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**COMMUNICATION AND  
COLLABORATION IN  
DISTRIBUTED COGNITION**

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## **Abstract**

Distributed cognition is manifest when individuals in an organization act autonomously, yet have interdependencies and must take knowledge of each other into account if a coordinated organizational outcome is to emerge. We have explored how managers can represent their unique perspective on a situation and communicate those perspectives among themselves. We have discovered that representing a perspective as the important factors in a situation and their causal relationships is a constructive process that involves the narrativization of experience in addition to an analytic mode of thought. Communication of a perspective involves dialogue with self during its construction and dialogues with others during its interpretation. The challenge for collaboration technology in distributed cognition is to provide a reflexive environment for the conversational construction of meaning as individuals engage in perspective making and perspective taking.

## **Introduction**

Our research is concerned with the processes of collaboration that are required by organizations as they increasingly adopt more network-like organization structures (Huber, 1984; Malone, et al., 1987; Drucker, 1988). We want to understand the kinds of communication that are needed, and design information technologies to support them (Boland, Tenkasi and Te'eni, 1994; Boland and Tenkasi, 1995). We refer to this kind of collaboration as 'distributed cognition'. Distributed cognition is the organizational phenomenon whereby individuals act autonomously within a decision domain, yet take each other and their interdependencies into account in their independent actions. This is in contrast to command and control approaches to coordination in which a hierarchical structure processes messages to and from a central point. In such a hierarchical structure, coordination is orchestrated from the central point through communication channels linking its semi-autonomous subunits. In distributed cognition, by contrast, coordination is emergent within the network of interactions and dependent on the members of the organization to communicate among themselves. Dougherty (1992), for example, found that successful new product development in multidisciplinary teams was associated with the creation of communication practices that encouraged appreciation of each other's perspectives and their mutual interdependencies. Unsuccessful teams were those where members failed to take each other into account in their individual decisions.

We began our research with the assumption that each autonomous unit in an organization has a complex understanding of its environment, technologies and constraints that determines its interpretations and actions. This understanding of its situation is unique and generally

unavailable to other units. Yet the actions of all the units are interdependent, each relying to some extent on assumptions as to how other units will respond to changes, threats or opportunities in their environment. When the environment is placid and relatively stable, such autonomous units could build suitably reliable images of how others were making sense of their situation and taking action within it. The logic of interpretation and action used by others could be learned from observed behaviors and a tradition of expectations could be built up by working together over time. Brown and Duguid (1991) have referred to this process as the development of “communities of practice”. But, as economic, political and market environments become more turbulent, and as technologies affecting design, production and distribution begin to change more rapidly, the diverse elements of a decentralized, networked organization face increasingly differentiated environments and develop unique local logics that could change rapidly. In circumstances of heightened uncertainty and complexity, it becomes more and more difficult to reliably take others into account in our independent actions, so that a coordinated outcome emerges.

The growth of the network-like organization is associated with the growth of knowledge intensive firms (Starbuck, 1992) such as those in the computer, pharmaceutical and biotechnology industries, which involve a complex synthesis of highly specialized expertise and knowledge domains (Purser, Pasmore and Tenkasi, 1992). The need to integrate distinctive knowledge domains has resulted in the development of new organizational forms, most notably the lateral-flexible form of organization (Galbraith and Lawler, 1993; Galbraith, 1994). Our research concerns the way information technologies can mediate and support collaboration through distributed cognition among multiple sets of expertise in lateral-flexible forms of

organization. Our findings to date indicate the importance of recognizing and supporting the process of hermeneutic inquiry (Boland, Tenkasi and Te'eni, 1994) through which distinct communities within an organization strengthen their distinctive ways of knowing, which we refer to as perspective making, and communicate about their perspectives with other communities, which we refer to as perspective taking (Boland et al., 1992; Boland and Tenkasi, 1995). Creatively managing the dynamic tension between making strong perspectives within a community of knowing and a being open to taking the perspective of another community of knowing is essential for collaboratively developing organizational knowledge. We find that the interdependent, dynamic processes of perspective making and perspective taking are achieved through dialogues that involve the narrativization of experience as well as explicit rational analytic procedures, and that both require a heightened sense of reflexivity.

### **The Role of Perspectives in Distributed Cognition**

Actors in an organizational setting have their own perspective through which they identify and interpret the salient features of their situation, understand the values and goals of the organization and employ a logic of action. For the individual, Boulding (1956) has referred to this perspective as an "image," Pepper (1942) has referred to it as a "world hypothesis," and Bartlett (1932) has referred to it as a "schema." In parallel with this, a number of scholars have commented on the unique cognitive repertoires that can develop at the group level. Fleck (1935/1979) has referred to a group's perspective as a "thought world," Fish (1980) has referred to it as an "interpretive community," and Barnes (1983) has referred to it as a "context of learning."

People in organizations do not have many opportunities to actively and openly reflect upon the characteristic way that they or their group interpret a situation or display a theory-in-use in their organizational practice (Argyris and Shon, 1978). This lack of reflection upon their interpretive practices has been identified as a potent reason for organizational failure (Starbuck and Milliken, 1988; Nystrom and Starbuck, 1984). Achieving significant change in the understanding of group members requires them to reflect upon existing assumptions, processes and structures. Making representations of those perspectives and placing them open for discussion is one way of doing so (Bartunek and Moch, 1987). Our first research question was how to enable individuals to make their perspectives visible and exchange them among those with whom they interdepend.

Much of social behavior is predicated upon assumptions an actor makes about the knowledge, beliefs, and motives of others. This process of perspective taking is fundamental: in any communication, the knowing of what others know is a necessary component (Bakhtin, 1981; Krauss and Fussell, 1991). As Brown (1981) has observed, effective communicating requires that the point of view of the other be realistically imagined. Others such as Rommetveit (1980) 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*.” (p 126).

Coordinated behavior of most kinds, including bargaining and similar structured interactions, requires that participants plan their own moves in anticipation of what their partner's motives are likely to be. Festinger's (1954) social comparison theory postulates that people evaluate

their own abilities and beliefs by comparing them with how they assume abilities and beliefs are distributed in their reference population. Predicting the other's moves requires extensive assumptions about what the other knows, wants, or believes, which is the process of perspective taking.

Clark and Marshall (1981) describe several heuristics that speakers and listeners might use to establish their *mutual knowledge* or the common ground of knowledge that they share, and know that they share. One such heuristic is the linguistic co-presence heuristic, in which, anything said at time T during the course of a conversation can be mutually assumed to be known at time T+1. However, others have argued that the reasoning communicators employ to assess what they and their co-participants mutually know is much more complex than such simple heuristics suggest (Mead, 1934). But even with this simple heuristic there is a deep underlying problem, since the thing said at time T is a string of words, and what is assumed to be mutually held at time T+1 is the meaning of that string, which may differ radically between communicators. This is the fundamental distinction between a signal which, by convention, indicates a specified action or object, and a symbol, which always carries a surplus of metaphorical referent and possible meanings (Giddens, 1979).

The task of assessing the knowledge held in common by members of a community, such as managers in an organization, is a complex one, and involves a variety of inferential and judgmental processes. Individuals may utilize a variety of inference heuristics to estimate what others know. Such heuristics can facilitate the task of drawing inferences, but they also can induce systematic errors and biases (Kahneman, Slovic and Teversky, 1982). For

example, an actor may use the *availability heuristic* to assess what others know. The ready availability of his own perspective may lead him 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 and 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; Mead, 1934).

The implication of these biases and heuristics is that humans communicate in organizations based upon implicit understandings of the beliefs, values and knowledge of others which are for the most part untested and assumed to be the same as one’s own. Dougherty (1992) provides detailed case studies of communication in product development teams, and shows how unsuccessful teams failed to identify and reconcile qualitative differences in their perspectives. As a result, they did not appreciate the same elements in the environment as being important, did not take the activities and priorities of others into account, and did not appreciate the differences between their “thought worlds” and the unique insights each had to offer. The communication that was needed, however, was not a message about those differences, but an appreciation of the way each group had a total and coherent view that was different from the others. As Dougherty (1992) put it, “Nor is the problem like the proverbial



set of blind men touching a different part of the 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, we see the problem of integrating knowledge in distributed cognition not as the sharing of a message or the joint access to the same data, but as a problem of: 1) making the unique knowledge and meanings of each group more accessible by strengthening and representing them, and 2) of exchanging and discussing those representations with others. It is a problem of perspective making and perspective taking in which the ability of each unique community of knowing to elaborate, differentiate and complexify its own perspective is balanced with the ability of communities to engage in dialogue among themselves about those perspectives.

### **A Tool for Making Perspectives Visible**

We have developed a software system named *Spider*<sup>1</sup> that enables individuals to create visual depictions of their perspective on a situation in the form of a cause map, showing their belief as to the factors that influence their sphere of concern. A cause map is a directed graph whose nodes represent concepts or factors in the individual’s decision domain, and whose arcs represent beliefs about cause-effect relations between source and destination nodes. We have tested the Spider system in several different settings where managers first made a map of their own causal understandings of the situation they faced and then exchanged cause maps and discussed the similarities and differences. We have found that just as Weick and Bougon (1986) suggested, building a cause map is highly evocative for the map creator as well as

surprisingly informative to the colleague who discusses it with them. Because the map making process confronts a person with explicating personal beliefs as to cause and effect in the organizational setting, it is an occasion to think carefully and deliberately about a situation in a way that is quite different from an everyday organizational experience. Similarly, discussing one's map with others almost always raises awareness of differences in perspectives that had gone undetected, sometimes for many years.

In our initial project, we worked with business unit planners from a large international manufacturing company who made and exchanged cause maps of the factors that would determine success or failure for the new products they currently had under development. These managers engaged in distributed cognition because each had interdependencies with other business units which should be taken into account in their individual actions. The managers used Spider to represent their understanding of the market for their products and to exchange and critique those representations among themselves in dialogue.

Project members from the company come from engineering, marketing, sales and manufacturing departments. Each company participant is involved in making quarterly sales forecasts of the company's major products over a three-year time horizon in units and dollars. The departments are different communities of knowing, and actors from these unique environments find that effective communication is very difficult to achieve. It requires substantial effort in representing their own context of assumptions and understandings and in exchanging those representations with others in a meaningful dialogue.

Traditionally, a researcher has constructed a decision maker's cognitive map for the researcher's own purposes, and has taken it to be a rather static representation (Axelrod 1976, Huff 1990). Our use of cognitive maps is unique in that these managers construct their own maps: exchanging them, critiquing them, modifying them and generally making them their own representation and communication device.

### **Cause Mapping as a Constructive Process**

In our experience with the business unit planners, as well as in our subsequent work with a wide range of managers and other professionals, including physicians and ministers, we have found the map making experience to be a more creative, constructive one than we had anticipated. We had expected that the Spider cause mapping system was essentially a tool for depicting an understanding an individual possessed, well developed and resident in the person's memory, ready to be portrayed as a map. What we found instead is that individuals would start making a map by putting up several factors, along with some causal relations and would then shift to a mode of discovery rather than representation. In discovery mode, factors would be put up, relations would suddenly be seen, and new factors would be suggested.

Typical comments made while working on maps, after the first few elements had been incorporated, would be: "Look what's emerging here", or "Oh, this is interesting". The map maker would be actively constructing an understanding while engaging with the tool. This suggests that the managers did not have well formulated causal understandings in the first place, and that the opportunity for reflexivity in the construction of maps was itself an innovation in their managerial practice.

The recognition that managers were experiencing a sense of discovery during map making, that they were actively constructing an understanding through reflecting upon the map as it was being developed, was a challenge to our original assumptions. We had entered into this project expecting that managers already had complex understandings of their situation and that the tool was going to be a simple and convenient way to make it visible. We had thought our project was about communication and that the problem was to provide an efficient, easy-to-use communication channel. But we came to see that it was really about reflexivity and interpretation, both in the construction and in the reading of maps. We have come to see communication of perspectives in distributed cognition not as a transmission of a message, but as a series of dialogues - first with oneself while constructing an understanding in the form of a cause map, and then with another while exchanging and discussing those cause maps. The communication is in these dialogues, not in the map as a transmitted message.

A second challenge to our initial assumptions came listening to what people said as they went about constructing a map. They do not use the abstract categories of causal factors and relations to think through the construction of the map, but instead use a process of storytelling. Instead of identifying a factor to include in a map by generalizing through inductive reasoning, and instead of linking factors with a logico-analytic statement of their causal relationships (if  $x$  increases, then  $y$  increases), our map makers would put a factor into a map and link it with other factors by telling a story about a dramatic incident with a customer, a competitor, a product designer, or another manager. This suggests that their way of thinking through their situation was not so much an exploration of a problem space using logical operators as suggested by Herbert Simon (1977) and others, as it was a narration of their experience of

being in that situation. Through narrating their experience, they identified important factors and explored how they were linked together. Subsequently, we have drawn upon the work of Jerome Bruner (1990) who posits that narrative is a fundamental mode of human cognition, and have found his work very helpful in understanding how people coordinate activities not only through exchanging messages about states and actions, but also through narrativizing real and hypothetical events in discourse with self and other (Boland and Tenkasi 1995). We even found this narrative mode of cognition to be evident when managers analyzed the seemingly abstract and unambiguous representations of an accounting budget report (Boland 1993). There, we observed that managers interpreted budget and performance reports by bringing to life the persons behind the numbers, endowing those persons with motivations and intentions, and narrating a sequence of events which produced those accounting numbers.

### **Rethinking Communication in Distributed Cognition**

Based on our work in this project, we now see the process of communication and coordination in distributed cognition much differently than we did at the outset. We had thought of communication as a problem of representing and transmitting a causal understanding in the form of a directed graph, and coordination as emergent from the actions of multiple agents who were better able to take each other into account having received and analyzed those messages. That way of thinking about communication and control assumes that a person already has a schema or cognitive map that can be made visible in the first place, and it also assumes that shared meanings and a resulting coordination can be achieved when these schemas or cognitive maps more or less coincide among members of the firm.

The notion of schemas and shared meanings now seems much more problematic. If a cause map is developed through a creative, constructive process - if it is not 'just there' to be recorded and exchanged with others - what could it mean to say that managers do or should have 'shared meanings'? When each actor must, in a sense, invent an understanding, how can one speak about people sharing something that they have yet to inventively construct? One possibility is to return to one of the origins of our use of terms like schemas, cause maps and frames, namely the work of Bartlett (1932) who adopted the notion of schema from Sir Henry Head to interpret his own studies of remembering. A review of his classic study shows that Bartlett was not intending to suggest that a schema was a well-formed structure or somewhat stable, but that a schema was an active process of interpretation that was continuously being constructed, interpretively extended and creatively revised. In fact, he refers to the way subjects in his experiments appeared to simultaneously employ multiple schemas and to inventively make associations among them in constructing a remembrance.

With this in mind, we now think of communication and coordination in distributed cognition as a skill for reflexively narrativizing ongoing experience in a way that constructs and reconstructs understandings of a situation, and of engaging in dialogue with others about these narrativized representations. We believe that information technology can support this process by enabling the construction of cause maps and other representations that "mirror" the notion of schema, including diagrammatic depictions a story, pictures or graphic images, among others (Boland and Tenkasi, 1995). We find Susan Leigh Star's (1989) description of the role of a 'boundary object' in doing science work to be useful here. A boundary object is not a message being transmitted between people with different expertise on a scientific team, but

something that can be put out between them and used as a focus for a dialogue among them in which they explore its possible meanings and implications. It is an occasion for conversation, not a self contained message for transmitting and decoding by a recipient.

Using the idea of boundary objects, we are now exploring how cause maps, narrative maps and other forms of representation can be used in distributed cognition to improve organizational practices of communicating and coordinating. We are interested in how communities develop ways of knowing by forming practices of narrativizing experience and engaging in discourse about boundary objects.

### **Conclusions**

We see the task of information technology to be one of supporting human inquiry as a subjective, interpretive process of perspective making and perspective taking. This is a hermeneutic process of inquiry in which the individual “reads” the situation he or she is in, makes that reading available for others, and engages in conversation with them, seeking to extend each others horizons of meaning (Gadamer, 1975). What is required from information technology in distributed cognition are facilities of self indication, reflection and interpretation - an environment for active sense making in which individuals can construct representations of their changing understandings and explore them in conversation with others.

In addition to specialized software such as the Spider cause mapping tool discussed above, the emerging field of groupware systems provides an ideal opportunity to enable perspective making and perspective taking. One way to do so is to create a series of discussion forums.

Boland and Tenkasi (1995) identify a number of different ways that such discussion forums can be used to strengthen knowledge structures within a distinctive community of knowing, and also to enable dialogue on the perspectives of others. Such forums can allow for narrative as well as calculative forms of reasoning, can include cause maps as well as maps of narratives and can structure the discussion of such maps along with their implications for collaboration in knowledge work. We see communication and coordination as an ongoing process of interpretation through dialogue. We are excited about the prospects for designing information technologies, organizational structures, and group processes that better enable such interpretive dialogues.

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<sup>1</sup>The Weatherhead School of Management makes the Spider cause mapping software available without cost for educational use. Access it through the research heading at <http://weatherhead.cwru.edu>



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