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Designing and Deploying Coordination Technologies for Fostering Organizational Working and Learning: From vision to reality?

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Abstract

Coordination Technologies (CT) that support various aspects of organizational working are now available in commercial markets. Still, research on their organizational use has shown their success is mixed. I employ Argyris' organizational learning theory to find out why organizations have been less successful in exploiting CT to support organizational effectiveness than their designers had hoped. Specifically, I identify two areas where explanations as well as potential solutions can be found: (1) people in organizations do not behave in the way the designers expect and (2) the designers of CT do not behave in the way they think they do. Drawing upon theory-based argumentation and a review of the literature, I argue that the benefits of CT will not be fully realized until organizations can deploy CT not only for routine communication and coordination but also for fostering on-going reflection of their working and learning practices, and for negotiating control over the rules and resources employed in these practices. Next, I focus on how organizations could design CT for use beyond routine tasks. I propose using a combination of Issue-Based Information Systems (IBIS) and Case-Based Reasoning (CBR) as a CT platform to support organizational working and learning. I evaluate this platform in light of the theory. But organizational change toward continuous learning and the use of CT to support working and learning are co-dependent and co-evolutionary. Consequently, I recognize two intertwined conditions needed to use CT successfully: (1) an organization's ability and willingness to become aware of cognitive and structural anomalies before and during the implementation of CT, and (2) the aptitude of CT in fostering and reinforcing this awareness. Finally, I use a case study to illustrate these conditions.

Keywords: coordination technology, defensive fit, negotiated control, organizational learning, reflection, and emory, productive reasoning, issue-based information systems, case-based reasoning.

1. Introduction

Rapid environmental and technological changes require flexible and effective team-based organizations. To meet the challenges of change, teams are now increasingly responsible for both thinking and doing, i.e. work as a whole. This places new demands on the competence of workers while at the same time making jobs more interesting and rewarding. For information systems to be useful in this context, their designers must acknowledge these conditions. Cleveland (1985, p. 18) points out: "Not 'command and control' but 'conferring and networking' become the mandatory modes for getting things done. … 'Planning' cannot be done by a few leaders. … Real-life planning is the dynamic improvisation by the many on a general sense of direction. … More participatory decision making implies a need for much information, widely spread, and much feedback, seriously attended, as in biological processes. … That means more openness, not as ideological preference but as a technological imperative."

A myriad of computerized systems such as computer conferencing systems, multi-user editors, workflow systems, and group decision support systems have been designed to support various aspects of individual, group, and organizational working (Bannon 1993, Ellis *et al.* 1991). These systems are increasingly available in commercial markets. In this paper, I call these systems Coordination Technologies[1] (CT). Their designers[2] have acknowledged participation, openness and many other requirements posed by team-based organizations. Yet research on their organizational use has shown mixed results (Grantham & Carasik 1988, Grudin 1988, Kling 1991, Markus 1994, Orlikowski 1992b, Orlikowski & Gash 1994, Perin 1991). I use organizational effectiveness as the measure of success. Effectiveness is a function, at the very least, of both reliable, efficient work routines and the ability to question these routines, to experiment with new ones to create flexible interpretations of computer-supported work, and to enact these interpretations to invent organizational environment (Daft & Weick 1984).

I employ Argyris' (1990) organizational learning theory to uncover why organizations have been less successful in exploiting CT to increase organizational effectiveness than the designers of CT had hoped. This theory argues that the traditional means of organizational change such as reorganizing work are necessary but not sufficient. To excel in the future, organizations must also learn to reflect upon and possibly change their behaviour in order to overcome defensive routines; they must learn how to learn. This theory has been used to interpret existing approaches to information systems design and implementation (Levine & Rossmoore 1994, Salaway 1987). I argue in this paper that the theory may also provide a fruitful direction of organizational and technological change that would improve the likelihood CT can be successfully deployed.

Organizational change toward learning orientation and the use of CT to support working and learning are co-dependent and co-evolutionary (DeSanctis *et al.* 1993, DeSanctis & Poole 1994, Lyytinen & Ngwenyama 1991, Markus & Robey 1988, Orlikowski 1992a, Orlikowski & Gash 1994). I regard the organizational learning theory as an emer-

gent process theory (Markus & Robey 1988), according to which the maximum benefits of CT are unlikely to be realized unless the organization (1) learns how to learn and (2) employs CT to reinforce organizational learning in addition to using them to control and coordinate work processes. For example, Ciborra & Lanzara state (1994, p. 64) : "... the effective adoption of new systems can only occur through processes of learning where organizations become competent in smoothly turning anomalies and novelties into innovative patterns of behaviour." The reasoning that underlies this emergent perspective is simple. Senge states (1990, p.7): "Over the long run, superior (organizational) performance depends on superior (organizational) learning." Similarly, superior long-term performance of CT depends on an organization's ability to employ CT to facilitate and accelerate organizational learning.

This paper proceeds as follows: I briefly present the organizational learning theory in Section 2. In Section 3, I employ this theory to identify two domains that explain and possibly solve the limited use of CT in non-routine situations: (1) people in organizations do not behave in the way designers expect them to behave and (2) designers do not behave in the way they think they do. On the basis of this theoretical backing, I argue that CT are unlikely to succeed until organizations deploy them not only for routine coordination but also for fostering on-going reflection of their working and learning practices, and for negotiating control over the rules and resources employed in these practices. In Section 4, I focus on how organizations could design CT that would be used more broadly. I propose a CT platform to support organizational working and learning based on a combination of Issue-Based Information Systems (IBIS) (Section 4.1) and Case-Based Reasoning (Section 4.2). In Section 4.3, I evaluate this platform in light of organizational learning theory. I recognize that any technology can be (mis)used to enforce old habits, values and norms. Therefore, I identify two intertwined conditions needed if CT are to succeed: (1) the organization's ability and willingness to recognize cognitive and structural anomalies before and during the implementation of CT, and (2) CT's ability to reinforce the development and sustenance of this awareness. Number one (1) helps determine to what extent it is possible to accomplish (2); number two (2) enables (1). I conclude section 4 by using a case example to elaborate on the nature of these anomalies and inefficiencies and to depict how the IBIS component of the CT platform could be used to reinforce learning processes necessary to overcome these anomalies and inefficiencies. I present conclusions and suggestions for further research in Section 5.

2. Theoretical Background

Current emphasis on supporting organizational working and learning with CT draws significantly on a theory of management called the involvement and commitment theory (Argyris 1990, pp. 125-133). The theory advises against submissiveness and unilateral control and for self-management, involvement, and commitment. It has proved powerful in helping organizations redesign their work and incentive systems. Moreover,

the advocates of Participatory Design (PD) draw upon this theory. A primary argument for PD is that through participation, users become more involved and committed to improving their computer-supported work. However, the theory has one major limitation: it does not explain how it can be implemented without triggering embarrassment and threat (Argyris 1990, p. 121). Indeed, the more empowerment, meaningful participation, and other social innovations are encouraged, the more potential exists for embarrassment and threat. For instance, when work groups deploy a CT to take on broader responsibilities and to become more autonomous, line management may feel threatened and enforce its unilateral control over the deployment of the technology.

Argyris draws upon extensive empirical and theoretical work to show that implementation problems stem from what he calls "programs" in the human mind. These programs guide actors,[3] especially in embarrassing or threatening situations where they might lose control. There are two types of programs (Argyris 1990, p. 13): (1) "the set of beliefs and values people hold about how to manage their lives" and (2) "the actual rules they use to manage their beliefs." These programs are called, respectively, *espoused theories* of action and *theories-in-use*. Argyris emphasizes that human action must be studied in terms of the theory-in-use rather than espoused theory, which may not reflect actual behaviour.

Argyris makes a critical distinction between two theories-in-use called Model I and Model II. Model I is dominant in society. It provides the governing values that guide actors to seek unilateral control, to win, and to suppress negative feelings toward others. Moreover, it recommends action strategies that are selling, persuading, and that save face for the actors. These governing values and action strategies may seem normal and acceptable because people are socialized to take them for granted. Indeed, they are applicable in handling routine situations where actors simply reproduce existing social practices (Giddens 1984). But they also have negative implications for organizational long-term effectiveness. If all actors act according to these rules, everyone may lose, and the organization may be unable to uncover the (possibly unjustified) beliefs underlying work routines. Model I reinforces existing practices by encouraging each actor to protect himself against other actors' attempts to dominate. Argyris calls the mode of reasoning that underlies actors' protective behaviour 'defensive reasoning.' Defensive reasoning occurs when actors (1) hold premises that may not be valid but think they are, (2) make inferences that may not follow from the premises but think they do, and (3) reach conclusions that they think they have tested carefully but they have not because they have framed the conclusions in a way that prevents inquiry.

Any attempt to redraw the domains of responsibility, autonomy, and control in connection with the introduction and deployment of CT is likely to threaten some actors and activate defensive routines in the organization. These routines distort or inhibit communication, deepen mistrust, and cover up the real problems. As a result, organizations keep solving easy problems caused by other deeper problems only to have the problems resurfaced later in another form. While sin-

gle actors may be able to work productively, interdependence, and consequently the working and learning of the organization as a whole, suffers.

Argyris suggests a new theory-in-use called Model II to help actors change their behaviour so that the benefits promised by the involvement and commitment theory can be fully realized even in embarrassing or threatening situations. Model II recognizes that actors, even if committed to change, cannot do so unless they learn how their behaviour and underlying values can lead to mediocre performance. Once they understand this, they must learn to act differently so that Model II moves from an espoused theory to the theory-in-use. The idea is simple: people must become proficient in acting and simultaneously reflecting on this action to learn from it. This so called double-loop learning implies the need to uncover and criticize the governing values and assumptions, construct different interpretations based on new governing values, and experiment with new ways of working in order to enact a new reality instead of merely solving problems in the present environment.

The governing values of Model II are choice based on *valid information*, and *responsibility to monitor* the implementation of the choice. These values require actors to use two action strategies: (1) advocate their positions and encourage inquiry into or confirmation of them, and (2) minimize unilateral face saving. The first strategy implies a new mode of reasoning, i.e. *productive reasoning*, in which people clarify their premises and inferences to themselves and others. Actors are open to constructive confrontation and evaluations. As a result, discursive social action (Habermas 1984) becomes the dominant type of interaction among actors in non-routine situations.

Face saving occurs when people censor information because they fear they will upset their colleagues if they are candid. Actors do not test whether this is truely the case. Rather, they cover up that they are hiding information and even cover up their cover-up. Thus it makes sense to minimize face saving.

Combined, these strategies improve the validity of information in several ways: Actors are encouraged to reflect thoroughly on their premises and assumptions so that they can be clear about their positions and the reasons for advocating the positions. They are also encouraged to discuss previously taboo issues because there is little fear that someone will manipulate such candor to win others over. Additionally, actors do not waste time defending themselves and distorting their true feelings and intentions.

In summary, the theory's power is that it concentrates on increasing organizations' ability to resolve deep problems, the problems causing or magnifying more easily visible problems.

3. Implications for Research and Design of Coordination Technologies

Most designers and researchers of Coordination Technologies espouse Model II because seeking to support organizational working and learning would make little sense under the authoritarian world of Model I. Yet many examples in the literature report how CT have been designed and deployed to reinforce unilateral control of certain groups (e.g., management) over other groups (e.g., workers). For ex-

ample, Orlikowski (1991) and Zuboff (1988) illustrate with many case examples how managers deployed CT to make organizational processes visible in a new way, and thereby enable ideational control. Workers behaved according to the rules and norms embedded in the technology because they realized their superiors or peers could see what they were doing.

In light of Argyris' theory, the use of CT to establish unilateral control is understandable in non-routine situations. Anderson (1991, p. 121) cites Krantz & Gilmore (1990) to clarify the point: "... bureaucracies, and their attendant structures and policies, function as social and psychological defenses. Positions and roles are institutionalized to avoid the anxiety and unpleasant situations that might arise in less structured organizations. To the extent that organizations and their component work groups function as defenses, it is likely that any computer systems developed and deployed will incorporate and further these defensive functions." I call this fit between defensive organizations and defensive technologies *defensive fit*.

A central paradigm underlying CT is that people use CT to share their work and knowledge and to accomplish more than any one person could achieve alone. In light of this paradigm, unilateral control of some influential group(s) over the resources and rules afforded by CT is often inappropriate. A move toward mutual control of all the involved groups is needed. However, the Model II theory-in-use does not imply full mutual control over the rules and resources (including CT) deployed. If this were implied, fully egalitarian organizations would be called for. But learning how to learn and internalizing Model II congruent governing values do presuppose that groups can negotiatiate control over the rules and resources openly and constructively. This is because decisions over autonomy, privacy, and control of work and the supporting technologies largely determine who has the right and responsibility to know, do, and learn in the organization. In a learning organization, these decisions can seldom be made unilaterally.

As a result of negotiations and on-going reflection of work and managerial practices, groups develop mutual understanding about their resource and control requirements so that they can effectively and efficiently share knowledge and perform, coordinate, control and transform their work processes. Each individual or group has primary control through the technology over the material and knowledge created by that individual or group, but this control can be shared or transferred as a result of constructive negotiations (or the contracts resulting from such negotiations) whenever necessary. I call this control scheme *negotiated control*.

The discrepancy between the paradigm underlying CT and the Model I-driven organizations is a critical factor in explaining why CT have not been fully exploited to foster organizational learning. Another critical factor is the defensive fit. In the following sections, I strengthen my argument that these factors bear the blame by focusing on two problematic domains: (1) designers espouse Model II but organizational actions are guided by Model I, and (2) designers espouse Model II but their theory-in-use is Model I. These domains are concerned with individual, organizational, and technological issues because the

explanations can be found from their interaction (Orlikowski 1992a).

3.1. Designers espouse Model II but the organizational theory-in-use is Model I

Researchers have paid much attention to helping organizations design and use CT to support effective enactment of work routines. Theoretical approaches such as speech-act theory (Flores et al. 1988), transaction cost theory (Ciborra 1987), and coordination theory (Malone & Crowston 1990) have been suggested to explain how activities are coordinated and how CT should be designed. However, none of these approaches has taken into account the perspective of organizational learning and the need for negotiated control over technologies and knowledge resources. Many existing development methodologies, for example, the sociotechnical ETHICS method (Mumford 1983) and Soft Systems Methodology (Checkland & Scholes 1990), do address the need for ongoing interpretation, learning, and negotiation between various stakeholders involved in design. But they do not tell how to enact such social processes without triggering organizational defenses (Hägerfors 1994).

The earlier research does take into account the discrepancy between systems based on the involvement and commitment theory and organizational values and norms based on Model I. In particular, structural aspects of organizations and technologies have been widely researched. For example, DeSanctis *et al.* (1993, 1994) present adaptive structuration theory stating that the structural properties of the technology must match the social, economic, and political structures for the technology to succeed. It is more likely, according to the theory, that the CT encouraging participation will succeed if an organization has instituted a total quality management (TQM) program specifically calling for participative decision making. Similarly, Orlikowski (1992b) argues that when the premises underlying CT are incompatible with an organization's culture, policies, and reward systems, effective, cooperative computing is unlikely unless these structural properties change. For example, Orlikowski and Gash (1994) focus on the use of a commercially available CT called Lotus Notes™ in a consulting company. They found that almost all the consultants hesitated to put anything more sensitive than routine information on the CT. Their hesitation was primarily the result of a mismatch between the designers' assumptions of openness and trust embedded in the CT and the consultants' use of unilateral control of information to reduce the possibilities of embarrassment and threat. Designers perceived the climate of the organization as open and trusting; consequently, they left up to users the security and privacy issues related to Notes databases. Their assumptions were unjustified. In fact, the consultants worked in a competitive and uncertain career environment. They feared betraying client confidentiality or subjecting their information to misinterpretation or criticism, if they used Notes to share information without unilateral control over their information resources in Notes databases.

A good description of a mismatch between Model II technologies and Model I organizations is given by Perin (1991), who calls CT 'electronic social fields.' She says (p. 76): "On the one hand, electronic social fields subvert managers' as-

sumptions about conventional bureaucratic organizations because they call into question organizational authority, they cross functional divisions, and they create options for the times and places of work. On the other hand, ... such autonomy, cross-functional cooperation, and alternatives meet many of the criteria said to be conducive to innovation and productivity in bureaucracies." She goes on to examine the impact of this mismatch on the adoption of CT: "Managers who see social fields as being antistructural, will be disappointed in groupware investments and unlikely to sustain them over the long run."

One alternative to avoiding the "antistructural" technology might be that management would enforce unilateral control over its use. However, this defensive action would likely trigger workers to activate their own defensive routines, possibly giving up on the technology altogether. Swanson (1993) calls for computer-mediated communication policies on the use and information content of CT and the consequences of violating the policies. These policies are intended to guide actors toward using CT in a way that is valuable to the organization as a whole. But Swanson does not acknowledge that such policies are difficult to write in ways that clarify what is sanctioned and what is not. As a result, actors may stop using CT whenever a chance of punishment exists, and cover up that they are doing so.

The odds are against CT as long as superiors see them as threatening their status and subordinates see them as a means of management control. The best hope is the gradual move toward Model II. Proper incentive structures must also be devised to help actors see CT as a means to reinforce double-loop learning. The use of incentives could dramatically reduce resistance to using CT.

Two types of incentive structures will work: one based on the effectiveness of team work (Kanter 1989), and the other based on the use of technology (Orlikowski 1992b). Kanter (1989) argues that cooperation and synergy between people and between organizational units remain buzzwords without real effect and meaning if incentives based on the effectiveness of team work are not in place. She implies that Coordination Technologies have scant meaning without incentives to foster team work. At best, they are used as individual productivity tools, since people get paid for personal excellence.

Orlikowski (1992b) states that actors in hierarchical positions below senior management cannot "afford" to use the technology without reward systems (incentives and proper evaluation criteria) based on its use. Clearly, changing incentive structures is easier when CT are not seen as antistructural but as means to reinforce organizational learning. When CT are in interorganizational use, clients' demands for improved service through improved coordination may also work as incentives.

3.2. Designers espouse Model II but their theory-in-use is Model I

I have emphasized the incongruity between Model I-related organizational factors and the involvement and commitment theory-based systems to explain the lackluster success of CT. This explanation does not imply that the design approaches of CT have no role. On the contrary, designers and researchers must focus on assessing and understanding the

true opportunities and limitations of new technologies at work. This is a challenging task for two reasons. First, the literature in the field is flooded with technological utopianism amplifying the possibility of valued social change and underplaying the possibility of significant social problems (Kling 1991). Second, the functionality of CT (possibly meant to foster actors' involvement and commitment) can actually trigger organizational defenses, a possibility that may not be obvious to the designers. I will focus on design issues next.

Coordination Technologies impose various social structures as rules for interaction depending on their functions and specific features (DeSanctis & Poole 1994, Lyytinen & Ngwenyama 1991). For example, they may emphasize efficient work processes and the task at hand and discourage socialization during work. Many structures are incompatible with Model II. First, many CT provide limited support for the on-going reflection that is necessary to create new knowledge and practices out of prevailing routines. Second, the concept of negotiated control is inadequately reflected in the structures of existing CT. This incompatibility may stem from designers' espousal of Model II but use of Model I. Salaway (1987) studied the nature of designer-user interactions and found theories-in-use of both designers and users were congruent with Model I.

This defensive fit between Model I congruent structural properties of technologies and organizations seems as appropriate a predictor for unimpressive organizational exploitation of technologies as the mismatch between Model II congruent properties of technologies and Model I-driven organizations. To elaborate my contention, I will discuss some typical features of electronic mail, workflow management, and group support systems, and examine how their designers' possibly unconscious Model I-driven thinking may have affected the structural properties of technology and thereby mediated unanticipated patterns in the organizational use of technology. I conclude by stating two design goals of CT.

Email systems have become widely used tools for routine communication and coordination, and as such are clearly successful. One of their main benefits is flexibility: they impose few rules for social interaction, making them especially suited to handle ad-hoc situations and to foster organizational learning through socialization. However, their control scheme is unilateral: actors can (in a technical sense) quickly and inexpensively process in any fashion the email received (e.g., forward a confidential message from actor X to actor Y without X knowing it), but cannot control what happens to the email they send. The lack of negotiated control in the design makes it difficult for actors to discuss issues they perceive as threatening or embarrassing. Instead, this design flaw may hasten the formation of defenses because all the parties involved eventually notice the (mis)use of email for unilateral control, but this very cognizance is itself never discussed due to the defensive routines (Markus 1994, Zuboff 1988). For example, Markus (1994) found in a case study that confidential messages were forwarded, and the actors in the organization were aware of it. Yet, most actors were reluctant to devise a solution that would have required forwarders to request permission from message senders. Markus hypothesized this solution was

perceived as too time-consuming for routine situations. Instead, most email users tried to word their confidential or sensitive messages obscurely so that they could be interpreted on several levels, at least one harmless. They also disguised their cover-up behaviour. Argyris (1990) calls such behaviour *skilled incompetence*.

Workflow management technologies have gradually improved beyond simply speeding up routines to supporting organizational working and learning (1) by making explicit which actors and work groups are responsible for which activities, documents and materials (Käkölä 1995), (2) by monitoring and measuring the enactment of work processes using various qualitative and quantitative attributes, and providing the resultant information to the responsible actors, and (3) by allowing the dynamic redesign of these processes as they are being enacted (Abbott & Sarin 1994, Rein *et al.* 1993). Unfortunately, while these CT provide extensive support for the creation and management of organizational role prescriptions and for the assignment of various system resources to actors enacting the roles, they provide little support for reflection and negotiation about how, when, and by whom the roles and the role-connected rules and resources are defined and controlled. This, in turn, may foster an institutionalized, congealed use of CT and lead CT to tighten the normative regulation of work. Of course, the designers and researchers of workflow management technologies have gradually begun to acknowledge the need of computer support for meetings and conferences in which performance is reviewed and plans are created to redesign organizational processes to make better use of workflow management technologies, see for instance (Abbott & Sarin 1994, p. 117). Yet, they do not recognize the possible need to uncover and question the premises and values on which these plans and decisions are based. Consequently, their conception of meetings and negotiations is limited as far as organizational double-loop learning is concerned.

Nor have the designers of systems specifically designed to support meetings and other equivocal work domains fully grasped the complexities of organizational behaviour. For example, anonymous idea generation and evaluation are standard features of group support systems. Anonymity allows mutual control within a group over sensitive and controversial issues and ideas, while ensuring that only the ideas are criticized, not their proponents. Additionally, anonymity is said to foster open and honest discussion and to help actors confront conflicts (DeSanctis *et al.* 1993, p. 13). Most people probably agree with such goals. But why is anonymity needed in the first place, if openness, honesty, and participation are so highly appreciated? This fundamental question has received scant attention in coordination technology research. Furthermore, the researchers who have addressed issues related to anonymity, see for instance (Connolly *et al.* 1993, Jessup *et al.* 1990), have primarily concentrated on how CT can be used to remove or reduce the effects of social dilemmas (e.g., status influence) without dealing with the causes of these dilemmas (e.g., status differences among team members).

Anonymity is nothing but a bypass strategy. It fails to address the underlying reasons why actors avoid openness, hon-

esty, and participation when held personally accountable for what they say and do. To put it more precisely, the technology bypasses the reasons. Even if a team produces good ideas through anonymous idea generation, many of these ideas may never be implemented. This is because organizational defenses are not reduced. Indeed, defenses may be made stronger by ideas that are threatening to some groups.

Technologies endorsing the concepts of Model I cannot be effectively deployed to reinforce Model II behaviour, unless users are knowledgeable, motivated, and powerful enough to substantially reinterpret them. In the long term, these technologies are unlikely to help organizations solve the tough problems requiring double-loop learning. However, this fact is difficult to realize in the short term since people can use the technology to speed up their work. Unfortunately, they continue to solve wrong problems and may disguise that they are doing so.

In fact, these technologies may hamper progress toward Model II by making people believe that some magical features of computerized systems permit discussions about topics that were previously taboo. Once people realize that little will change as long as real problems are ignored, they are likely to defend themselves vigorously again. The outcome of a well-intended technological intervention may end up making the buried problems worse.

To overcome this defensive fit, designers must start surfacing their own Model I-related values and beliefs that govern both their design decisions and expectations about the usefulness of CT. Perin says (1991, p. 81): "The challenge is to create computer support that acknowledges, if not incorporates, these realities (social and cultural dynamics), rather than presume that the technology will by itself reform or obliterate them." However, she presents no strategies to meet the challenge.

Organizational learning theory takes a step in the right direction by indicating that organizations can change their behaviour toward Model II and establish organizational norms and values that reinforce the new learning orientation. CT must become part of this new culture if they are to be fully exploited in Model II organizations. Two interrelated design goals are needed: CT should function to (1) reinforce the effects of organizational learning and (2) facilitate the learning process itself. In light of the concept of negotiated control, fulfilling these goals presupposes that, as already discussed in the panel on privacy issues in CSCW '92 (Clement 1993), CT should support not only the completion of tasks but also reflection and negotiation over control of the tasks and the resources used in these tasks. These goals are realistic because they recognize that no CT can make an organization adopt Model II. In the following, I illustrate the realization of these goals in the context of one CT.

4. Supporting Organizational Learning with Issue-Based Information Systems and Case-Based Reasoning

Many organizations are trapped in a doom loop: as long as coordination and control of work is in disorder, resolving the underlying largely Model I-related reasons for the disorder is difficult. Part-

ly as a result of organizations' inability to look inward and resolve significant problems, much time is spent trying to produce order through easy but superficial solutions (Argyris 1990, Senge 1990). Nothing is inherently bad in chaos and disorder. Quite the contrary, they can foster innovation and the creation of new knowledge (Nonaka 1991). However, organizations need to learn to *manage* disorder and chaos productively and constructively instead of resorting to the use of power and unilateral control to establish order. Thus, achieving and reinforcing a shift from Model I toward Model II theory-in-use can be a fundamental and complex organizational challenge. The shift may take years and its impacts pervade the organization.

In my view, this challenge has significant implications on the design and use of CT for organizational learning. To reinforce a move in the direction of Model II, these systems should not only foster the production and reproduction of social order but also help organizations deal with the ambiguity and threat inherent in social change. Kling supports this argument when he states (Kling 1991, p. 86): "We cannot advance our understanding of CSCW with discussions such as The Coordinator,[4] which focus on specific kinds of conversations about tasks in organizations, and ignore conversations about the processes of organizing, which might restructure patterns of authority, obligation, and cooperation."

Ciborra & Lanzara (1994, pp. 82-83) go one step further than Kling by arguing for two specific qualities for CT. First, "systems should be 'expert,' though quite a different way from current conceptions: In addition to supporting or replacing knowledge-based established routines of professionals and managers …, they should support their capabilities for reflection and inquiry within the contexts in which they are embedded, helping them to build up, question, and modify practical knowledge according to the emergence and the shift of problematic situations and contexts." Second, "systems should be designed as proactive, dynamic mirrors of human action, supporting and enhancing perpetual individual and institutional self-questioning: in short, they should play the role of 'reflectors,' helping the users connect their practical and argumentative routines to the established or emerging formative contexts, rather than concealing that connection, as they often do." Unfortunately, Ciborra and Lanzara (1994) do not elaborate on how to build 'expert reflectors' or what they would look like.

In this section, I envision a CT platform that could complement systems such as the Coordinator to facilitate the reflexive monitoring and self-questioning of existing actions and routines, and to ease the consequent shift toward Model II. As Model II calls for discursive social action (Habermas 1994), this process is best supported by the use of discourse and argumentation-oriented technology. Organizational learning also requires some type of organizational memory (Huber 1991, Walsh & Ungson 1991). First, in order "to demonstrate or use learning, that which has been learned must be stored in memory and then brought from memory" (Huber 1991, p. 106). Second, organizational memory allows an organization to learn more (Huber 1991). Issue-Based Information Systems (IBIS) and Case-Based Reasoning (CBR) are two methods that can meet these requirements.[5] In the following, I

propose that IBIS and CBR could be used to build a CT platform that would support both single-loop and double-loop learning.

This section is not intended to convince the reader that a new technology alone would solve the cognitive and structural challenges that organizations confront as they deploy CT. Instead, I make two points. First, instead of bypassing the effects of Model I behaviour, and thereby reinforcing the defensive fit, CT should be (designed so that they can be) used as interactive mirrors to make actors aware of their skilled incompetence and to enable them to reflect critically on their behaviour. DeSanctis *et al.* (1993, p. 26), though not addressing skilled incompetence, partially support this claim by stating that when a CT "helps the group organize its work and, perhaps more important, learn to reflect on and control its (work) processes, the group should be more effective." Even if behavioural change is not possible, increased awareness alone may help build trust, thus improving organizational long-term effectiveness. Second, while it is necessary and fruitful to criticize previous research and existing or envisioned technologies, and to present abstract statements and prescriptions on CT design, it is not sufficient. Criticisms and prescriptions should be crystallized into a form solid enough to allow further development, testing, and criticism in order to foster the accumulation of knowledge in the CT research domain. The CT platform envisioned below is one such crystallization.

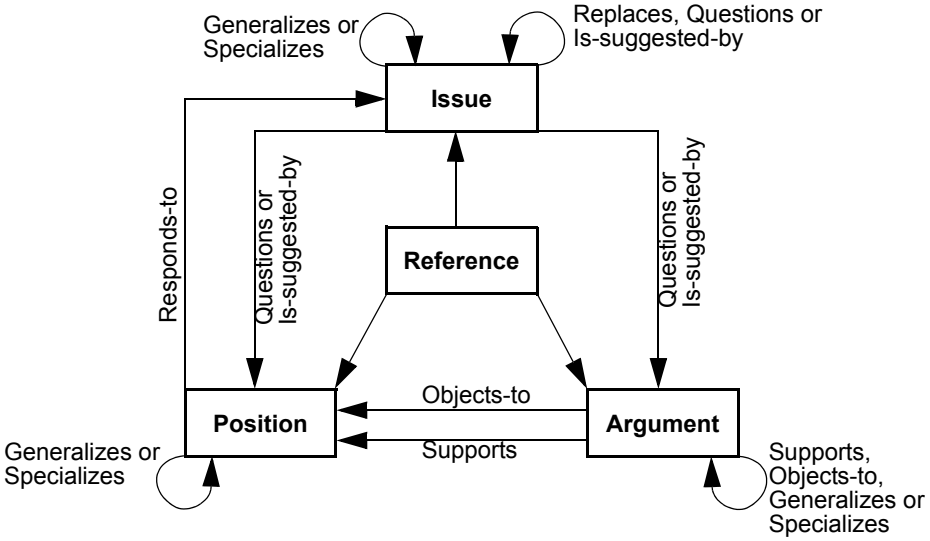
4.1. Facilitating structured discourse with IBIS

Learning and self-questioning processes require actors to communicate. Argumentation theory (Toulmin 1958) and especially the Issue-Based Information Systems method (Rittel 1972) help to structure discourse, thereby clarifying the nature of problems under discussion. The method provides three conceptual entities for structuring discourse: Issues, Positions and Arguments. The entities are related to each other by labelled links; each label describes the type of relationship. For example, an Argument either Supports or Objects-to Positions. Another entity called Reference represents facts that support or object to the other entities. The resulting network structure is called an issue-net.

Issues represent controversial decisions to be made and problems to be resolved through a discussion. Positions stand for possible resolutions. These positions are often contradictory and none is necessarily the *right* solution. Each position is supported or refuted by arguments. The underlying rationale is that actors choose the solution that seems most plausible in light of the arguments. Validation of the cogency of the arguments can be carried out by subjecting them to a process of repeated attacks and defenses (Hashim 1993). The entities and the relationships of the IBIS method are represented in Figure 1.

The primary advantage to deploying IBIS is the improved quality of the discourse processes. The quality can be defined with three components: discourse coherency, completeness and ambiguity (Auramäki *et al.* 1988, Brown & Yule 1983). Coherency refers to how logically the discourse proceeds through various

FIGURE 1. The entities and the relationships between them in the IBIS-method (Hashim 1991, p. 286).



stages. A complete discourse is coherent and fulfils the conditions needed to terminate it (i.e., the issue has been resolved through argumentation). Ambiguity refers both to the ambiguity of the roles of the actors involved in the discourse and to the clarity of the issues discussed. In Section 4.4, I illustrate the use of IBIS to help organizations learn to manage ambiguity productively. Naturally, these three components are intertwined. For example, it is difficult to establish conditions for completeness in embarrassing, highly ambiguous situations.

IBIS improves coherency by emphasizing the creation of new issues as possible sources of new knowledge and investigating these issues through argumentation while reducing the likelihood that the discourse processes devolve into insignificant issues. According to Chang *et al.* (1993, p. 63) "it supports constructive discourse by focusing on the central issue, encouraging relevant questions and answers, and being specific about the supporting or objecting evidence on any position." IBIS also helps assess the completeness of discourse. For example, discourse is usually incomplete when issues lack positions or positions lack arguments (Hashim 1991). Moreover, the IBIS structuring is natural, intuitively appealing, and consequently easy to understand. It allows for informal dialogue, and thus does not require actors to alter their ordinary forms of discourse (Chang *et al.* 1993). The method has been tested and used to assist civic and policy planning (Rittel 1972), auditing (Chang *et al.* 1993), collaborative learning (Rathnam *et al.* 1992), software design (Conklin & Begeman 1988), and scientific collaboration (Hashim 1991, Hämäläinen *et al.* 1992).

The features of IBIS are well suited to the action strategies of Model II. By constructing personal issue-nets, actors are able to make their positions and arguments clear and recognize possible gaps and inconsistencies. Actors can also make their conclusions publicly testable by sharing their issue-nets and can learn productive reasoning and conflict resolution through argumentation. As a result, it is easier for actors to reflect upon their actions and the underlying premises and values, and thus reach a shared understanding of problems.

The chief limitation of many implementations of IBIS is their inability to augment individual work in the way most decision support systems do. For instance, other than retrieving old discussions, no memory aids are provided. Thus, enhancing the systems with a method such as case-based reasoning would provide an interactive working and learning environment.

4.2. Case-Based Reasoning as an organizational memory

In some cases, learning *before* doing is more effective than learning by doing. This type of learning requires that redundant knowledge, i.e. potentially relevant knowledge for which actors may have no immediate or planned use, be developed and shared with all actors for eventual application in new, rapidly evolving situations (Nonaka 1991). One way to achieve this is to rotate people through different jobs and experiences. A supplementary method is to build and maintain computer-based organizational memories or experience bases to facilitate learning. Case-Based Reasoning is a way to build and use such an experience base.

CBR uses reasoning from past experience to interpret and explain anomalous situations and to propose and critique solutions (Kolodner 1991). It is a powerful method of reasoning because it is consistent with people's natural behaviour and applied daily by all of us. As opposed to artificial intelligence research, CBR emphasizes augmenting rather than automating human work.

Walsh & Ungson (1991, p. 62) state that "interpretations about organizational decisions and their subsequent consequences constitute an organization's memory." In CBR, these interpretations are represented as cases, each describing the state of the world before action; the problem (issue) to be solved; the solution (position) to the problem, and the consequences. Additionally, causal connections among the initial situation, the solution, and the consequences should always be included in a case (if these connections can be identified) so that the reasons for the outcome can be recalled later. This method facilitates learning before doing.

CBR supports two modes of behaviour: problem-solving and interpretive. In the problem solving mode, cases offer old solutions as a guide for solving new problems, and old mistakes and failures as a way to prevent actors from repeating them. Past solutions are adapted to new situations. In the interpretive mode, cases are used to evaluate new situations and validate or invalidate possible solutions. Sometimes, solutions are fixed beforehand and cases are needed to justify them. Evaluation is carried out through argumentation as explained in Section 4.1. The cases are employed to generate supporting and refuting arguments and to serve as references for the arguments. Of

course, these two modes are intertwined. For example, a solution proposed by one case during the problem solving mode may be found unworkable in the interpretation mode. Actors must then either readapt the solution or search for others by retrieving new cases.

Cases can stimulate the creation of knowledge and organizational learning in many ways. For example, organizations can resolve present contradictions (such as developing a high quality product that is cheap to make) by studying analogous situations from the past that applied to totally different products, processes, and even industries (Nonaka 1991). CBR is well suited to provide such analogies (Kolodner 1991). It has been applied to planning (Hammond 1989), medical diagnosis (Turner 1989), and legal reasoning (Ashley 1988).

4.3. Combining IBIS and CBR to facilitate organizational learning

Combined, IBIS and CBR create a CT platform with a strong theoretical base. CBR assists individual and organizational learning and interpretation processes in a way that social psychologists have proven natural and consistent with cognitive aspects of human behaviour (Read & Cesa 1990). IBIS allows actors to share experiences and interpretations in a dialectical manner that encourages inquiry into actors' beliefs and premises (Churchman 1971) and supports constructive negotiation to resolve conflicts (Chang 1993).

Nevertheless, in light of Argyris' theory it is unlikely that this CT platform could be fully exploited in defensive organizations. The content of the experience bases reflects interpretation processes based on single-loop learning. Therefore CBR produces, at best, partial solutions to complex organizational problems requiring double-loop learning. For example, Kanter (1983) has found that when organizational conflicts are resolved by consensus, winners conveniently "forget" losers' critique to save losers' face. Losers also are willing to forget for the sake of the common good. This implies that little incentive exists for either party to memorize the process of change and its underlying reasoning. However, because these issues often cannot be discussed, the possibly detrimental implications of forgetting on building up organizational memory remain unresolved. The same weakness applies to IBIS. If nothing else changes, issues that cannot be discussed before the introduction of CT remain taboo after its introduction. For example, Arendt (1958, p. 82) states: "Authority ... is incompatible with persuasion, which presupposes equality and works through a process of argumentation. Where arguments are used, authority is left in abeyance." Consequently, faced with threatening and embarrassing situations, actors in defensive organizations usually stick to their positions regardless of the supporting and objecting arguments. They also want unilateral control over the pieces of knowledge (such as the cases in the case-based part of organizational memory) and other resources that could be drawn upon during the argumentation process. As a result, discussions progress slowly or are terminated by the most powerful actors. Many designers neglect this fact altogether or implement features that bypass the behavioural problems (e.g. Section 3.2).

Organizations face two alternatives in appropriating this platform: either to

use CT only in domains where the likelihood of embarrassment and threat is minimal, or to deploy them additionally to foster and reinforce organizational learning, in cases where the prevailing division of work and the standard operating procedures are inadequate and a fundamental organizational redesign is essential. Clearly, the first alternative is viable and technologies are used effectively, for example in technical design applications, where rational interpretation process is preferable. However, for organizations that want to reap the benefits of the involvement and commitment theory, the second alternative is the obvious choice. This alternative also accords with the two design goals presented in Section 3.2.

While the theoretical base of the CT platform cannot explicitly address all the virtues of Model II, the following analysis suggests that the platform could be applied to support and reinforce learning. As noted above, CBR reinforces Model I behaviour because the experience bases reflect interpretations based on Model I. This process must be interrupted by reinterpreting the cases in light of Model II. Facilitators are usually needed to set the process in motion. One purpose of the process, however, is to train actors to interpret cases themselves without outside help. This is the only way to ensure that actions as well as the cases describing the actions will reflect and reinforce Model II.

Argyris (1990) argues that the best way of learning how to learn is through solving actual business problems in training seminars that specifically address organizational learning dilemmas. In his method, each actor envisions in writing how he or she would communicate with other actors to solve a problem. A group discusses the cases to make individual actors aware of the discrepancy between intentions and actions and how this discrepancy contributes to mediocre performance. Finally, the actors learn to redesign their conversations so that issues that were previously off-limits become discussible. An IBIS-based system could be very useful in this process. Each actor could write the case as an issue-net in which she or he would explicitly distinguish between the envisioned conversation and information that the actor would not communicate for whatever reason. The group could then analyze these issue-nets to find out how the conversation, its results, and the reasoning underlying the results would change if the undiscussibles were discussed. The computer-supported argumentative case method is likely to be a good basis for extending existing CT because several researchers (among them Argyris (1990), Rossmoore (1994), and Senge (1990)) have found the case method useful for learning how to learn. In the following, I elaborate on how the IBIS component of the CT platform could be used to support and reinforce Model II learning processes.

4.4. Learning productive reasoning and negotiated control with IBIS

I sketch in this section (a) how Model I-related defensive routines and the defensive reasoning on which these routines are based are evident in discussions about threatening and embarrassing issues; (b) how these discussions must shift to reflect productive reasoning, if defensive routines are to be engaged, and (c) how actors can deploy IBIS to reflect upon their discourse and to learn to nego-

FIGURE 2. Using the IBIS — structuring of a discourse to illustrate defensive reasoning in the organizational design context. I=Issue, P=Position, A=Argument

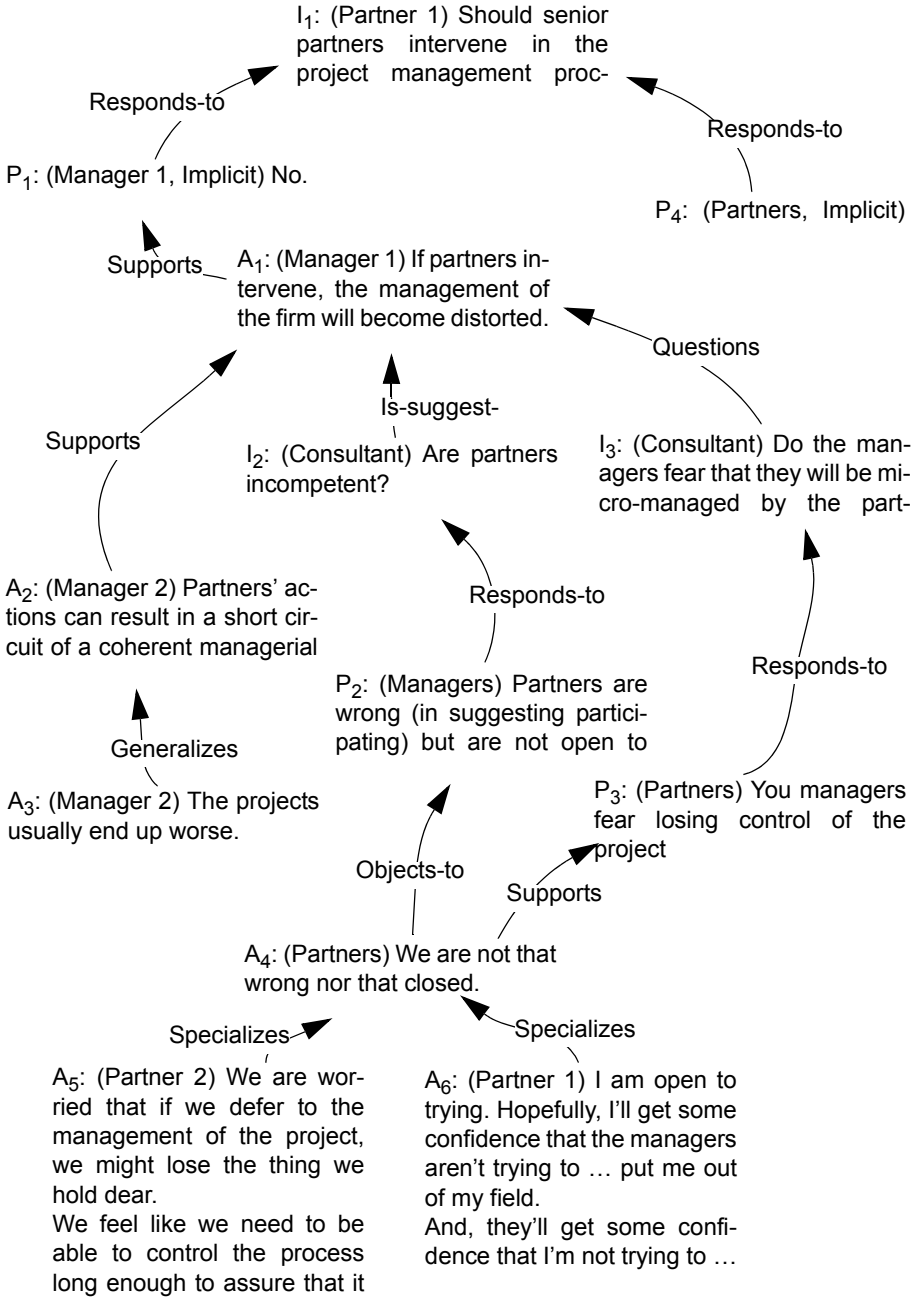
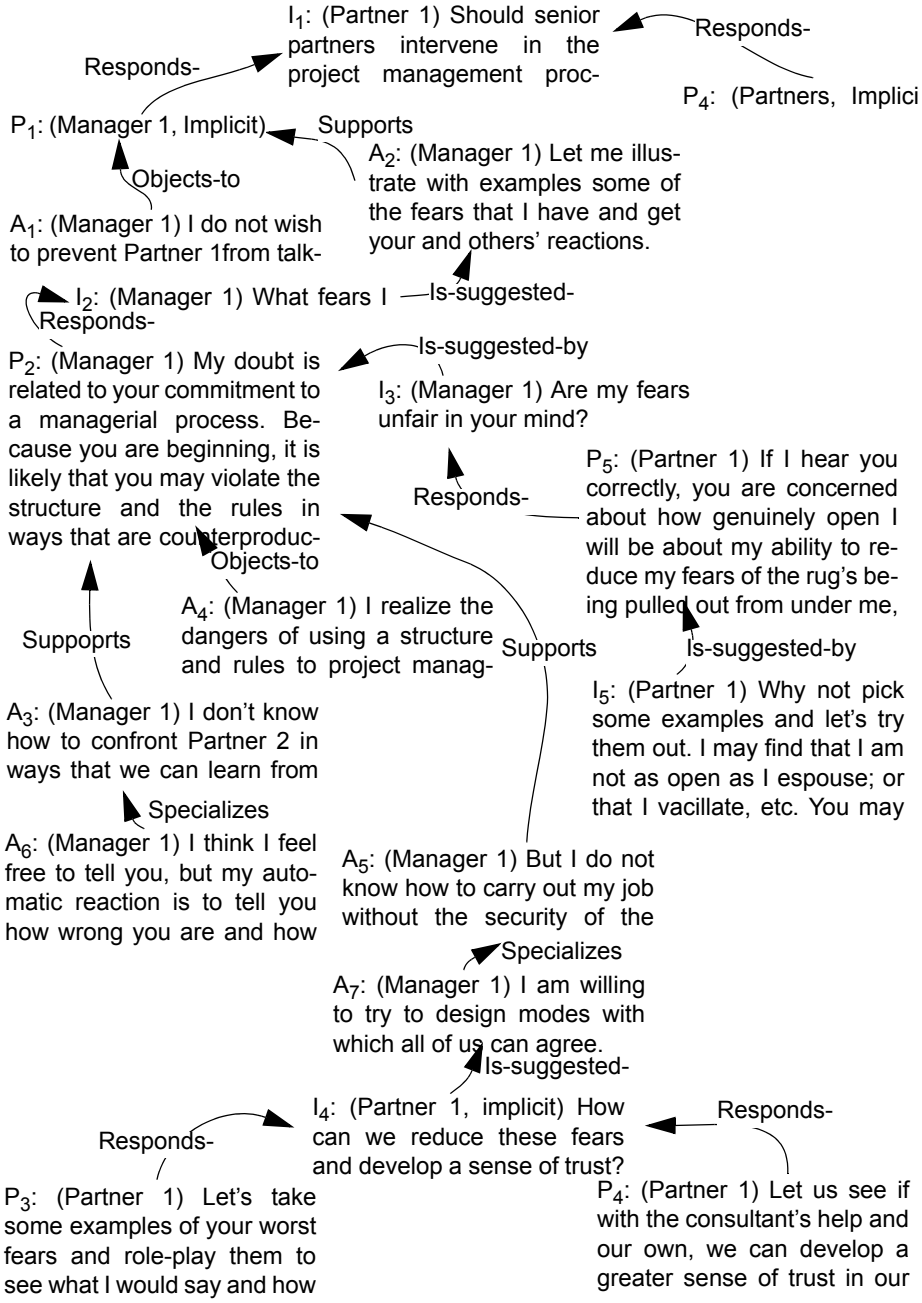


FIGURE 3. Using the IBIS — structuring of the redesigned discourse to illustrate productive reasoning. I=Issue, P=Position, A=Argument



tiate control of their work constructively. To illustrate, I employ the IBIS method to analyze and interpret Argyris' (1990, pp. 111-116) case example of a discussion about a threatening and embarrassing situation related to organizational design. The illustration is of special interest to coordination technology research: a thorough understanding of the complex social processes inherent in situations where the prevailing social order is disrupted and restructured is required before CT can be designed to foster on-going reflection, self-questioning, and negotiated control of work routines as effectively as they now support the enactment of routines (Kling 1991).

4.4.1. The case example and its IBIS interpretation

The case concerns the organizational design process of a small architectural and real estate development company. The company suffered from severe structural problems: actors' areas of responsibility were unclear, tasks were poorly coordinated, and senior partners gave contradictory orders to the technical staff. Yet, the company was successful because the actors were highly committed to providing excellent customer service. The company had decided to expand its business significantly, however, making a new organizational structure crucial. The senior partners sought more order, stability and clarity. A new organizational structure should redefine job responsibilities and the relationships between various groups. A consultant was hired to help.

The consultant reasoned that most actors were well aware of the existing work roles and structure as well as the chaos embedded in them. Yet, because of the prevalent defensive routines, actors had done nothing to change the structure or to employ this chaos as a source of innovation. The consultant recommended a two-step process in which the senior partners would (1) jointly develop a new organizational design while at the same time reducing defenses, and (2) acquire the skills and establish the sense of trust that enables productive reasoning, and helps actors continue to reduce old and prevent new defenses. This recommendation was accepted and the design process was started. During design sessions, the need for double-loop learning quickly became clear, and the actors realized that the new design would likely fail if the defensive routines were not eliminated.

I analyze a specific discussion during which Partner 1, one of the two senior partners, has suggested that the partners should have the right to intervene in the management of projects. His comment has upset the two project managers. The transcription of this discussion is given in Appendix A. I use the IBIS method to interpret and visualize causal structures reflecting the actors' theories-in-use (Figure 2). The interpretation makes explicit the implications of defensive reasoning. The central issue is should the senior partners intervene in the project management? (I_1). The partners argue for intervention (P_4) but hide their reasoning and present no evidence to justify their argument. The managers draw conclusions about the partners' motives based on assumptions they do not reveal. Their arguments A_1 and A_2 (management of the company will become distorted if partners intervene) are assertive and discourage inquiry. Furthermore, the managers make a generalization, A_3 (project quality would suffer), an out-

come that contradicts to the purpose of the organizational design process (bringing order to and reducing chaos in the management of the company) without giving any evidence to support or explain this generalization. The logical but misleading interpretation is that the managers regard the partners as incompetent. This interpretation, if not investigated, would probably divert the discussion even further from the real problem, i.e. both parties' fear of losing unilateral control of projects. Therefore, the consultant now raises two issues: I_2 (are the partners incompetent?), and I_3 (do the managers fear they will be micro-managed?). The managers respond by blaming the partners both for being wrong and blind to the fact that they are wrong (P_2). But as is evident from Figure 2, the managers fail to support their claim. This suggests that they are (maybe unconsciously) accusing the partners of something of which they are equally guilty. The partners defend themselves (A_4), and then state that the managers fear losing control (P_3). But, the partners admit at this point that they too fear losing unilateral control. They are willing to be candid because they know the discussion is meant to reduce, not reinforce, defenses.

After the discussion, the consultant helped the actors redesign their roles. Then he focused the group's effort on redesigning their discussions by using the case writing method outlined in Section 4.3. A transcription of the redesigned conversation appears in Appendix B. In the following, I use the IBIS method to analyze the conversation (Figure 3) and briefly compare it with the earlier conversation (Figure 2). Model II action strategies are evident: the actors now engage in dialectical thinking and minimize unilateral face saving. For example, the managers present an argument A_1 (I do not wish to prevent Partner 1 from talking to others) that undermines their position P_1 (Partners should not intervene in project management) and supports the partners' point of view. They also make themselves vulnerable by openly revealing their fears. For instance, the managers state they fear the restructuring program will fail because the partners may violate the new structure and rules (P_2). But instead of blaming others (A_3, A_6) the managers now recognize that their own behaviour may actually cause the partners to violate the rules and the structure. They also undermine their position P_2 by stating that they realize the dangers of using the structure to protect themselves (A_4) and then explaining why they think they need protection (A_5). The partners propose role-plays to let everyone see the benefits of discussing fears openly (P_3, I_5).

4.4.2. Discussion

I have illustrated the IBIS method as a resource that could be used to make explicit actors' defensive reasoning, and thereby help them reflect on their conversations and actions. My illustration implies that the IBIS-component of the CT platform might facilitate and reinforce the ability of both individual actors and groups to productively negotiate control over their work, rules and resources. The proposed CT component would enhance this learning process by helping actors visually structure and analyze their discussions. More important, it could be linked to other CT components such as workflow management technologies, so that the IBIS-compo-

nent could be invoked whenever an ambiguous situation involving multiple actors disrupts routine workflow. The resulting conversations would provide the basis for a new division of work and for the allocation and enactment of rules and resources (including CT) to foster working and learning.

Yet it would be naive to think that any kind of computerized system is a panacea that enables organizational learning. For example, the IBIS method is not powerful enough to elicit the values, beliefs, and experiences of actors nor the expertise embedded in them. This flaw lets actors simply learn the new Model II congruent rules of the game and produce issue-nets that illustrate productive reasoning without having to change their governing values. The IBIS method does not pick up on the problem. Therefore, shared understanding and productive reasoning remain difficult to accomplish. In fact, Eden (1991) states that real beliefs and values of actors cannot be elicited and incorporated thoroughly into any computerized system because actors are often incapable of fully externalizing their interpretation processes. Moreover, several structural and behavioural issues may impede learning and cannot be addressed by any technology alone.

Shared understanding, even if achievable, will not resolve all conflicts (Gabarro 1991). Moreover, mutual trust, which is a precondition to productive reasoning and negotiated control, cannot be established solely by making a commitment to understanding the points of view of others, as Argyris seems to suggest. Each actor also assesses the motives, discretion, and competence of other actors and many other factors in deciding whether or not to be candid (Gabarro 1991). Gabarro (1991, p. 109) identifies yet another barrier, which he calls "managerial paradox": "while it is crucial that managers be able to listen nonjudgmentally (to understand other points of view and get valid information), the essence of management is to do just the opposite—to make judgments. Managers … in turn, are evaluated on how well they do this. The danger, then, is that this bias for judging will subvert a manager's inclination to listen carefully and, in doing so, sabotage his or her ability to make accurate business and people judgments." As long as actors seek unilateral control and are rewarded for doing so, organizational learning is learning by the few to reinforce control over the many.

5. Conclusions

I have employed Argyris' (1990) organizational learning theory to uncover reasons for the mediocre exploitation of Coordination Technologies in organizations. This theory states that organizations have to adopt Model II theory-in-use to benefit fully from the ideas in the involvement and commitment theory of management. I have noted that the bulk of CT literature does not fully acknowledge that deep organizational changes requiring double-loop learning may be needed before organizations can improve work performance and their employment of CT to enhance organizational coordination and learning.

I have identified three organizational implications of this theory: First, Coordination Technologies will be underused as long as the organizational theory-in-use is Model I. Second, the designers of CT must make a cognitive shift toward Mod-

el II so that CT support and reinforce ongoing reflection on unquestioned routines and practices as well as negotiated control over the rules and resources drawn upon in these routines and practices. Otherwise, organizations are likely to continue to reinforce the defensive fit with technological properties such as anonymity. Third, other structural properties, such as incentive schemes to foster the effectiveness of computer-supported team work, should be employed to reinforce this cognitive shift. When these implications are taken into account, CT will likely be regarded as less threatening and more useful than otherwise would be the case.

I have presented Issue-Based Information Systems and Case-Based Reasoning as two promising methods that can be deployed to design CT that foster reflection and learning. I have also used a case example to illustrate how the IBIS method could be employed to help actors reflect on their defensive reasoning processes and to facilitate the redesign of their discourse patterns to permit productive reasoning. An interesting topic for future research is whether the envisioned CT platform can be combined with existing workflow management technologies to give the transformation of chaos and ambiguity into novel and innovative institutional arrangements and routines equal support with routine coordination tasks.

Researchers and practitioners can now argue that the technologies that call for major changes in organizational behaviour should not be introduced (or even developed) because their chance of success is questionable. For example, Kanter (1983) claims that successful technological innovations minimize the need for organizational change. Unfortunately, the business value of such innovations is usually questionable, making Kanter's position untenable.

At least two challenges must be overcome before the above-mentioned implications can be considered in the design and deployment of CT. First, a major organizational shift toward Model II is very cost-intensive. It takes several years of training and mentoring at the workplace because actors tend to act defensively unless they are exposed to Model II thinking and action for a long period. Second, not everybody is capable or willing to reflect upon their defensive routines. Hence, the learning process must inevitably be reinforced by firing actors who cannot or will not unlearn their outdated behavioural patterns (Charan 1991, Hedberg 1981, Tunstall 1983). The diffusion of Model II is likely to be slow even with training and discharging. If executives are to become and remain motivated to meet these challenges, they must see shift toward Model II as giving their companies a competitive edge. Moreover, the executives must themselves learn how to learn before they can expect their subordinates to. If executives are unable or unwilling to make themselves vulnerable despite their power and formal authority, the credibility of the whole process is in doubt (Argyris 1990).

Another approach would be to enact CT-enabled structural designs such as network organizations to outperform large companies with a set of small, relatively autonomous companies operating under a common business strategy and top management (Charan 1991). These leaner and simpler organizations within the network structure need less internal

communication and coordination, thus making the organizations less political and easier to manage (Argyris 1990, Pfeffer 1992). Indeed, the potential business value of employing CT to plan, execute, and monitor contract-based transactions within and between network organizations is huge (Charan 1991). However, if these structural designs are employed to bypass 'political problems,' this approach is problematic for at least two reasons (Pfeffer 1992). First, "It is not clear that by ignoring the social realities of power and influence we can make them go away, or that by trying to build simpler, less interdependent social structures we succeed in building organizations that are more effective or that have greater survival value" (Pfeffer 1992, p. 30). Second, "by trying to ignore issues of power and influence in organizations, we lose our chance to understand these critical social processes and to train managers to cope with them" (Pfeffer 1992, p. 30). This approach reinforces superficial learning because the new skills needed to use power and negotiate control constructively cannot be learned. Consequently, these structural designs should be complemented with new skills that enable actors to increase their capacity to tolerate the ambiguity and threat inherent in social and technological change without diminishing their ability to reflect on the prevailing practices and to constructively negotiate control.

Organizational learning is such a complex social process that the role of CT in fostering it will remain bounded regardless of the sophistication of technology. Moreover, the reliable enactment of interdependent work practices sets limits on the level of autonomy, and most organizations at least *seem* to be doing fine, even if the levels of autonomy and privacy are decided unilaterally. These facts imply that organizations may not need CT to facilitate double-loop learning processes. Maybe they do not. But the question remains: do organizations need CT to bypass defensive patterns? Maybe. Yet, the role of CT in bypassing these patterns has received more than enough attention in coordination technology research.

Coordination technology researchers must more actively create and share new knowledge about the implications for the design and deployment of CT of the discrepancy between CT that endorse the values of the involvement and commitment theory and the realities of Model I-driven organizations. Researchers must also recognize that achieving a fit between the structural properties of CT and the structural properties of organizations will not guarantee successful, learning-enhancing use of CT if the fit is defensive. Unless these issues are adequately addressed, the future CT may be carefully designed to support unilateral control over all (in some way sensitive) information so that they better match the requirements of defensive organizations. In this paper, I have made one of the first attempts to address these issues.

One fundamental and extremely challenging question for future research is how to operationalize the organizational implications identified in this paper and integrate them into a sound, cost-effective development and implementation approach in a way that helps organizations (1) ensure that they are on their way toward Model II before introducing CT, (2) identify those possibly new features of CT fostering and reinforcing organizational learning, and (3) evaluate

the success of CT using criteria that acknowledge the equal importance of effective organizational working and learning, and thereby help sustain the learning effort during implementation. Conducting this research is resource-intensive because studying CT as mediators for and products of human action and organizational learning must be done in the field using many case studies and real work situations. Moreover, it is challenging to do research on a politically and emotionally sensitive topic that few people want or are even able to discuss constructively. Providing research-based guidance to people who may not want it is difficult. Nevertheless, the incentives are high. Meeting this challenge will be one of the most valuable contributions that coordination technology researchers can make, if the use of CT to foster working and learning is to move from vision to reality in organizations with complex, unfriendly and authoritarian work relations.

Notes

[1]Holt (1985) coined the term 'Coordination Technology' to depict computer support for cooperative work on heterogenous computer networks. Other widely used and somewhat synonymous terms include CSCW (Computer Supported Cooperative Work) and Groupware.

[2]I use the word 'designer' to refer primarily to technologists who work within an organization to develop, tailor, and/or maintain self-developed or purchased CT. When technologists are employed by specialized vendors of CT, teh time-space disjuncture between the design and use of CT is often large enough to significantly limit possibilities for interaction and learning between vendor designers and users.

[3]I use the word 'actor' to refer to people in situations where there is no need to focus attention on role-related issues such as whether a person uses CT or is a manager.

[4]The Coordinator (Flores *et al.* 1988) is one of the most famous CTs. It meets well the formal, predefined coordination and unilateral control requirements of the relatively stable bureaucracies (Grantham & Carasik 1988).

[5]Naturally, there are many other suitable methods. For example, cognitive maps are structured representations of an understanding that have been argued to support organizational learning (Boland *et al.* 1992, Eden 1991). Toulmin's (1958) argumentation language is another representation method that could be deployed for modeling discourse inherent in working and learning. Hashim (1993) has combined IBIS and Toulmin's argumentation language by using a dialogue logic approach to ensure that the validation of arguments is captured. While all of these, and many others, are interesting from the perspective of computer science, it is beyond the scope of this paper to explore them as possible ways to foster organizational working and learning.

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Appendix A: Discourse reflecting defensive Model I reasoning (Argyris 1990, pp. 113-116).

(Interpretation linking the statements of the managers and the partners is provided by this author on the basis of Argyris' extensive case analysis.)

> "Manager 1: I'm afraid that if Partners 1 and 2 have the right to enter the process (as they just described it), they will cause the management of the firm to become distorted.
>
> Manager 2: Yes; their actions can result in a short-circuit of a coherent managerial process. It throws the weight of decision-making out of kilter, I think.
>
> It makes the management of a project very difficult, if not impossible. It usually ends up a poorer project."

The managers' arguments can be interpreted in two ways: either the partners are incompetent, or the managers fear they will be micro-managed by the partners. When the consultant intervened in the discussion and presented these interpretations, the managers responded by arguing that the partners were wrong but refused to admit it. The partners dismissed the managers' argument by stating that they were neither *that* wrong nor *that* inflexible. Encouraged by the consultant, the partners then revealed reasons behind their suggestion, reasons they had initially covered up because they assumed that revealing them would alienate the managers.

> "Partner 2: You managers fear losing control of the timing of the project; profitability, and billability... . Partner 1 and I worry ... if we defer to the management of the project, we might lose the thing that we hold dear (the design and implementation of a high quality building in a profitable manner).
>
> Partner 1:I am open to trying. We'll have to have rules at the beginning. Hopefully I'll get some confidence that the managers aren't trying to pull the rug out from under me, to push me out of my field. And they'll get some confidence that I'm not trying to run away with the projects and do things behind their backs."

Appendix B: Discourse reflecting productive Model II reasoning (Argyris 1990, pp. 113-116).

> "Manager 1: On the one hand, Partner 1, I do not wish to prevent you from talking to others; on the other hand, I should like to illustrate with some examples some of the fears that I have and get your and others' reactions.
>
> Manager 1: The doubt that I have is related to your commitment to a managerial process. Because you are beginning, it is likely that you may violate the structure and the rules in ways that are counterproductive to the program. These fears I have may be unfair in your mind. I'm open to discussing them.
>
> I don't know how to confront Partner 2 or you in ways that we can learn from the violations. At best, I think I feel free to tell you—but as you can see from this conversation—my automatic reaction is to tell you how wrong you are and how we must constrain you.
>
> Manager 1: I realize the dangers of using a structure and rules to protect us (the managers), but I do not know how to

carry out my job without the security of the structure. I am willing to try to design modes with which all of us can agree.

Partner 1: Let's take some examples of your worst fears and role-play them to see what I would say and how you would react. Let us see if with the consultant's help and our own, we can develop a greater sense of trust in our competence to integrate.

Partner 1: If I hear you correctly, you are concerned about how genuinely open I will be about my ability to reduce my fears of the rug's being pulled out from under me, etc. Why not pick some examples and let's try them out. I may find that I am not as open as I espouse; or that I vacillate, etc. You may find similar problems."

■