epistemological inhibitions imposed by paradigms" (1984, p. 138). Collins (1983) also notes the hidden nature of such processes. He argues that many times it is only when the rules go wrong that the scientist questions the nature of his or her interpretation. "Otherwise, our giving of meaning to objects—our interpretive practices are so automatic that we do not notice that any interpretation is involved" (Collins 1983, p. 90). In Schutz's (1964) terms, reflexivity is the ability to periodically suspend our natural attitude and notice the matter-of-course, taken-for-granted ways in which our communities of knowing are constructed and interpreted, which can open possibilities to change them (Collins 1983). Rubinstein et al. (1984) posit that becoming aware of, evaluating, and modifying perspectives is required for maintaining adaptive knowledge. There are many possible forms for boundary objects that can represent knowledge from one community for perspective taking by another, including physical models, spreadsheets, or diagrams. We will present two examples that could be incorporated in communication systems: cognitive maps (Axelrod 1976, Huff 1990, Boland et al. 1994, Weick and Bougon 1986, Weick 1990, Eden 1992), and narrative structures (Tenkasi and Boland 1993, Mulkay et al. 1983, Knorr-Cetina 1981).

A cognitive map is a directed graph whose nodes represent concepts or factors in the actor's decision domain, and whose arcs represent cause-and-effect relationships between source and destination nodes (Boland et al. 1992, Burgess et al. 1992). Figure 1 presents an example of a cause map depicting a physician's understanding of quality in medical care. Creating this map is an exercise in perspective making, and exchanging it with actors from other communities of knowing within the hospital makes it a boundary object and opens the possibility for perspective taking in the search for quality in medical care. Building such a map can be evocative for the map creator, as well as informative to its recipient. Creating cognitive maps can reveal personal cause-and-effect logic, which in turn forces the individual to confront the reasonableness and validity of previously tacit cause-effect assumptions

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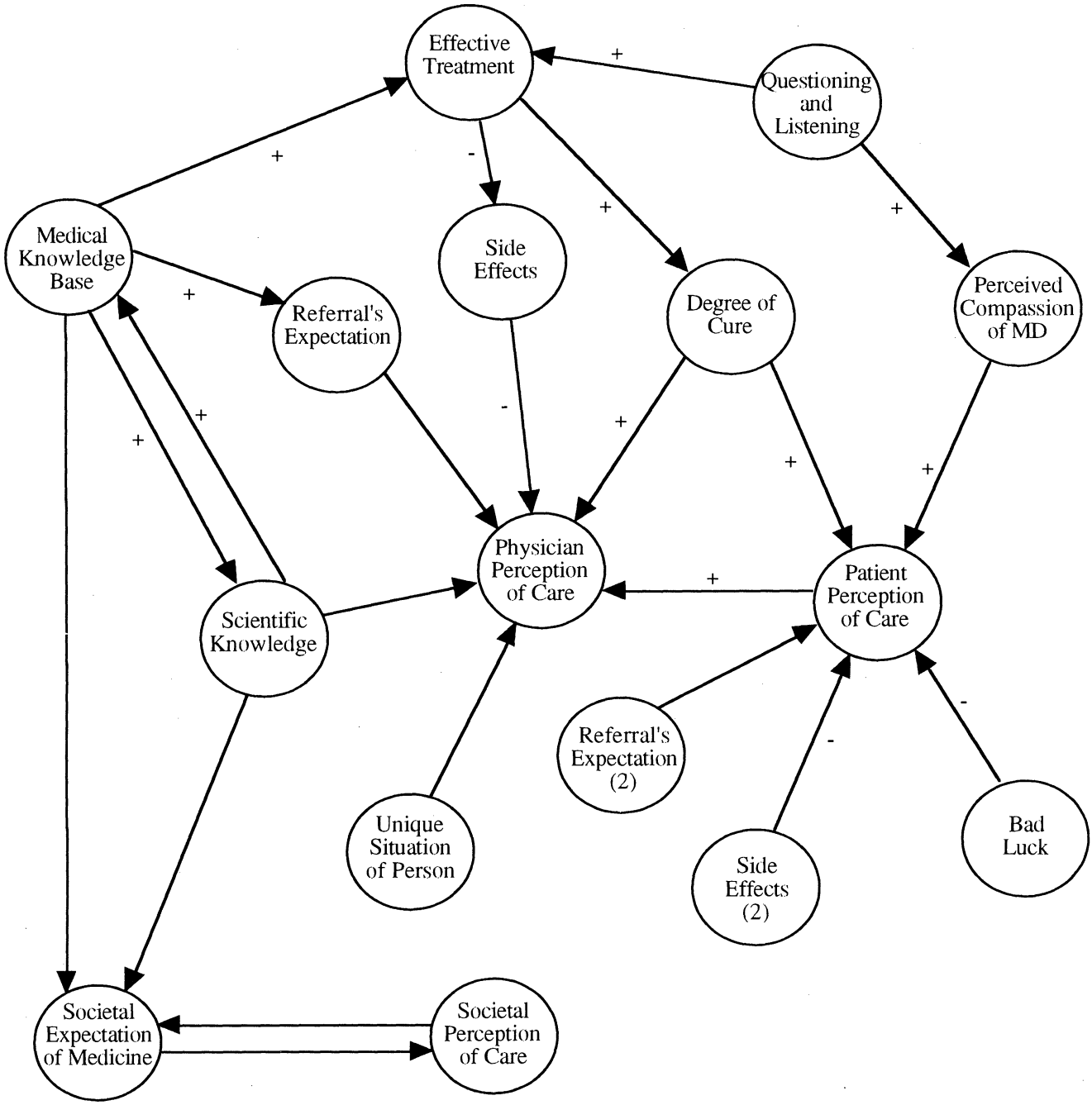
Figure 1 A Physician's Map of Quality in Medical Care



Note: Arcs without positive or negative relations shown indicates uncertainty of causal effect.

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(Fiol and Huff 1992, Weick and Bougon 1986). Creating maps of one's understanding of a problem domain and reflecting on them can also facilitate new and more complex understandings of the situation at hand, improving the chances for scientific success (Weick 1990).

Cognitive maps are a good beginning for making rich representations of an understanding within a perspective. But a key ingredient for communicative success is a way to link elements and relations in a map, as well as the map itself to unstated elements and assumptions of the perspective. That is, the knowledge representation grows richer as context is added, layer by layer, to individual elements in the cognitive map. This suggests a hypertext or hyper media communication environment in which actors find a self-reflective space to build rich knowledge representations whereby factors in a cause map are linked to underlying beliefs, values or assumptions in the form of spreadsheets, notes, or graphs or other cause maps (Boland et al. 1992, 1994).

Another kind of boundary object that can serve as a focal point for perspective taking is a narrative structure. Narratives, if bracketed and approached for analysis with an interpretive stance can also provide elements of the reflexive quality we see as necessary for perspective taking. Narrative analysis can reflexively give access to the implicit and unstated assumptions that are guiding perspective making, and in so doing help enable a perspective taking process. We will demonstrate this by first presenting a narrative from an actual incident collected during field work in a pharmaceutical company, and then analyzing and interpreting its narrative structure.

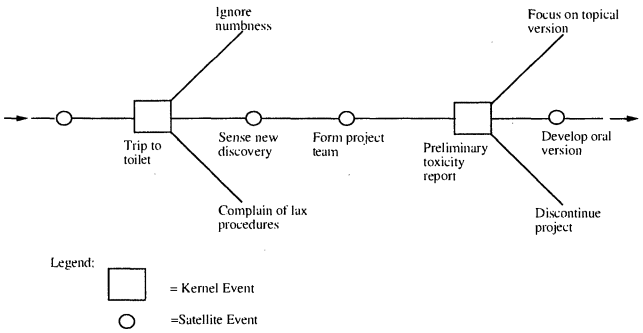
The Story of Norman, a Chemist

Norman stood up from his work bench in mid-morning and went to the men's toilet where he used the urinal. Shortly after returning to his work bench, Norman felt a numbness in his penis. He was startled, but he immediately thought that trace amounts of the XV75 hypertension compounds he had been working with that morning had been on his hands and may just be a powerful topical anesthetic.

He told two colleagues about this potential discovery and created an informal team to explore its possibilities. After about six weeks, he obtained formal approval from the Assistant Director for this project and his team. At this stage, the idea was to go for a topical application of the compound. After several weeks, Norman went to see the Assistant Director to inform him of a metabolic study of the compound in a cell culture that showed some indications of toxicity. He learned from the Assistant Director that a market study had just been completed showing that an oral form of the drug would be very successful and highly profitable, whereas the topical version would actually have a very limited market potential.

The Assistant Director told Norman that the toxicity report was uncertain and that he should reorient his team toward an oral form of the compound. "Think positive," he told Norman. "We have to move on and we have to take risks if we expect to reap rewards." Market projections of the proposed oral form of the drug were presented to the Executive Committee of the corporation, and were enthusiastically received.

Figure 2 Narrative Structure of the Story of Norman



Chatman (1978) presents an elaborate framework for diagramming narrative structure, and we can use some of his techniques in a simplified form to show how narrative analysis can surface assumptions and aid reflexivity in perspective making. In diagramming the structure of events in a story plot, Chatman (1978) distinguishes between major and minor events. He calls major events kernels and shows them as a square in his diagrams. Chatman refers to minor events as satellites (1978, p. 54) and shows them as circles in his diagrams. Satellites are events which enrich the story aesthetically, but are not crucial to the plot. Satellite events "necessarily imply the existence of kernels, but not vice versa." (Chatman 1978, p. 54). Figure 2 is a partial diagram of the plot of Norman's story.

In diagramming the first part of this story, we have identified two kernels, treating the other elements as satellites. Other readers might interpret the structure differently, but that is what keeps an interpretive conversation lively. The two kernels we isolate are: the trip to the toilet and the initial toxicity report. For purposes of an example, we will provide a brief analysis of the two kernels.

First Kernel: A Trip to the Toilet. From this kernel, the story could have taken several different paths. First, Norman could have simply returned to his work station, and waited for the numbness to go away. Eventually it would have and this episode would be

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over. Or, Norman might have become enraged that no one had warned him that the XV75 compounds could have this effect. After much finger-pointing and the establishment of stricter chemical handling policies, this story would also eventually end without a new project being instituted. Instead, Norman used the event of the numbness to engage in perspective taking, looking at XV75 and his own experience from a perspective other than that of hypertension or personal discomfort. In so doing, much about the canonicallity of the world of the lab is revealed.

First, the way the kernel is resolved shows that it is canonical to be open to the meaning of an unexpected event, that science will take strange twists and the seemingly irrelevant could be the basis for an important new discovery. It is canonical in this lab for a scientist to take any event, no matter how bizarre or personal, and view it as a potential for creating new knowledge. Second, we learn that it is canonical to see the event of numbness as an experiment on oneself. This lesson of the narrative is supported by field work which confirmed that self-experimentation is a frequent practice among the lab workers. The first kernel, then, can tell us much about the values and lab practices in this community.

Second Kernel: *The Preliminary Toxicity Report.* In this kernel, we can imagine several alternatives that did not happen; the project could have been focused on a topical version only, because of the risk of toxicity, or the project could have been dropped altogether. Instead, canonicallity is restored by a call for positive thinking and the lure of a large profitable market for an oral version. The tension between the market/profit-seeking perspective in product innovation and the toxicology perspective is lopsidedly made canonical in favor of the market. In this kernel there is a distinct failure of perspective taking on the part of the Assistant Director. As a result, the possibilities for knowledge creation in this network are diminished, the framing of the problem is constrained, and opportunities for a complex exploration of how risk, rewards, toxicity and efficacy can become a topic of open dialogue are diminished.

There is obviously more that could be done in reading the canonicallity of the lab in these kernels, but these examples should suffice. The important point is that the kernel is a "hinge" in the structure of the story and interpretation of the kernel gives access to what is canonical in a community that may be difficult to surface otherwise.

Implications

Perspective taking through boundary objects is a relatively unexplored frontier in electronic communication. One can expect that tools and media to support reflexivity, representation of knowledge structures and their exchange with others in a perspective-taking process will increase over time. Paradoxically, it is a kind of communication with others that grows out of an improved communication with self. Communication with one's self is the basic stance of reflexivity; an inner conversation that builds and reflects upon a representation of one's understanding of a situation. Being able to do so implies that the perspective making in a community of knowing has progressed far enough to provide a sufficiently strong perspective to reflect upon. Having had this type of communication with one's self, the actor is equipped to enter into a new kind of communication with others, that of perspective taking. We now present some examples of the types of electronic communication systems suggested by our analysis thus far, by describing an idealized firm that displays strong capacities for perspective making and perspective taking.

Some Examples of Designing Communication Systems to Support Perspective Making and Perspective Taking

The implications of using information technologies to provide support for perspective making and perspective taking are best understood as the interrelationship of organizational, cultural and technological elements. This insight was evident in the first experiences with industrial research laboratories (Marcson 1960, Carlson 1992), in the Manhattan project (Davis 1969) and also in recent studies of new product innovation (Law and Callon 1992, Carlson 1992, Dougherty 1992). In keeping with an emphasis on how a narrative and language game orientation can be interweaved with paradigmatic reasoning, this section will present a plausible, but admittedly utopian form of a knowledge intensive firm. In this idealized firm, a reflexive hermeneutic attitude (Gadamer 1975, Boland 1993, Boland et al. 1994) and an open recognition of language games and the process of perspective taking is assumed to be well established. We will first describe the technological, organizational and cultural backdrop for such a hypothetical knowledge-intensive firm of the near future. We will then describe some applications of information technologies that could be employed for perspective

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making and perspective taking by its communities of knowing.

Technologically, we expect to see that computing, imaging and communication devices have become ubiquitous. The information environment in this hypothetical firm is a seamless integration of multimedia devices for collection, storage, processing and display. The organization is replete with systems based on the conduit model and language games model. Once certain kinds of knowledge are established and the perspective of a community of knowing becomes mature, the decision routines are embedded in project management and other kinds of software, although such decision premises are always subject to question and revision. Graphics, texts, models, audio and video applications are all radically tailorable to a user's needs. Hyperlinks from an element in any one application to elements in any other application are fully supported, making contextually rich, complexly layered representations the norm. Groupware is highly developed, with multimedia meetings, and discussion groups in a wide variety of issue forums. A sophisticated vocabulary of electronic forms for initiating, replying or commenting on decisions models and discussion topics has emerged through an open process of structuration (Giddens 1979).

Organizationally, the firm is characterized by a critical density of interdependent knowledge communities. There is a post-modern (Harvey 1989) quality to the organization, and groupware communication processes are marked by multiple voices with shifting patterns of interest, giving a sense of a fragmented, almost chaotic communication environment compared to the predominantly hierarchical one of the late 1980s. The organization uses lateral teams extensively in which the vertical authority structure plays a muted role while the principle value adding activities of knowledge creation and knowledge application are carried out in a changing mosaic of lateral project teams. Because of the firm's strong lateral form and collaboration-based reward structure, parochial interest groups and fiefdom-like power bases which used to subvert efforts at free and informed communication have largely disappeared. Individuals who play important liaison roles between strong communities of knowing use their newly developed skills as "semiotic brokers" (Lyotard 1984) to help facilitate the perspective-taking process.

Culturally, the idea that doing work in a knowledge-intensive firm means perspective making and perspective taking in communities of knowing has taken hold and has shaped both individual and group identities. Individuals have a reflexive awareness of their paradigmatic as well as their narrative modes of cognition. The culture reinforces an awareness of the individual's capacity to step outside of a message stream and engage in meta communicative analysis (Bateson 1972). Members of the firm are used to taking an interpretive stance, playing with possible meanings, searching for underlying structures, questioning the social construction of new nouns and verbs in their language games. They enter into and make readings of communication episodes with an open awareness of the hermeneutic circle in which they tack back and forth from an interpretation of the larger context of a perspective to an interpretation of the detailed elements of the message at hand (Palmer 1969). Their hermeneutic attitude means they avoid debate in favor of dialogue unless compelling reasons call for a dialectic communicative process. They realize that debate is a win-lose polarizing strategy that rarely results in true synthesis or creative insights. Dialogue, in contrast, is a mutually reinforcing, working together through language. It is a realization that we can assume a perspective-taking orientation and benefit from opening ourselves to the horizon of another.

Within the organizational, cultural and technological environment sketched above, communities of knowing are using advanced groupware facilities to conduct meetings, construct multi-author documents, and coordinate their promises and deadlines, all with the capability to access data and knowledge through a worldwide network of knowledge repositories. As is true today, the groupware systems are composed of a series of forums which serve as "containers" for dialogue on certain topics, issues, concerns, projects or tasks. Forums reflect the way the knowledge work is being focused, and the kinds of knowledge structures that are emerging in the firm, and are thus one avenue into its communities of knowing. Individuals participate in many forums in an evolving pattern. The lateral groups to which they belong and their unique expertise defines the types and kinds of forums in which they participate.

What takes place in these forums are language games. The mode of cognition is a mixed one in which paradigmatic reasoning is interwoven with stories and narration. The applications of advanced information technologies for perspective making and perspective taking that we describe below depend upon there being a higher level of reflexivity in knowledge intensive firms than is presently the case. These communication systems depend not only on talking about issues and problems within a groupware environment, but on talking about how they are talking (Bateson 1972). It depends upon a critical hermeneutic attitude in which

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the strangeness and multiple possibilities for making meaning in our conversations are constantly in our awareness (Gadamer 1975, Ricoeur 1981, Boland 1993).

As groups form and reform in a knowledge-intensive firm employing a lateral organization structure, we anticipate five new classes of electronic communication forums as examples of ones that would enhance the processes of perspective making and perspective taking. Within each class there would be several different types of forums as we will discuss below. The five new classes of forums we propose as examples are:

1. Task Narrative Forums;
2. Knowledge Representation Forums;
3. Interpretive Reading Forums;
4. Theory Building Forums;
5. Intelligent Agent Forums.

Task Narrative Forums

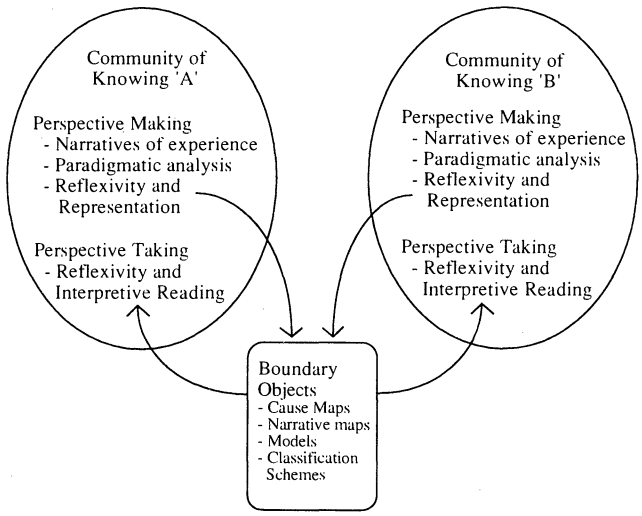
This type of forum has been envisaged by Brown and Duguid (1991) and Galbraith (1994) among others, and is an implicit recognition of the importance of narrativizing our experience and sharing the narratives with others in our community. Through narrative, the community constructs its practices and its social world by building and restoring its sense of the canonical. Narrative, by making the implicit and the tacit inferable to the reader or the listener, is a critically important first step in achieving perspective taking within and among communities of knowing. Because these task narratives would be multimedia, and include video and audio, they enable the benefits of learning by experience to extend beyond normal constraints of space and time.

Task-narrative forums serve as perspective making for those creating the narratives and also serve as a perspective-taking experience for those reading the narratives. The narrative is always incomplete and the reader must "read into" the story in making it sensible. Bruner (1990) refers to this "reading into" as a subjunctive process and is a primary vehicle for opening oneself up to the perspective of another and making real its possibilities for seeing the world differently.

Knowledge Representation Forums

Current groupware enables linking from a text document to a spreadsheet, decision model, graphic depiction, or picture. Once a document is hyper-linked in this way, the context it carries with itself is enriched and its possibilities for interpretation are increased. So we are already used to seeing a message with other documents linked to or embedded within it. A knowledge representational forum, in contrast, is one which focuses on the understanding that lies behind such

Figure 3 Perspective Making and Perspective Taking



complex documents. It is a forum that captures a community's cooperative efforts to reflect upon, interpret and depict an understanding of their situation to themselves.

It is not a problem-solving or task-practice forum so much as a sense-making forum in which the objects of discussion are visual representations of their understanding of a situation, a problem or an objective. It is an openly reflexive forum in which communities of knowing explicitly talk about their understandings. Such forums could use storyboards in which still or animated pictures are assembled in a sequence, in a kind of visual depiction of an understanding, or these forums could use cause maps as in Figure 1, or other diagrams and models for representing an understanding.

Like narrative forums, representational forums serve as a perspective-making experience for those constructing, revising, or commenting on an emerging representation within a community of knowing. They also serve as a perspective-taking experience for those who read them with a hermeneutic attitude of engaging the horizons of another thought world (see Figure 3).

Interpretive Reading Forums

Whereas representation forums are overtly reflexive in that participants are trying to reflect upon their current state of understanding of some issue, interpretive reading forums are a space for reflecting upon the assumptions and meanings revealed by the communications in other forums. In this forum, participants are subjecting other texts to re-readings in hopes of portraying the tacit and implicit meanings characterizing a community

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of knowing, their own or others' (Czarniawska-Joerges and Guillet de Monthoux 1994).

Discussions in this forum could resemble dialogues of literary criticisms in which critical-reflexive readings are made of the streams of entries in other forums. Eventually, re-readings could even be made of the dialogues in the interpretive reading forum itself, as layers of reflexivity begin to compound (Ashmore 1989).

In addition to interpretive essays, such a forum would also be used for discussing the narrative structures in the task narratives forum and in the narrativization that is evident in all other forums as well. Here, the diagramming of narrative structures, the isolation of kernels, and the unpacking of how the canonical and noncanonical are revealed for different communities of knowing would take place.

Another type of forum within this class could be focused on words and might be known as a word-talk forum. This would be another type of reflexive analysis in which words (new words, especially nouns and verbs, as well as familiar ones) were systematically considered as to their changing meanings and uses, their shifting contexts and connotations, and the implicit and tacit assumptions they reveal.

The interpretive reading forums discussed above are the most explicitly hermeneutic-interpretive ones we envision and have the greatest dependence on the supportive organizational and cultural qualities discussed above. Without a widely shared sense of the importance of perspective making and perspective taking in knowledge creation, and a well established sense of the value of a hermeneutic attitude, these forums would not be possible.

Theory-building Forums

These forums would most closely reflect the dialogue of theory that is woven throughout scientific practice. We envision this as a series of forums in which different communities of knowing articulate, critique, extend and explore the theories that do or should guide their work. Theory-building forums are not just for science work, however, and we would anticipate that in a knowledge-intensive firm the ethos of perspective making and perspective taking also would be held by the financial, marketing and other nonscientific fields of discourse within the organization, and between the organization and its many environments.

In addition to "Theory Corners", or forums dedicated to dialogue on theories within and across specific communities of knowing, we would also expect theory-building forums to include "Thought Experiment" forums, where individuals played with theories and their implications by narrativizing thought experiments. Thought experiments entail the construction of mental models by a scientist who imagines a sequence of events, and then uses a "narrative" form to describe the sequence in order to communicate the experiment to others (Nersessian 1992). Thought-experiment forums would also include the construction and playful exploration of simulation models, especially multimedia simulations and virtual reality systems.

Once again, we see this class of forums playing an important role in perspective making and also perspective taking. Constructing theories and conducting thought experiments in dialogue within a community of knowing is essential for strong forms of perspective making. Participating in these forums from the fringes of the community, or reading and interpreting the theory building from outside the community is a powerful means of perspective taking.

Intelligent Agent and Expert System Forums

The final class of conversational forums we will present have to do with intelligent agents and expert systems. By intelligent agents we mean personal assistants in the form of software systems that can roam the network of forums within a firm as well as libraries, repositories and information sources outside the firm. These agents help an individual to direct her attention within the burgeoning field of forums that could be of importance and interest to her, and also help assemble contextual materials for building cross-document links in complexly layered representations.

We see these intelligent agents as well as expert systems as another important form of reflexivity within the firm. Both are classes of software systems where expertise and interests have been reflected upon, made visible and embodied within these artificial agents. In the forums we envisage, individuals would develop and share insights into how these systems can best be constructed and deployed, and how their results can best be interpreted. The forums would thus be directly concerned with thinking about thinking, especially as thought processes are embodied in the active agents and expert systems.

Summary

The applications described above are not intended as an exhaustive listing, nor as a taxonomy of ways in which perspective making and perspective taking can be supported by electronic communication. Rather, we intend merely to open a discussion of some possibilities for appreciating language games, narrative cognition and reflexivity in the design of electronic communica-

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tion systems. No doubt, many of these kinds of activities are already being explored in nascent form by those organizations that are installing extensive groupware capabilities.

Concluding Thoughts

Any design of an electronic communication system implies a model of human communication and of human cognition. We have explored how principles and policies for the design of electronic communication systems are affected by incorporating a language games model of communication and an awareness of the narrative mode of cognition. In so doing, we have argued that perspective making and perspective taking in the science work of knowledge-intensive firms and in firms generally using lateral organizational forms would benefit from systems designed with this sensibility in mind. We have also provided some examples of computer-based applications which embody these ideas and the types of organizational, cultural and technological preconditions for them to succeed.

Behind all the arguments and examples we have presented is an interest in strengthening the possibilities for perspective making and perspective taking in communities of knowing. Making a strong perspective and having the capacity to take another perspective into account are the means by which more complexified knowledge and improved possibilities for product or process innovation are achieved. Our discussion has necessarily emphasized narrative cognition at the expense of paradigmatic, and reflexivity at the expense of action. This was necessary, we believe, in order to open a space for dialogue on these often overlooked features of social life that are none the less central to creating knowledge in communities and organizations.

Some of our assumptions about organization culture and power as well as our proposed applications may seem optimistic about the chances of overcoming deeply entrenched fears and resistance to change in organizations and their communities of knowing. We believe, however, that designing electronic communication systems with a language game model of communication that explicitly incorporates a narrative mode of cognition and heightened levels of reflexivity is an important means to achieve just those organizational qualities we are assuming.

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