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PERSPECTIVE MAKING AND
PERSPECTIVE TAKING IN COMMUNITIES
OF KNOWING

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Abstract

Communication in knowledge intensive firms involves perspective making and perspective taking within and between their communities of knowing. In this paper we look to science as an example of knowledge work in a community of knowing, and draw implications for the design of electronic communication systems and policies to support perspective making and perspective taking. The role of narrative in perspective making and of reflexivity in perspective taking are highlighted. Two models of communication, the conduit model and the language games model, are proposed for guiding the design of electronic communication media, and their relative strengths and weaknesses are considered.

Introduction

It is often observed that the world of organizations and the nature of work is changing, and at an accelerating rate. Intensified global competition and rapid technological and social changes mean that organizations must respond to a turbulent market environment with better, and more innovative products and services faster than ever before (Purser and Pasmore, 1992; Lawler, 1992). Two outcomes of this increased pace of environmental change and new product development are the gradual replacement of capital and labor intensive firms by 'knowledge intensive firms' (Starbuck, 1992), and a shift of work from routine to 'knowledge or non-routine work' (Pava, 1983).

Labeling firms as knowledge intensive denotes a new species of organization where knowledge has relatively more importance than the inputs of labor and capital (Starbuck, 1992). The key input in such firms is expertise, both strategic and technical, which enables the firm to outperform rivals that possess only commonplace market knowledge. As Starbuck (1992) comments on one such knowledge intensive firm (Garden); "The key labor inputs came not from the machinists in the plant, but from the engineers and managers in the office building. These people had created monopolistic opportunities for Garden over and over again. Garden was the only producer of many of its products, and the dominant producer of all of them" (pg. 715).

Knowledge work involves the creation of knowledge and its application for the firm in new or improved technologies, products, services or processes. Companies in the computer, pharmaceutical and bio-technology industries are clearly knowledge intensive, requiring expertise from many different domains to successfully perform in their markets. These firms are primarily characterized by knowledge work as opposed to routine types of work where the steps and procedures to transform inputs to outputs are well understood. Routine work can be well defined, repetitive, and embedded in clear, shared goals. Building the one-thousandth car on the assembly line is not radically different from building the first car. In contrast, knowledge work such as new product development is an

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inherently complex, uncertain, and ambiguous process. It is typified by high task variability, uncertainty, and competing, multiple goals.

A critical feature of knowledge work in the emerging knowledge intensive firms is that it requires multi-disciplinary expertise in order to achieve a complex synthesis of highly specialized technologies and knowledge domains (Purser, Pasmore and Tenkasi, 1992). In the process of new product development, for example, we see that the requisite knowledge is diverse, multi-faceted, multi-leveled, and highly detailed (Dougherty, 1992). For example, a typical pharmaceutical product development team is composed of members (many of them Ph.D.s) with specializations in medicine, chemistry, life sciences, biopharmaceutics and toxicology.

It is our contention that all organizations are becoming more knowledge intensive and that knowledge work is increasingly important across the service, industrial and government sectors. It is easiest to see the fundamental importance of knowledge work in firms involved with leading edge technologies, but the relentless pace of change in markets and expectations means that all organizations will increasingly rely on creating new knowledge for their products and processes in order to innovate and survive. In spite of the trend towards knowledge intensive firms and knowledge work, we know very little about how these tasks are performed and how we can facilitate their effective execution. As Purser and Pasmore (1992) note, if we consider research and development as an example, there is almost nothing in the management literature that relates directly to how the process of creation and application of knowledge takes place.

Communities of Knowing as Open Systems

In this essay we present an open system, cybernetic model for understanding knowledge work in organizations as a process of communication within and between communities of knowing. Science will serve as our principal example of knowledge work, and Thomas Kuhn will provide a basis for insights on the process of development and change in communities of knowing within a scientific discipline. Organizations, by bringing

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multiple specialized knowledge workers together in an organizational mission, represent the added requirement for communication between communities of knowing. Communication within and between communities of knowing will be referred to as perspective making and perspective taking, respectively. Two communication models (one based on Shannon and Weaver and one based on Wittgenstein) will be employed to identify some of the different types of impacts that electronic communication media have on organizations as systems of knowledge work.

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, Tenkasi and Te'eni, forthcoming). 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).

As an open system of knowledge work, organizational patterns of behavior remain relatively stable even though the component parts of the organization (its communities of knowing) continuously enter, transform and exit (Bertalanffy, 1968). In fact, it is the dynamic open system process by which new communities of knowing emerge, change and interact with other communities of knowing within and outside the organization, that explains the organization's ability to endure, adapt and innovate (Bertalanffy, 1968).

From a cybernetic view, we can identify two kinds of control in the knowledge work of organizations: feedback control and control through open system transformation. Maintenance and refinement of the existing knowledge in the organization is a result of feedback control operating within established routines and policies. The creation of new knowledge in the organization over time, however, is understood as the result of an open system transformation of its communities of knowing as they question and revise routines

and create new products, processes and relationships amongst themselves (Weiner, 1954; Argyris & Sch"n, 1978). In this paper, we will focus on this second form of control in knowledge work. Perspective making and perspective taking are the basis of transformations within and between communities of knowing and thereby the basis for its open system control. Our principal contention is that designing electronic communication for knowledge intensive firms requires an appreciation of how it can mediate the transformation and changing relationships among their communities of knowing through affecting their perspective making and perspective taking capabilities.

Two Models of Communication

In considering how electronic communication media can be employed to support knowledge work in organizations, two communication models are important to consider. One is the conduit model of communication inspired by the work of Shannon and Weaver (1949), the other is the "language game" model as found in Wittgenstein (1953). Each of these models is useful for thinking about 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. We will employ each for different needs in our later 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; and 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, 1978). The symbolic or interpretive character of messages is not considered. The encoding and decoding activities are treated as discrete

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selections of messages from a predefined set. In short, the problem of human meaning is avoided, as the emphasis is placed on patterns of message selection and networks of information processing. In organizational studies we see this model being used for discussing media richness (Daft and Lengel, 1984) and organization design (Galbraith, 1973; Tushman, 1978; Allen, 1986), as well as research and development and innovation (Davis and Wilkof, 1988; Allen, Tushman and Lee, 1980; Allen and Cohen, 1969).

The second communication model we will consider is Wittgenstein's image of communication as language games in forms of life (Wittgenstein, 1953; 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 confirm the usefulness 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, or 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 where meaning was uniquely identifiable and stable. He came to see how language cannot be understood apart from its rootedness in life experience, nor can it stand alone with unambiguous meaning. Language games in forms of life are the basis for all we know, and emphasize the primacy of communities of knowing not only for confirming knowledge as valid, but also for making and remaking language, communication, and knowledge. From a language games model of communication, there is no fixed set of messages from which to choose in communicating.

> 23.   But how many kinds of sentences are there?...There are countless
>   kinds...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.

83.   Doesn't the analogy between language and games throw light here?...And
        is there not also the case where we play and make up the rules as we go
        along? And there is also one where we alter them--as we go along.
(Wittengenstein, 1953)

Language and communication within a form of life are a communal product.

Individuals can participate in a community only to the extent that they learn to engage in its

language games. In this sense, language games in our forms of life are powerful

determinants of what and how we can know.

103   ... it is like a pair of glasses on our nose through which we see whatever
        we look at. In never occurs to us to take them off.

114.   ..One thinks that one is tracing the outline of the thing's nature over and
        over again, and one is merely tracing round the frame through which we
        look at it. (Wittengenstein, 1953)

In the remainder of the paper, we will proceed by first looking to science for

insights on how communities of knowing develop and change. For this we will draw from

Kuhn's (1970) classic description of the process of science and the role of communication

in shaping knowledge. We will then draw implications for designing electronic

communication systems for knowledge work in organizations, and also consider multiple

communities of knowing in organizations and their processes of interaction. We will then

explore how perspective making in a community of knowing develops through narrative,

and how different communities of knowing interact through perspective taking processes.

Finally, we will draw implications for how the conduit and language game models can be

used to guide the design of electronic communication systems and policies so that they

support perspective making and perspective taking in an organization's communities of

knowing.

Science as Knowledge Work in Communities of Knowing

It is our position that considering science as organized knowledge work has many insights to offer for thinking about the conceptual dynamics of knowledge production in knowledge intensive firms and more specifically, speculating on how electronic communication can be designed to support the change toward knowledge intensive organizational forms. A central source for these insights is provided by Thomas Kuhn (1970) as he describes the historical process of knowledge work in science as scientists strive to understand, predict, and explain the world. In contrast to science, knowledge work in organizations has the added burden of acting and achieving desired outcomes in the world. As indicated above, knowledge work in organizations requires that multiple communities of knowing must interact and co-develop knowledge. Nevertheless, knowledge work in both domains has sufficient similarities that an understanding of science as knowledge work can profitably guide our thinking about the requirements for electronic communication in organizations.

Readers are no doubt familiar with Kuhn's argument of how doing normal science within paradigms leads to crisis and revolution. With this overall image of knowledge development in science as a backdrop, we will explore some central ideas of Kuhn that are sometimes overlooked, yet are important for thinking about knowledge work in an organization.

First, those doing knowledge work require a paradigm, or a shared sense of what part of the world they are concerned with, what the metaphysical nature of the world is, what problems are important, and what serve as good exemplars for their domain of concern and their shared set of beliefs and values. In the absence of a paradigm, all available facts would be equally relevant. Doing knowledge work by posing a law about the world, or deducing a hypothesis, or defining an acceptable test, means relying upon a shared paradigm in order to construct an argument acceptable to a community of knowing.

There are many problems with Kuhn's notion of paradigm, 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 ideas of tacit knowledge, Boulding's discussion of 'the image', Pepper's notion of 'world hypotheses' and numerous others (Burrell and Morgan, 1979; Bartunek, 1984) who point out how perception is only accomplished through a perspective. It is important to remember that the paradigm or perspective is a community product. The standards for deciding the appropriateness of the features of a paradigm, such as its specialized vocabulary, accepted methods for observation and measurement, and criteria for accepting and rejecting arguments about the domain of interest, emerge within the social practices of those working within the community of knowing.

Knowledge work is thus fundamentally located in a language game and form of life. It is a 'community of practice' (Lave and Wenger, 1990; Brown and Duguid, 1991; Orr, 1990). Workplace learning and innovating unavoidably rely on and are produced within a community's interpretive conventions. Understanding and interpretation involve a great deal that is not explicit or explicable, and that is developed and framed in a crucially communal context, whether it be a "community of nuclear physicists, cabinet makers, high school classmates, street corner society..." (Brown and Duguid, 1991; pg. 48).

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

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There are two types of knowledge development or learning that concern Kuhn. One type of knowledge development takes place within a community that shares a paradigm and conducts normal science within it. Puzzles are posed and solved, and anomalies are recognized and responded to by elaborating or refining techniques within the paradigm. A second type of knowledge change involves the questioning of the paradigm itself, through posing of an alternative. This second kind of knowledge change takes place between paradigms.

Viewing the organization as an open system, we consider these two types of learning to be associated with the two forms of control mentioned above. Maintenance of knowledge can be accomplished through feedback control processes, but this will be insufficient for change in the paradigm or perspective of a community of knowing. The stronger and more well developed a community's perspective is, the more useful a conduit model of communication becomes. As theories, puzzles, measures and accepted results become more 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 paradigms is not as well handled by a conduit model. Work that questions paradigms is of a different logic type than work within a paradigm, and is primarily controlled by the dynamics of change in an open system rather than simple feedback (Weiner, 1954; 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 can not be separated from the evolving context of making and using them as in the conduit model.

Organizations as knowledge work systems are somewhat more complex than the image of science portrayed by Kuhn, because organizations often require that multiple types of expert knowledge be brought together for developing new products or processes. Thus, knowledge work in organizations may take place between paradigms as often as it does within paradigms, and the between paradigm knowledge work is not aimed at upsetting an established one with a new alternative, but is instead aimed at creating new knowledge through the interaction of different perspectives.

Thus, the organization as an open system of communities of knowing has a communication need that is not found in Kuhn's work on science within disciplines. This is the need for different communities of knowing to interact in ways that are not directly intended to change the other, but are instead aimed at finding a way that each can add something to a joint effort at knowledge development by developing a new product, strategy or process for the larger organizational community. Here is where the organizational problem of knowledge work becomes more complicated than that depicted by Kuhn and where the features of structural hierarchy in open systems (Smith, 1981) becomes important to consider.

The communities of knowing that comprise the organization as an open system are not separate components that fit together like gears in a machine, but are ones that overlap in complex and shifting ways. There is a rich hierarchical structure of communities of knowing within the firm, and between the firm, and its environment. For example, we can consider the organization as a whole as a community of knowing to the extent that it has a strong identity accepted and used in action by its members. This is the level of organization culture and at a limit may have all organization members as participants. Divisions, functional areas, departments, product lines, professional specialties, project teams, issue-based committees, and so on are all possible sites for communities of knowing at their various levels within the organization. Communities of knowing within

the firm overlap in scope, responsibility and membership. Individuals may find themselves as members of several communities of knowing operating at different levels within a firm.

The type of knowledge work that is highlighted when considering knowledge firms takes place primarily between their complex, overlapping communities of knowing. As opposed to the adversarial image of interaction between communities presented by Kuhn, we are concerned with the firm's requirement for successful collaboration between communities of knowing. For this purpose we will later discuss the process of perspective taking, in which members of different communities take each other into account without losing the integrity of their own distinctive way of knowing.

Two final themes from Kuhn that we will consider before drawing implications for knowledge work in organizations are the incommensurability between paradigms and the emergence of new paradigms. If a community is to share a paradigm and do distinctive and important knowledge work, it will of necessity approach becoming incommensurable with other paradigms. 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 of practice, but will see different problems, different opportunities, different challenges (Czarniawska-Joerges, 1992). As Kuhn puts it, they live in a different world from knowledge workers in other communities of practice. Data important to one are irrelevant to another, or are used for entirely different purposes. Arguments that persuade convincingly in one community of practice have little or no weight in another. And the more developed and refined the community of knowing becomes, with an increasingly elaborate and detailed paradigm, the more nearly incommensurable it becomes with others (Brown and Duguid, 1991; Fleck, 1979; Dougherty, 1992). If the 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.

Fleck's (1979) notion of 'thought worlds' is similar to Kuhn on this point. His concept of 'thought worlds' emphasizes the unique interpretive repertoires of different communities of knowing. The interpretive repertoire of each community of knowing is characterized by two distinctive aspects: 1) their 'fund of knowledge', or what they know, and 2) their 'systems of meaning' or how they know. What is already known influences the method and content of cognition. A thought world evolves in a community of knowing as an internally shared system of meaning which provides a 'readiness for directed perception' based on common procedures, judgments and methods. 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. Ideas that do not fit in with one's system of meaning may be reconfigured or rejected outright.

Knorr-Cetina (1981) provides a good example of how local communities of knowing develop their own contextual worlds. In her sociological study of different research units, she discovered that research laboratories develop local interpretations of methodical rules, or a local know-how in regard to what is meant and how to make things work best in actual research practice. She cites the example of a research lab that had several services designed to perform standard but required analyses for identifying chemical compositions. Many of these analyses were also official in the sense that they had been tested, documented and recommended for use by the American Chemical Association or some such group. A scientist who came to the institute from a different area when first using these facilities, was surprised to learn that the tests were performed without replication, apparently under the assumption that such standard routines carried no risk of uncertainties. The scientist's interpretation was just the opposite; "measurements become routine, he explained, precisely because they are important, which means that precision is their foremost requirement. Precision without replication, he said was 'crap'" (p. 29).

Knorr-Cetina (1981) suggests that many selections of the research process reflect local interpretations. Criteria for 'what matters' and 'what does not matter' are neither fully

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defined nor standardized throughout the scientific community. Nor are the rules of official science exempt from local interpretation. In summary, she found that local interpretations impact at least three areas of selection: 1) questions of composition, or which specific substances, ingredients or means of instrumentation are to be selected; 2) questions of quantification, or how much of a substance is to be used or how long a process is to be maintained; and 3) questions of control, or which methodological option such as simplicity of composition versus complexity, or strict versus indirect comparability, is to be employed.

This near incommensurability between well developed communities of knowing doing science work poses a special problem for designing electronic communication in knowledge intensive firms. It suggests that the process of perspective taking may be the most crucial communication process to an organization's success. In considering the communication needs for perspective taking, we will emphasize the importance of the language games communication model. In fact, we will argue, using the conduit model may well inhibit the very communication behaviors required for perspective taking.

The final theme from Kuhn we will review concerns the process by which new paradigms emerge. For organizations concerned with reformulating strategies, production processes, labor relations or basic identities this is a major concern. Kuhn argues that new paradigms emerge with a few initial adherents and that the ability of the new community of knowing to do knowledge work is limited. New perspectives are usually weak and fragile at first. They cannot explain as much or as well as existing paradigms and require a core of adherents drawn by an as yet unfilled promise.

Adherents to the new paradigm may be new knowledge members of the community or experienced ones who, because of individual characteristics or an experience of crisis within an existing paradigm, have experienced conversion to the new one. At first, the new community is essentially bounded together by a faith in the potential that they can sense in the new paradigm. It is not as elaborate and well developed as an existing paradigm, and

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cannot produce the same breadth, quality or reliability of knowledge as older paradigms can. If judged on performance of their knowledge work alone, the new community of practice would not persist. It is a shared belief in the promise that the new paradigm holds for future development that binds individuals to the community. Kuhn argues that it is often a source of aesthetics, symmetry, beauty or neatness that draws and holds them to it in its early developmental period.

Implications of Kuhn and Knowledge Work in Science for Understanding Knowledge Intensive Firms

A first implication of Kuhn and his study of knowledge development in science 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 a paradigm in order to do knowledge work. We will use the less loaded term of 'perspective' to refer to this essential feature of communities of knowing in an organization. The doing of knowledge work is the elaboration of the community's perspective. The perspective develops by refining its vocabulary, its methods and measurements, 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 the community of knowing to do knowledge work is a function of the level of development of its perspective. Without a strong perspective it cannot produce important knowledge work.

Fourthly, the ability of one community of knowing to work jointly with another requires an ability to overcome the degree of incommensurability between them. This, of course, must be done without sacrificing the integrity and distinctiveness of their own

perspective. Below we will explore this process as one of 'perspective taking' in which the perspective of another can be taken into account as part of a community's way of knowing.

Fifthly, the conditions for change in the perspective of a way of knowing primarily come from within it, as it is exercised, developed and enhanced. 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 firm, then, we look to its ecology of communities of knowing to understand its possibilities for doing knowledge work. As an open system of communities of knowing, its electronic communication can mediate how communities emerge, develop, elaborate, suffer crisis, and transform within it. They 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.

The Process of Perspective Making

Drawing from the cybernetic stream of work including von Foerster (1960) and Ashby (1962), Knorr-Cetina (1981) proposes that scientific conceptual systems have to progressively complexify themselves over a period of time to successfully solve scientific problems. Complexification is the ability of a cognitive system, such as a community of knowing, to construct and reconstruct itself in new and complex ways. This is a process of ontogenetic development that also 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). In other words, the notion of complexification implies that the ability of a 'community of knowing' to do knowledge work is a function of the level of development of it's perspective.

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A good example of complexification perspective making is presented by Bradshaw (1992) in his analysis of the Wright brothers' invention of the airplane. In a rather comprehensive account, Bradshaw attempts to examine the question: why were the Wright brothers so successful in conquering the challenge of manned flight, while so many others failed? From almost any angle, their effort was a long shot, opines Bradshaw. Wilbur just finished high school, while Orville never did. They were bicycle mechanics, with no formal training in engineering, fluid mechanics or physics. They had no external support but funded their research from proceeds generated during the summer months when they made, sold and repaired bicycles. Many of their contemporaries such as Dr. Samuel Langley of the Smithsonian Institution enjoyed more promising circumstances such as better training, a large staff of supporting mechanics and shop workers, and extensive funding.

The unsuccessful inventors, Bradshaw argues, had a propensity to construct complete aircrafts that exemplified different designs and then to test the craft by measuring distance and time in flight. To these designers, the airplane consisted of a set of structures, such as wings, fuselage, and method of propulsion, and developing an aircraft meant exploring possible designs for configuring these elements.

However, for the Wright brothers, the major concern was how to achieve certain functions in the airplane such as lateral control, sufficient lift, a reduction in drag and so on. They first isolated a smaller number of these functional problems that they then proceeded to solve 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 lift and thrust were solved through the use of wind tunnel experiments. Another characteristic of the Wright brothers' research was the extensive testing performed on each model; "By testing the early gliders as kites, the Wright brothers were able to measure lift and drag, and discovered an important error in aerodynamics overlooked by other investigators" (p. 246-247). Thus, only when each problem was understood and solved, did the Wright brothers invest time and energy in building a new craft.

In summary, the brothers' modeled and developed more complex understandings of the workings of aerodynamic laws, indicating a complexification of perspective. 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 their models would fly, without having any conception of why. They lacked the strong perspective necessary to do important knowledge work.

Perspective making within communities of knowing is a social practice in a form of life. We have noted that a paradigm or perspective is implied by action in a community of knowing and that the paradigm or perspective is elaborated, enhanced and refined over time. For insight into how this process takes place in a community of knowing, we will turn to Anthony Gidden's structuration theory (1979) and to Jerome Bruner's work on the role of narrative in constructing knowledge of self and world (Bruner, 1990).

Gidden's structuration theory has been well described in the management literature (Whittington, 1992; Orlikowski, 1992; Orlikowski and Robey, 1991, Poole and DeSanctis, 1992). For our purposes, the central point of structuration is that the interpretive schemes, understanding of power relations, and sense of moral order that constitute social structures are never 'simply there' for actors to display. Instead, they are constantly being produced and reproduced in situated action.

The production and reproduction of social systems and structures are governed by two critical interdependent processes; the agent's reflexive monitoring of conduct and rationalization of action (Giddens, 1976). The process of reflexive monitoring is one where actors intermittently monitor ongoing actions and their setting. That is, they take stock of goals, plans, interactions, conversations, reactions, and surroundings, including their emergent retrospective meanings (Poole, et. al., 1986). Based on what meanings are made in the situation, plans are maintained or changed, goals are reaffirmed or modified and narratives are retold or made anew. Narratives, or stories of how things are and how they came to be that way ground the reflexive monitoring of conduct. "The reflexive

monitoring of behavior operates against the backdrop of rationalization of action"
(Giddens, 1979; pg. 57). Our reflexive monitoring of action is impelled by and involves
giving narrative accounts of our actions to ourselves and others. "We rationalize - make
our conduct "rational" - in discourse in socially prescribed terms" (Poole, et al., 1986; pg.
249). However, rationalization entails more than simple account-giving; it is a process of
seeking on-going coherence of actions and practices. It is a process of narrativizing our
experience in a way that makes it believable and livable within the canons of signification,
legitimation and domination that is our culture (Bruner, 1990).

Structuration theory, with its focus on action and the reflexive monitoring and
rationalization of conduct as it progresses, provides an explanation for how perspectives in
a community of knowing develop and change. The reflexive monitoring and rationalization
of conduct takes place through the continual process of constructing narratives of our
experience. In situations where contradictory structural modalities from different
perspectives are drawn upon, the challenge for constructing a livable, believable narrative
are all the greater. But even in the absence of clear contradiction between different
perspectives, we are constantly explaining to ourselves how the canonicality (or cultural
validity) is being tested, maintained or modified. It is to narrative, and in particular to how
actors make meaning of their organizational experience through narrative, that we must
look if we are to understand the process of perspective making.

Returning to our earlier examples of science as knowledge work, we see that
scientific reasoning is manifest in narratives and scientists' interpretative practices are
embodied in their discourse (Knorr-Cetina, 1981; Mulkay et al., 1983). Paying attention to
the narrative streams and discursive practices of scientists is essential to capture the
cognitions and meaning systems of their community of knowing. For example, Knorr-Cetina
(1981) argues that to get at the 'meaning systems' of scientists we must rely on their talk:

> "Strictly speaking, it is not really scientific action we have to confront in direct
> observation, but the savage meaning on ongoing events for and by the scientists.

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To get at this meaning we have to rely on talk... We must listen to the talk about what happens, the asides and curses, the mutterings of exasperation, the questions they ask each other, the formal discussions and lunch time chats." (p. 21)

The importance of narrative has not gone unnoticed in organizational research either. Clark (1972) explored the importance of narrative as it is manifest in organizational sagas. He noted the importance of organizational sagas for making sense communally of significant events in an organization, and for enabling individuals to rationalize dedicating so much of their lives to organizations. Mitroff and Kilmann (1976) recognized the primacy of stories for humans, declaring them to be "natural, born storytellers," who tell stories in order to give meaning to their experience and to themselves as persons. But Clark, as well as Mitroff and Kilmann, focus attention on the saga or the myth - the grandest overarching type of story to be found in our organizations or our culture. Structuration, in contrast, is concerned with the day to day stream of ongoing interaction and narrative making.

Myth and saga are important, but they distract our attention from the way that human cognition operates principally in a narrative, story telling mode. Our position is to emphasize the way narrative, as a fundamental innate capacity of humans (Bruner, 1990) is the basic and determining process for the construction, maintenance and change of all understanding in an organization. Perspectives in a community of knowing are a product of story telling as much as they are a medium for it.   More recently, the role of stories and story telling in the day to day functioning of organizations has been addressed by Boje (1991). The dynamic, 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 Clark (1972), Martin (1982), Martin and Meyerson (1988), McConkie and Boss (1986), Gabriel (1991), and Wilkins (1979), and turns our attention to the community dependent process of producing the story. Boje, however, was concerned with the performance of story telling as but one tool of sense making for the individual.

We instead argue support for Bruner's (1990) restatement of psychology as being fundamentally based on the human narrative capacity for making meaning. We join with Bruner in arguing that the organizing principle of cognition and perspective making is narrative, and not conceptual or schematic. Once this turn is made in our understanding of cognition, the role of story telling and narrativizing of experience generally, shifts from a secondary role as a way of dramatizing concepts to a primary role as the generative process in a community of knowing. What perspectives we do have in communities of knowing are constructed through narrative.

"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)

Bruner, synthesizing studies of child development, language acquisition and concept formation, proposes an innate narrative capacity as the 'engine' for our cognitive activity (p. 92). He identifies four constituents of this innate narrative capacity (p. 77):

1. A sense of human agency in which actions are taken toward goals by agents.
2. A sense of sequential order in which events occur in a linear fashion.
3. A sense of canonicality or how things should occur in a 'normal' story.
4. A sense of a narrator's perspective.

He argues that our primary cognitive mode is to make narratives with the exceptional (anticanonical) in our reflexive monitoring of events or experiences. Logical or paradigmatic thinking is a 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 life like and fits the culturally bound demands of forms of life. It makes our experience meaningful within our language games.

"The object of narrativizing our experience is not a match with a reality or a predefined system of logic, ...but achievement of coherence, livability and adequacy." (Bruner, 1990, p. 112)

Bruner, in parallel with Giddens' structuration theory, emphasizes that an important part of narrativizing is the exploration, construction, and validation of the self. The narrator's perspective as a constituent of our innate narrative capacity assures this. The self is always at stake in the individual's narrativizing of experience (p. 111). 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).

Perspective Taking

In knowledge intensive firms, competitive advantage and product success is a result of collaborative, on-going learning. That is, success depends on how effectively the diverse individuals are able to organize and develop their unique knowledge competencies, as well as how effectively they can integrate and synergistically utilize their distinctive knowledge through a process of perspective taking (Dougherty, 1992; Purser, Pasmore and Tenkasi, 1992; Nonaka and Johnson, 1985; Stata, 1989; Meyers, 1990; 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,... It 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 Johnson, 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 communication. In any communication, the knowing of what others know is a necessary component for coordinated action to take place (Bakhtin, 1981; Clark, 1985; Krauss & Fussell, 1991). As Brown (1981) observed,

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effective communicating requires that the point of view of the other be realistically imagined. Others such as Rommetevit 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" (Rommetevit, 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 expert 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.

Failures of Perspective Taking

The task of taking each other's knowledge and background into account is fundamental for successful coordinated action among actors with diverse knowledge and expertise. It 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

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unique understandings dramatically reduced their possibilities for successful team knowledge work.

In order to understand break downs in 'perspective taking' a discussion of the process of perspective taking is in order. Perspective taking involves a variety of inferential and judgmental processes. Individuals may utilize an assortment of knowledge structures, such as schemata, interpretive schemes, stereotypes, and inference heuristics to estimate what others know. Such structures can facilitate the task of drawing inferences, but they can also induce systematic errors and biases (Kahneman, Slovic, and Tversky, 1982; Nisbett & Ross, 1980). For example, an actor may use the availability heuristic to assess what others know. 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. This false consensus effect, in which subjects assume that others are more similar to themselves than is actually the case (Ross, Greene & House, 1977) is a form of bias particularly relevant to the perspective taking process. Steedman and Johnson-Laird (1980) have proposed that "the speaker assumes that the hearer knows everything that the speaker knows about the world and about the conversation, unless there is some evidence to the contrary" (p. 129). This heuristic should lead to overestimates of the extent to which a speaker's knowledge is shared by others, and studies support the existence of such a bias (Dougherty, 1992; Krauss & Fussell, 1991).

According to Starbuck (1992), this a common problem with experts in knowledge intensive firms. Expertise implies specializing and moving into distinct occupational niches. This reduces versatility and limits flexibility, and niches can often become evolutionary dead-ends in terms of being open to learning outside one's expert domain (Beyer, 1981). Since expertise entails perceptual filters, experts may be gaining knowledge within their specialties, but they are often closed to important and relevant events outside their limited province (Starbuck, 1992).

Dougherty (1992) provides an insightful analysis of break downs in the perspective taking process due to actors' inability to surface and examine their differing interpretive schemes. In her pioneering study of new product development efforts across multiple firms, she examines how differing interpretive schemes of the various players involved in product development can be a major barrier to the linking and collaboration essential to successful product innovation. Data regarding 18 new product efforts in five firms, which incorporated new or unfamiliar technology, were collected. Her findings suggest that, uniformly in all the unsuccessful cases, 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. Each stakeholder made different sense of the nebulous future by looking at disparate aspects of it. 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 identifying the right potential customers. They partitioned the product into separate sources of uncertainty, which kept them from developing a more comprehensive understanding of the market. As in the Purser et al. (1992) study, integration mechanisms failed because differentiation mechanisms were not adequate to enable the perspective taking required for effective communication and collaboration.

A second theme characteristic of failed teams involved people's understanding of the development process itself. Each department concentrated on different subsets of the overall process. People not only ignored the activities of others and failed to argue over relative priorities, they completely glossed over the concerns of others, and tended not to appreciate their complexities. Once again, it was a failure of perspective taking -- a failure to represent and appreciate the different knowledge and understandings involved -- that led

to an inability to integrate their efforts. In a sense, it was a failure of strong perspective making and subsequent perspective taking that led to a failure to integrate their knowledge work.

A third theme characteristic of failed teams involved the different 'thought worlds' of team members. For new product development, different departmental thought worlds developed in different communities of knowing, can selectively filter information and insights. Because of different funds of knowledge, a certain thought world is likely to best understand certain limited issues, but to ignore information that is equally essential to the total task. This would also reduce the possibility for creative perspective taking, since members of a department may think that they already know everything (Dougherty, 1992).

Thought worlds can have an all pervasive influence on an actor's perception and interpretation. As Dougherty found in her study, each departmental thought world was truly concerned with the successful development of the product. Each had an important insight into the product or market that was essential to the new product's development. However, each emphasized different aspects of development, and conceived of the whole in a totally different way. 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" (pg. 191).

In summary then, the problem of integration of knowledge in knowledge intensive firms is not a problem of 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 and exchanging representations of one's knowledge and understandings enables others to better anticipate the distinct ways of knowing of others as they attempt to communicate. The problem of integration in knowledge intensive firms is a problem of supporting diversity of knowledge in order to strengthen the differentiation of perspectives of communities of knowing within

the firm. Only after knowledge is differentiated and represented do the actors have something to integrate through a perspective taking communication.

Implications for Electronic Communication Systems and Policies

Electronic communication media help build communities. The communities can be as diverse as the 'wasteland' of commercial television and the 'cyberspace' of computer networks, but a common characteristic is the way of knowing and perspective associated with communicating in a given community. 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. Complexification in the ecology of these communities involves two intermixed yet distinct processes: perspective making and perspective taking.

As a community of knowing enriches and refines its distinct perspective and way of knowing it is complexifying: its categories for partitioning the world are becoming more numerous and subtle; the distinctions it makes as to the appropriateness of problem statements, measures, models, tests and logics for a given situation are becoming more esoteric and precise. Talking and acting as a member of a viable community of knowing means making its perspective more complexified and able to do knowledge work. As a perspective develops, it becomes less and less available to members of the organization from outside the community to participate in its language games and communicate within its form of life.

Using an open system model, we portray the organization as a nested hierarchy of such communities of knowing, extending from a 'community of the whole' as it were, to very local and specialized groups. As an open system, an important source of control and adaptability for the organization is the continual renewal of knowledge communities as new ones emerge, existing ones change and the relationships and interactions among them shift over time. Interactions among communities of knowing require a process of perspective taking in which members of one community attempt to take the perspective of

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another into account in order to enable a coordinated outcome between them, such as developing a new product.

The ecology of communities of knowing in an organization is characterized by the complexification of its perspective taking ability as well as that of the perspective making within a community, as discussed above. Complexification of perspective taking is 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 both structurational in character and 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. But the entire set of these issues is beyond the scope of this paper. Here, we will concern ourselves with a way of thinking about how electronic communication media provide the conditions of possibility for the two dynamics of complexification of perspective making and perspective taking. We are proposing then, a certain sensibility with which the questions of designing electronic communication media for a particular organization might be addressed.

The sensibility we propose has two major elements. First, a recognition that any design idea for establishing electronic communication systems or policies implies a communication model. We pose the conduit and the language games models, not as an exhaustive set, but as useful pointers to the ends of a continuum. Design ideas based on the conduit model have certain strengths and weaknesses, as do design ideas based on the language games model. Within the overall problem of supporting complexification of

perspective making and perspective taking, different communication models are more or less appropriate. In fact, inappropriate use of a given model can positively inhibit the outcomes desired.

The second element of our sensibility is to always approach design as a two sided question. It is not just a question of "what can we do to induce or enhance complexification of a given type?" but also a question of "what should we avoid doing in order to not to disturb complexification in a community of knowing?" Sometimes the latter is as important as the former.

With regard to the first element in the sensibility we propose, we will review the strengths and weaknesses of the two communication models for achieving complexification of perspective making and perspective taking. 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 techniques 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 that we spoke of earlier, where organization culture and identity are acted out and a sense of institution is developed is also well suited to a conduit model, at least as far as the broadcast bandwidth and development of firm wide vocabulary is concerned. Recent research in corporate strategy emphasizing the importance of shared interpretive schemes (Bartunek, 1984; Ranson, Hinings, & Greenwood, 1980), common visions (Collins & Porras, 1991; Elms & Wynkoop, 1990; Bennis & Nanus, 1985; Adams, 1986) or shared strategic image (Hamel & 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 more of 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 & Chaudhry, 1992; Targowski, 1988; Richardson, Jackson & Dickson, 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 a principal concern with end-used computing is the reduction of diversity and the establishment of standards and common structures for data and models (Brown & Bostrom, 1989; Munro, Huff & Moore, 1987; Rivard & Huff, 1988).

The conduit model is also inappropriate for supporting the narrative forms of cognition which we believe are so central to the perspective making process. Broadcasting a story is well within its scope, but the locally situated, evolving

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narrativization of experience requires an appreciation of language practice and forms of life that is more sensitive to the ambiguity experienced by members of a community as they experiment with narrative representations of their experience. A shared database of stories, for example, indexed by key words, incidents and actors, is in keeping with the conduit model, but not necessarily with the experience of an actor who narrates the experience differently each time in a sense making effort.

The language games model, in contrast, also has its strengths and weaknesses. It is good for 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, local practices and local vocabularies (J"nsson, 1992), even within space and time distant communities. The language games model is also useful for emphasizing the need for isolation and identification with a community of knowing. Language games within a community of knowing only develop through acts of speaking and doing - not through community members thinking about it. 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.

Finally, the language games model is 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. Through narrative, the language game moves from pure action to include attempts at reflecting on underlying logics, values and identities of the community of knowing.

A major limitation of the language game model is the "epistemic inhibitions of its own paradigm" (Rubinstein et al., 1984). The stronger a community of knowing is

supported by a language game model of communication, the stronger its perspective making complexifies, the less able it becomes to allow for other ways of seeing. As Wittgenstein (1953) puts it:

> 103.   ...It is like a pair of glasses on our nose through which we see whatever we look at. It never occurs to us to take them off.

> 114.   ...One thinks that one is tracing the outline of the thing's nature over and over again, and one is merely tracing round the fame through which we look at it.

As we have seen, both models have strengths and weaknesses that primarily relate to their role in perspective making, but both models have distinct weaknesses with respect to perspective taking (see summary of table 1). 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

TABLE 1

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 a community of knowing's vocabulary 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 primary 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

models presumes that each member of the organization participates in the same way of knowing and needs no 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 suppressed in the conduit or language games models. This aspect concerns the richness of representations and the reflexive capacity of a communication system.

In our discussion of perspective making in communities of knowing, we saw the individual heavily dependent on the form of life of the community for the kind of speaking and acting or knowledge work that was possible to do. For perspective taking we need a shift in emphasis, with more reliance on the individual's ability to make his or her own understanding of a perspective visible for self reflection. Once these personal representations of knowledge are made available for analysis and communication, a basis for perspective taking is available. Representations of ways of knowing from members in one community can then be communicated to 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 themselves and another. This taking of the other into account, in light of a reflexive knowledge of one's own perspective, is the perspective taking process.

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" (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

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objects- our interpretative 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'. Interpretations normally given in a matter-of-course, taken-for-granted 'natural' way should be suspended so that we will be able to notice and understand the ways in which our communities of knowing are constructed and interpreted and can change them appropriately (Collins, 1983). Rubinstein et al. (1984) posit that becoming aware of, evaluating, and modifying perspectives is required for maintaining adaptive knowledge. In their words:

> " [scientists] are capable of transcending constraints imposed on their own cognized environments by normatively accepted cognized logics, and hence entering into a direct and complex interaction with the operational environment...The result of such an activity ought to be a more effective and complex modeling of the operational environment, and thus the development of more fully isomorphic models of the environment. **Certainly one way of facilitating this inquiry is by examining the cognized logic that recognizes the limits it places on inquiry**." (p. 35)

Scott et al. (1979) maintain that the task of studying cognitive content is different from that of studying cognitive processes. To describe the contents of a perspective is to describe a representation of reality, and thus to describe facts from an individual's point of view. Cognitive processes on the other hand, involve not beliefs and representations, but mechanisms and procedures.

Raising awareness of the content of cognition is facilitated by employing self-reflective artifacts such as cognitive maps (Huff, 1990; Boland, Tenkasi and Te'eni, forthcoming; Weick and Bougon, 1986; Weick, 1990; Eden, 1992), or being able to capture actors' narrative streams and discursive practices (Tenkasi and Boland, 1993; Mulkay, Potter and Yearly, 1983; Knorr-Cetina, 1981).

Cognitive maps are graphic representations of a person's understanding of a situation. They provide a frame of reference for what is known and believed and thus

exhibit the reasoning behind purposeful action (Fiol and Huff, 1992). In more technical terms, a cognitive map can be viewed as 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, Schwartz, Tenkasi, Maheshwari, and Te'eni, 1992). Thus, as Eden (1992) suggests, cognitive maps can be seen as a picture or visual aid in comprehending an individual's or group's understanding of particular and selective elements of a situation.

Weick and Bougon (1986) suggest that building a cognitive 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. A cognitive map provides an occasion to think carefully, deeply and deliberately about a situation. Weick (1990) similarly argues that the act of creating maps (or other rich representations) of one's understanding of a problem domain and reflecting on them can facilitate new and more complex understandings of the situation at hand, improving the chances for scientific success.

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 hyper text 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).

As we noted above, electronic media based on the conduit model of communication can hinder perspective taking in interactions between emergent communities of knowing.

An example from the author's research on new product development processes will illustrate the point. The task for this new product development team engaged in pharmaceutical research was to choose a non-human 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 non-human analogue most appropriate for the task. As a result, the team members resorted to a popular GDSS 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 3 years of development time. The GDSS, with its emphasis on forcing consensus, hampered the team members from deeply examining their own perspectives as well as engaging in a dialogue of perspective taking with each other. The GDSS helped reduce noise in the communication and provided an illusion of certainty. What was required, however, was a language games model of communication and recognition of a need for complexifying their understanding through community dialogue, and using a technology that would support reflexivity and perspective taking.

Perspective taking 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, one of perspective taking.

The final consideration of the approach to designing communication media systems and policies that we are proposing is to balance an emphasis on asking what we should create to enable an appropriate communication media with a recognition that we must also ask about what we should not do. Communities of knowing are communities in an important sense that often escapes organization analysis. They are a locally produced, locally controlled, self-organizing phenomena. Communication is the fabric of a community of knowing. Efforts to intervene by, for instance, creating common vocabularies or decision models across the organization can tear the fabric and damage a local community as easily as help it.

Schon (1979) provides a vivid example of how a failure to recognize the importance of not disturbing the communication and exchange patterns of the local community haunted town planning for decades. When town planners saw their task as a need to cure urban blight, they intervened with all manner of planned renewals to tear down and remake whole sections of a city. But their efforts went terribly wrong, again and again, until they came to see the 'blighted areas' as a series of folk communities with a strong network of communication and support that sustained them quite well in the face of substantial difficulty. The problem then became how to design systems and policies without disturbing that natural capacity of the system to self-organize, regenerate and control itself. May we learn from their lesson and build such an awareness into our approach to thinking about electronic communication from the start.

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