TECHNOLOGY TRANSFER AS
COLLABORATIVE LEARNING

CEO PUBLICATION
G 94-2 (245)

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January, 1994

Introduction

The field of technology transfer studies has been traced back to the European beginnings of social science (Rogers, 1983) and in the United States to the 1920's with a continuing wave of interest and activity till the 80s (Backer, 1991). After a period of relative lull, the field has seen a resurgence in the late 80s and the 90s (Backer, 1991). Currently it is a subject which is receiving increasing currency in business, government and academic domains with uniform calls to develop more creative approaches to the problem of technology transfer (Reich, 1989; Breuder, 1988).

Although application of the term carries unique interpretations in different domains such as government, business, economic development, or drug abuse the common definition of technology transfer reflects the transmission of ideas, knowledge, information and/or equipment from the developer (normally a research laboratory) to the user (marketplace). The implicit model of the process is one of a 'source-destination paradigm' (Williams and Gibson, 1990) or a 'conduit model' of communication with the sender(s) transmitting information from one end and the receiver(s) faithfully receiving it at another (Reddy, 1979; Doheny-Farina, 1992).

The approach we take in this paper is that this information transmission model may be inadequate to represent the realities and complexities involved in effective technology transfer irrespective of the domain of application. Our contention is that a fundamental reframing of our understanding of the process needs to occur for technologies to be adopted successfully, particularly 'soft' (Backer, 1991), 'disembodied' (Feeny, 1985), or 'dynamic' (Greer, 1988) technologies as prevalent in the arena of drug abuse; technologies that are not equipment based but rather have to do with techniques, approaches and methods, or what is commonly referred to as procedural knowledge (Singley and Anderson, 1989). A shift in frame needs to take place, from one that views technology diffusion as a problem of knowledge/information transmission or even knowledge utilization to one of 'contextual-collaborative knowledge creation' through mutual learning.

The rest of the paper is organized in the following manner. We briefly review the traditional transmission models of technology transfer; point out the limiting operative assumptions of this predominant information transmission paradigm; propose a different set of assumptions about the nature of knowledge that provide the rationale for 'contextual collaborative knowledge creation' through mutual learning processes as an alternate model of technology transfer; examine potential barriers to such mutual learning; and conclude by discussing ways of facilitating contextual-collaborative knowledge creation for technology transfer.

Traditional models of technology transfer

While technology transfer is an umbrella term that covers an entire range of activities around development of technologies and their applications to the market place, attempts to model the process can be classified into three major approaches; the 'appropriability model', the 'dissemination model' and the currently popular 'knowledge utilization' model (Williams and Gibson, 1990). A fourth and emergent stream called the 'communication model' (Williams and Gibson, 1990; Gibson, Rogers and Wohlert, 1990; Doheny-Farina, 1992) is closer to our notion of technology transfer. However as we will clarify later in the paper the image of `communication' though definitely a step above the information transmission approaches still does not do justice to the complexities of the diffusion process.

The appropriability model follows the logic that good technologies sell themselves. It is really the quality of research and competitive market pressures that promote the use of research findings (Devine, James and Adams, 1987). Therefore purposive transfer mechanisms are unnecessary. Once the researcher develops the right idea and makes the results available through various forms of mediated communication such as technical reports and professional journals the customer will automatically show up at the inventor's door. Kozmetsky (1970) summarizes the dominant presumption of this approach as being grounded in a view of technology transfer as an automatic process; "the result of an automatic process that began with scientific research and then

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moved to development, financing, manufacturing, and marketing ....[One] did not necessarily need to be concerned with linkages in the technology commercialization process"

(p. 23).

The technology dissemination approach popularized by Everett Rogers (Rogers, 1983; Roger and Kincaid, 1981) takes the view that diffusion of innovations is best facilitated when experts inform potential users of the technology. The situation is one where an expert transfers specialized knowledge to the user who is normally a willing receptor. As Williams and Gibson (1990; p. 15) comment; "Once the linkages are established, the new technology will flow from the expert to the non expert much like water through a pipe once the channel is opened"

The Knowledge utilization model is an increasingly popular view of technology transfer reflected in much of the current literature (Zacchea, 1992; Szakonyi, 1990). The knowledge utilization paradigm represents an evolutionary step that focuses on strategies to put knowledge to effective use in the recipient settings (Backer, 1991). According to this model interpersonal communication between technology researchers and clients plays an important role. Further it also attempts to identify the organizational barriers or facilitators of technology transfer.

While there is an appreciation of the complexities of transfer, it has been argued that the knowledge utilization model suffers from a linear bias (Dimancescu and Botkin, 1986). "The stated or implicit notion is that basic research moves from researcher to client, in one direction, to become a developed idea and eventually a product. This model reduces the transfer process to chronologically ordered one-way stages, whereas practice shows the process to be interactive and complex" (William and Gibson, 1990, p. 15).

Unpacking the operative assumptions of the traditional models

The major arguments against the predominant transfer approaches is that they entail a 'one-way transmission' of information, from source to destination or from originator to receiver. While this is a valid criticism, we posit that the 'one-way transmission of information' is essentially a manifestation of three interrelated theses about the 'nature of [transferred] knowledge' that serve as

operative assumptions for the technology transfer / knowledge utilization field. The real challenge lies in reframing these operative assumptions particularly in relation to 'soft' or 'disembodied' technologies. Such a cognitive turn we believe is essential to get in touch with the realities and complexities of the transfer process and adopt a perspective of 'contextual-collaborative knowledge creation' as the heart of effective technology transfer.

The three conjoint operative assumptions about the nature of transferred knowledge are what we will term as the theses of 'knowledge is objective' 'knowledge is universally applicable' and 'knowledge is complete'.

1. *Knowledge can be objectively determined and will be objectively consumed*: The assumption behind this thesis is that truthfulness of knowledge can be empirically determined. Thus forms of knowledge that have been determined in such ways are objective, have validity, and will be seen so by others. An example would be that all high performers are driven by the need to achieve.

2. *Knowledge is applicable across contexts*: An interrelated postulate is that knowledge that has been objectively determined will apply uniformly across contexts and time. An example would be that irrespective of the country, people trained in achievement motivation will perform better.

3. *Knowledge is complete*: The assumption here is that knowledge can be created in its complete form by people who have the expertise. A single individual or group can hold all the requisite knowledge necessary for productive action and the issue is one of transmission of this knowledge so that non-experts (users) can put it to productive use. This assumption would be embodied in approaches to the diffusion of technology that involve 'packaging' or 'instrumenting' the technology. The diffusion of quality circles in the 1980s as a methodology for involving people in making process improvements in organizations is an example. Technology developers packaged steps, structures, training, and role descriptions in 'products' they sold to the users.

The above operating assumptions about the nature of knowledge are well reflected in the appropriability and the diffusion models of transfer. In the first model the users simply absorb the knowledge/technology 'as-is' and in the second instance the absorption of knowledge is facilitated through instructions by an expert. And one can infer that these one-way transmissions of knowledge are guided by the implicit frames of ' objectivity', `universal applicability' and 'completeness' of knowledge theses.

In the knowledge utilization model there is an element of two way communication. However as Doheny-Farina (1992) and Dobrin (1989) argue, the two way communication is primarily oriented towards maneuvering around the communication barriers between the originator group and the user group. The assumption still is that there is "a body of information, of objective facts, just lying there waiting to be communicated" (Dobrin, 1989, p. 60). The underlying tenet is that knowledge is an object that exists independently, is valid, is complete, and has universal applicability. It is the job of the implementers to transfer the knowledge correctly through the appropriate channels. If there are problems with the user group adopting this knowledge it is because they do not understand. This would entail finding better ways of managing those channels to achieve better dissemination or diffusion of knowledge.

If the foregoing assumptions about knowledge (objectivity, universal applicability and completeness) were true then the information transmission model is most appropriate. Then technology transfer would be a simple process of moving innovations from one source to one or more receivers. However, we believe a that a different set of theses about the 'nature of knowledge' are closer to managing the complexities of technology adoption. An alternate set of assumptions that presents us with a rationale to understand technology transfer as a process of contextual knowledge creation through collaborative learning. In the next section we will examine this alternate set of assumptions and provide case examples to illustrate how they are closer to the complexities of the technology transfer process.

An alternate set of assumptions about the nature of knowledge

In contrast to the generally accepted views of knowledge, we posit that three different assumptions can provide a more relevant set of operating assumptions to comprehend the technology transfer process; 'knowledge is subjectively constructed', 'Knowledge requires contextual adaptation' and 'knowledge is incomplete'. In essence these alternate set of assumptions are;

1. *Knowledge is subjectively constructed and may be subjectively consumed*: Knowledge is a belief or set of beliefs about a segment of reality that is socially constructed by a community of knowing (Denzin, 1989). It is based on a set of assumptions about the nature of such segment of reality. And any information or knowledge, irrespective of how well it is empirically determined by an outside authority, may still be subjectively consumed. Each community of knowing (development versus marketing) has it's distinct interpretive conventions, whether they be a "community of nuclear physicists, cabinet makers, high school classmates, street corner society...(Brown and Duguid, 1991; p. 48). Kuhn (1970) calls this the 'incommensurability' of meaning systems among different communities of knowing.

Fleck's (1979) concept of 'thought worlds' is similar to Kuhn's notion. Thought worlds emphasize 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 that provides a readiness for directed perception. A fund of knowledge can be for example be primarily 'conceptual' (such as research and development) acquired through education, training and laboratory experimentation or 'practice based' (such as marketing) acquired through direct interaction with customers.

Ideas cannot be easily shared across thought worlds with different funds of knowledge and systems of meaning. People in different thought worlds will attempt to interpret each other's ideas

based on their unique thought worlds. If such interpretation fails then they may view the other's central issues as esoteric, if not meaningless.

A good illustration of this subjective construction and consumption of knowledge in technology transfer is provided by Dougherty (1992). In her study of transfer processes in 18 new product efforts she found that key players from development, manufacturing and marketing interpreted and understood issues around technology-market linking in qualitatively different ways from each other. The technical (research) group's focus was on establishing the product's performance specifications. They defined the market in terms of what the product could do; the stress was on product features. However when research transferred their technology to marketing they looked for what the user wanted to do with the product; and the user needs were unique or constantly changing. Manufacturing people's concern was with reliability, quality, and manufacturability and they evaluated and defined the product and the market in those terms. They felt the higher the number of product features the more difficult it was to establish reliability and quality. When transferred products were very antithetical to what the manufacturing and/or marketing groups defined as product requirements, the process of transferring and adopting the technology became extremely difficult.

2. *Knowledge may require contextual reconfiguration to be adopted in the new context, otherwise it could be rejected outright*: For a community of knowing to adopt an idea, information or knowledge from a different community of knowing, the information or knowledge may have to be reconfigured or adapted to fit in with the recipient community's meaning system. External ideas that may not fit in with one's system of meaning may be rejected outright (Fleck, 1979).

Drawing on Gidden's (1974) theory of structuration, Orlikowski and Robey (1991) and Poole and DeSanctis (1992) call this reconfiguration process as the phenomenon of appropriation. The theory of structuration essentially argues that human understanding and behavior is contextual. Knowledge, cognition, and behavior in any social system is guided and constrained by the contextual rules and resources resident in the social structures. And actors use these rules to make

sense of their own acts and those of other people. The structurational coventions that condition human understanding, behavior, and practices are constituted by three interdependent structures, what Giddens (1974) terms as the 'modalities of structuration'. These interdependent structures are interpretive schemes, norms and power relationships.

Interpretive schemes are standardized, shared stocks of knowledge and beliefs that actors in a setting draw upon to interpret behavior and events. Norms are the rules governing sanctioned or appropriate conduct. Power enters into human interaction by providing humans the capabilities to accomplish outcomes and most social systems are marked by an asymmetry of power distribution. Frequently there is a defined pattern of power relationships within a social system.

Technology or for that matter any external knowledge or information may be appropriated by a social system within the context of it's structurational conventions. The structurational conventions can mediate the appropriation process. If an idea is too antithetical to a system's structurational conventions then the system could reject it. So the task becomes one of reconfiguring the technology to fit the situational contextual requirements or changing the structurational conventions of the recipient group.

Kelly et.al. (1993) illustrate how social norms of certain communities stifle the adoption of technologies intended to combat HIV infection. They argue that social and peer norms that favor risk taking behaviors have come in the way of accepting safe sex practices and technologies. The drive now is to try and create new norms of social responsibility to foster openness to safe sex practices.

A good example of contextual adaptation of received knowledge is illustrated in the global campaign to eradicate smallpox (Thachankary, Tenkasi and Cooperrider, forthcoming). Smallpox, a dreadful disease known to mankind since 12th century B.C, was successfully eradicated globally. As the result of a ten year effort spearheaded by the smallpox eradication unit instituted by the World Health Organization, the last case of smallpox was detected in Somalia in 1977. However the technology (in the form of a vaccine) to eradicate smallpox had been in existence for over 177 years. In fact several earlier attempts to combat the dreadful disease failed; "a century

and a half of vaccination attempts yielded only modest results" (Fenner, et.al, 1988, p. 1346). One of the major barriers to the earlier campaigns was that in many countries the indigenous system of medicine held beliefs and advocated practices that interfered with the concept of vaccination.

The earlier programs tried to force the vaccination technology without understanding or acknowledging these local belief systems. However, in the case of the successful campaign some of the local leaders recognized this problem and made an attempt to present the vaccination technology as complementing the local knowledge and belief systems. For example, in India the folk goddess of smallpox was a deity named Shitala Mata. She was represented as riding on a donkey with a basketful of grain on her head. In one hand she had a pitcher of water and in the other a broom. The belief was that when she shakes her head the grains that spill turn into smallpox pustules. The victim survived if she cleaned the spilt grain with water, but did not if she only used the dry broom. To incorporate the vaccination technology within this local meaning system, hundreds of large posters were created where the water in the goddess's hand was replaced by a large syringe containing the vaccine.

In a similar vein Brown and Duguid (1991) present interesting examples of how Xerox repair service technicians effectively appropriated and modified the 'prescribed and directive repair procedures and knowledge' of the company, to develop local and often more effective know-how and methods to fix malfunctions. This modified knowledge became part of their community of interpretation.

Bruce and Peyton (1990) argue that such reconfiguration of received knowledge is essential for successful innovation adoption. They posit that the so called distortion of innovations is in reality adaptation of innovations to suit the local context. These perceived distortions are an integral part of 'appropriating' the technology or fitting it to the situational context of the transfer domain. This might well be a pre-requisite for successful adoption of an innovation.

"The prevalence of distortions of innovations is a clue that the conventional model of implementation is inadequate. The "distortions" arise because the innovation is not the only active element....In reality, the innovation is but one small addition to a complex social system.

Instead of seeing it as the primary instrument of change, it is better to see it as a bit of raw material that may stimulate the creation of something new.

We are thus led to a different model for implementation of innovations. In this model, the active agents are not innovations, but the participants in the setting in which the innovation is placed. These participants develop a perception of what the innovation is and then re-create it as they adapt to fit with institutional and physical constraints, and with their own goals and practices. What they produce are different realizations of the original innovation (Bruce and Peyton, 1990; p. 172-173).

3. *Knowledge is incomplete (both received and contextual) and effective contextual adaptation may require a creative synthesis of different thought worlds to produce new knowledge*: Frederich Hayek (1945), a Nobel price laureate in Economics has argued that the knowledge necessary for productive action rarely resides in any one place, person, or group, but is divided throughout society. The knowledge challenge society faces is how best to tap into and communicate the additional knowledge required for effective action.

This premise implies that effective contextual reconfiguration of knowledge cannot be purely based on the receiver's thought world since it is as incomplete as the originator's thought world. Knowledge for effective action requires a fusion of distinct knowledge domains. As Dougherty (1992) found in her research, thought worlds can selectively filter information and insights. Because of different funds of knowledge, a certain thought world is likely to best understand certain issues and further ignore information that is equally essential to the total task. Relying on such partial knowledge may result in ineffectual 'contextual adaptation'.

Poole and DeSanctis (1992) term this process as 'ironic' appropriation. In their study of adoption of computer technology by users they found two types of appropriation patterns; faithful appropriation was when the technology was adapted to the local requirements but was still consistent with the 'spirit' of the technology. Spirit is defined as the general intent of something and can be construed as the designer's intention behind the technology. An 'ironic' appropriation involves use of a technology that is inconsistent with or violates the spirit of the technology. As they clarify the faithful-ironic distinction lucidly; "Ironic use of a GDSS does not include using it

in creative ways different from those envisioned by the developer...It means using the system in a way that violates or negates its spirit" (p. 10).

Orlikowski (1991) provides a good illustration of such ironic appropriation. In her example she describes a company that had implemented new information technology 'aids' designed by the developers with the intention of enhancing productivity, delegating and enriching work at lower levels of the organization by providing users with the requisite knowledge to carry out more complex work, and facilitating better communication among levels of organization. However in actuality the information system was used for electronic surveillance and constant monitoring of employees by the managers. This ironic appropriation resulted in producing the opposite effects of what was intended with the introduction of the technology; lower productivity, less communication, lower morale, and tighter controls. The managers were left wondering as to what went wrong and blamed the systems development department for giving them a technology that did not work.

Dougherty attests to the fact that effective contextual adaptation was best achieved when there was a creative synthesis of distinct knowledge domains. Successful product transfers involved a fusion of 'conceptual knowledge' of the development group and the 'practice based knowledge' of the marketing group. The various actors established collaborative mechanisms that took into account their unique interpretive dynamics, --their distinct thought worlds-- and interactions at this core level of understanding made possible joining of their knowledge domains to produce new insights and new facts. Successful technology transfer required the creation of new knowledge through collaboration and mutual learning.

The problem with soft technologies

The subjectivity of knowledge, the need for contextual adaptation, and dialoguing at the level of values, assumptions, and beliefs takes on more acute proportions with soft or disembodied technologies. Soft technologies such as procedures or systems can be conceived of as essentially 'social practices' that may reflect a specific system's structurational conventions about how to

organize, work, or manage people. They are more abstract than hard technologies and the developer's contextual assumptions behind the nature of the technology have to be explicated and their relevance have to be examined in light of the contextual background of the recipient. This combined approach may result in creative approaches to contextualize the technology productively.

Hofstede (1980) extends an interesting example of how attempts to transfer 'Management by objectives' (MBO) to some other countries failed miserably. He argues that MBO presupposes that subordinates are sufficiently independent to negotiate meaningfully with their boss, and that performance is seen as important by both.

When MBO was first introduced in France in the 1960s people expected that this new technique will result in the long overdue improvements in productivity. However by 1970 MBO was severely discredited in France. The reason argues Hofstede is that the French culture encourages dependency relationships among superiors and subordinates. The traditional hierarchical structure protects against anxiety, while MBO generates anxiety.

As Hofstede (1980; p. 325) elucidates;

"The reason for the anxiety in the French cultural context is that MBO presupposes a depersonalized authority in the form of internalized objectives; but French people, from their early childhood onward, are accustomed to large power distances, to an authority that is highly personalized. And in spite of all attempts to introduce Anglo-Saxon management methods, French superiors do not easily decentralize and do not stop short-circuiting intermediate hierarchical levels, nor do French subordinates expect them to."

Technology transfer as contextual-collaborative knowledge creation

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These alternate sets of assumptions about the nature of knowledge provide us with a different view of technology transfer; that it entails the creation of new knowledge. If innovations have to be adopted successfully then knowledge has to be contextually adapted; "technology transfer demands the shaping of the technology to fit the detail of the different system which comprises the new context....contextual mapping to use the jargon of morphological analysts" (Bradbury 1979, p. 112). And effective contextual shaping is best achieved by a fusion of thought worlds that makes possible new knowledge, new insights, and new facts through creative joint learning.

Viewed from this angle technology transfer involves more than information transmission or knowledge utilization. It even suggests an evolutionary move beyond the emergent 'communication' images of technology transfer to a learning notion since successful transfer and adoption requires the creation of new knowledge. Webster defines the verb communicate as "to air; to make known" while the verb to learn is " to understand, to discern, to acquire knowledge or skill". While communication is an essential aspect of learning, it cannot replace learning. Learning is more than a message exchange process, and as Dougherty evidenced it is the act of dialoguing at the level of interpretive dynamics; the task of opening up one's preconceptions, assumptions, and meaning systems to oneself and to others (Habermas, 1981).

In sum, collaborative learning requires a process of mutual 'perspective taking' where distinctive individual knowledge, meanings, assumptions and beliefs are exchanged, evaluated, and, integrated with that of others (Duncan and Weiss, 1979; Shrivastava, 1983). Much of social behavior is predicated upon the assumptions an actor makes about the knowledge, beliefs and motives of others. The knowing of what others know is a necessary component for coordinated action to take place. As Brown (1981) observed, understanding another requires that the point of view of the other be realistically imagined. 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. This is the essence of the process of 'perspective taking' (Bakthin, 1981; Clark, 1985; Krauss and Fussell, 1991).

Barriers to perspective taking

Mutual perspective taking of each other's knowledge and background into account is fundamental for collaborative learning. However it is a complex process and can frequently break down. There are two principle and interrelated barriers to mutual perspective taking; namely that knowledge and meaning systems of a community of knowing are often `tacit and taken for granted' and second because such knowledge and meaning systems are 'tacit and taken for granted' and one's interpretative procedures are so automatic that most people assume that the rest of the world's perspectives are similar to one's own than they actually are.

Knowledge as tacit and taken for granted: At least part of the knowledge, beliefs, meaning systems and norms that form the structurational or interpretive conventions of any group or 'community of knowing' are tacit in nature. Understanding and interpretation involve a great deal that is not explicit or explicable, that is framed and developed in a critically communal context and that one is not aware of in the daily conduct of life (Brown and Duguid, 1991).

As Giddens (1974) elaborates, there are at least two levels of consciousness in any social system; 'discursive' consciousness that involves knowledge which actors are able to express at the level of discourse, and 'practical' consciousness' that involves tacit stocks of knowledge which actors are normally not able to formulate discursively, but draw upon in the constitution of social conduct.

Collins (1983) also notes the hidden nature of such processes. He argues that many times it is only when the rules go wrong that a community of knowing examine the nature of their interpretation. "otherwise, our giving of meaning to objects- out interpretative practices are so automatic that we do not notice that any interpretation is involved" (Collins, 1983; p. 90).

False assumption that other's knowledge and meaning systems are similar to one's own than they actually are: Since a group's knowledge and meaning systems can operate outside the bounds of day- to-day consciousness there is a tendency to automatically assume that others' world views are similar to one than they actually are. Fleck (1979) calls this the 'inherent tenacity' of thought worlds to focus on their own perspectives.

The false consensus effect, in which subjects assume that others are more similar to themselves that is actually the case (Ross, Green 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 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.

Denzin (1989, p. 11) elucidates how this false consensus effect can come in the way of designing effective social programs:

"In social life there is only interpretation. That is everyday life revolves around persons interpreting and making judgments about their own and others' behavior and experiences. Many times these interpretations and judgments are based on faulty, or incorrect understandings. Persons for instance mistake their own experiences for the experience of others. These interpretations are then formulated into social programs that are intended to alter and shape the lives of troubled people....But often the understandings that these programs are based on bear little relationship to the meanings, interpretation, and experiences of the persons they are intended to serve. As a consequence there is a gap or failure in understanding. The programs don't work because they are based on a failure to take the perspective and attitude of the person served"

Facilitating the Perspective taking process as mutual learning

Perspective taking cannot be facilitated by normal structures of integration. As Dougherty (1992) experienced in her research, the traditional integrative mechanisms, such as project teams and matrices, structures that are often recommended for innovation and technology transfer (Tushman and Nadler, 1986) did not help the mutual exchange of perspectives. Rational tools and processes, the infusion of market research information, and the redesign of organizational reporting structures, while important, were not enough to manage the transfer process.

These traditional measures were not sufficient since they did not deal with issues of interpretation; they did not provide for the opening of one's preconceptions, assumptions, and meaning systems to oneself and to others (Habermas, 1981). Becoming aware of tacit consciousness requires self-reflexivity on part of the actors. 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 one will be able to notice the assumptions, beliefs, and meanings that is the basis of our knowledge. And perspective taking best happens when individuals interact with each other at the level of interpretive dynamics.

Facilitating perspective taking requires what we will summarily term as **interpretive spaces** for mutual learning and joint meaning making. According to Denzin (1989) interpretation or the act of interpreting creates the conditions for understanding. Thus interpretive spaces are interactional mechanisms that create the conditions for understanding by intervening at the level of knowledge structures, interpretive schemes or 'thought worlds' and bringing them to conscious awareness and facilitating their exchange in a process of mutual dialogue.

Surfacing interpretive schemes enables the explication of hitherto tacit knowledge (Polanyi, 1967) and extends a space for deeper self-reflection of one's interpretations. The process can be evocative since it can reveal an individual's personal cause and effect logic. This in turn forces the individual to confront the reasonableness and validity of tacit cause and effect understandings. Comprehensive understandings of a situation can be best developed by making possible for individuals to portray their original understandings of a situation, self-reflect, re-examine these displays in the process of exchange with others and come away from these re-examinations with different interpretations and perspectives of what they might mean (Weick, 1990).

This need can be abstractly described but the issue of practice is to concretize it and make it actionable. The 'technologies' for perspective taking are just beginning to evolve. We will briefly present three such approaches that support interpretive processes and collaborative learning. The different approaches though rooted in different disciplines (Information and decision

sciences, organizational development, and sociology) are in their own right interpretive spaces and mechanisms aimed at creating conditions for understanding through mutual perspective taking between disparate 'thought worlds'.

Spider, a computerized interpretive medium for perspective taking: Spider is a computer aided interpretive environment for people to portray in a structured way their interpretations and causal understandings of a situation, reflect on these interpretations, and share their interpretations with others in dialogue (Tenkasi, Boland and Purser, 1993; Boland, Tenkasi and Te'eni, forthcoming).

One of the central elements in Spider that enables the surfacing of tacit assumptions and knowledge are cognitive maps. Also called cause maps, belief nets, and influence diagrams, cognitive maps reveal the causal logic behind a persons view of a situation. The effectiveness of the cognitive mapping model to elicit tacit knowledge has been well documented. According to Weick and Bougon (1986) a cognitive map provides an occasion to think carefully, deeply and deliberately about a situation and the knowledge in a cause map gives knowledge about an organization.

Spider enables each actor to build a cognitive map of the factors that influence his/her sphere of concern, and each factor in a map in turn is linked to other maps, spreadsheets, descriptive notes, or graphs for revealing underlying assumptions. The multiple forms of representing one's understanding enables an actor to build a multi-layered and rich depiction of a complex understanding. Individuals can mail their understandings to other actors who are system users.

Our early experiments with Spider with a group of product planners have shown that this computerized interpretive medium has been a source of new understanding for the managers involved. The intellectual effort and careful self-examination required to interactively construct a cognitive map and the process of exchanging understandings and comparing their own assumptions, beliefs, and causal logics behind a situation vis-a-vis others have led to significant new learnings and collaborative approaches.

Search Conferencing: An Organization Development approach popularized by Weisbord (1987), 'search conferencing' is a powerful method to "excite, engage, produce new insights, and build a sense of common values and purpose" (p. 285). It is an exercise in learning, awareness, understanding, and mutual support.

Frequently in a search conference all parties who are stakeholders to a decision are brought together; the whole system to the extent possible. Next the groups go through a series of activities to examine their past and present, with a specific emphasis on laying bare their understandings, assumptions, beliefs and meanings to themselves and one another. Participants use different devices such as stories, pictures and skits to help them explicate their tacit understanding to oneself and to others. The whole system looks at this information, interpret what they find, and draw conclusions for action for the future. Successful search conferences always uncover shared values, new possibilities, and congruent action plans for the future.

Interpretive interactionism: Grounded in sociological theory, interpretive interactionism (Denzin, 1989) is an approach to social research that renders to clarify meanings. By producing meaningful descriptions and interpretations of social processes from the subjective point of view of different actors, interpretive interactionism attempts to create conditions of understanding and "translate what is said in one language into the meanings and codes of another language" (p. 32). It is a mode of research that can expose and reveal the assumptions that support competing definitions of a problem.

The interpretive researcher uses naturalistic inquiry methods such as case studies and biographical approaches to identify different definitions of a problem and competing models of truth that may operate in an interactional setting. Armed with this rich data the researcher then facilitates the process of mutual perspective taking and collaborative learning among the different parties.

Conclusion

In this paper we have called for a fundamental reorientation of our understanding of technology transfer. A shift that is based on a different set of assumptions about the nature of knowledge- one that appreciates knowledge as subjectively constructed and consumed, that knowledge may require contextual modification to be adopted in the new context, and effective contextual adaptation may warrant a creative synthesis of different thought worlds to produce new knowledge. A turn that implies a move away from the traditional information transmission approaches to one of collaborative learning through a process of perspective taking.

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