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Structuration, Situated Action and Distributed Cognition: Rethinking the Computerization of Organizations

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ABSTRACT

This paper compares three theoretical approaches that appeared in the computerization literature in the early 1990s. It examines the way in which structuration, situated action and distributed cognition conceptualize action, technology and interaction. This analysis serves as the basis for an assessment of the contribution of these approaches and of the research agenda they propose

Key-words: Interaction, Technology, Structuration, Situated action, Distributed cognition.

RÉSUMÉ

Ce texte compare trois approches théoriques différentes qui ont fait surface au début des années 90 dans la littérature sur l'informatisation des organisations. La structuration, l'action située et la cognition distribuée seront comparées en fonction des définitions qu'elles offrent de l'action, l'interaction et la technologie. À partir de cette analyse, nous pourrons dégager les contributions de ses approches et les pistes de recherche qu'elles suggèrent.

Mots-clés : Interaction, Technologie, Structuration, Action située et cognition distribuée.

The evolution of work practices in newly computerized organizations has been the subject of many studies for over 30 years. In the last ten years, concern has been expressed about the contradictory and often irreconcilable nature of the findings of various studies.

Work practices evolved differently in the organizations analyzed. Most importantly, the justification for these different results changed from one study to the next. As Kling (1991) reported, the proposed explanation usually clarified the empirical work it referred to but could rarely be extended to other contexts.

A variety of avenues for getting around this impasse have been suggested. Attewell and Rule (1988), for example, advocated field studies in order to identify regularities in empirical data:

> We believe that the social impacts of computing are infinitely variable but that the sources of these variations are eminently accessible to study. As long as investigators continue to study new organizations in new settings, new effects can be expected to emerge. The essential thing is that we continue confronting our theories with new data and that we not be afraid to modify theories in light of such confrontations. (571-572)

Like Steinfield and Fulk (1990), Joerges and Czarniawska (1998) felt existing organizational theories were ill-equipped to address this issue. Joerges and Czarniawska (1998) emphasized the need to question our understanding of technology and to recognize its material nature. The need to integrate the material and social dimensions of technology has been recognized by many in the organizational computerization literature (Orlikowski, Walshman, Jones and DeGross, 1996; Bowker, Star, Turner and Gasser, 1997; Taylor, Groleau, Heaton and Van Every, 2001).

Researchers shared a desire to gain a better understanding of the problematic and the issues linking work practices, organization and technology. In 1991, George and King wrote:

> As with many aspects of computing in organization, the most interesting "impacts" of the technology have been to alter our views of what we are studying in the process, we have learned that the real mystery is in the nature of organizations themselves... computing technology has become an important instrument in our efforts to learn more about organizations, but the quest for knowledge on that front is far from over. (70)

A decade later this preoccupation remains present in the organizational literature. Barley and Kunda (2001) argue that while shifts in work from craft and agricultural work to factory and office work have been well documented by theorists, we desperately need to revise our conceptualizations of work in our changing times.

This reflection on the nature of work practices and their underlying sociological and technological dimensions made for a fertile environment for the development of new approaches. My analysis will compare three of these approaches: the use of structuration, situated action and distributed cognition in computerized settings. I will examine and draw parallels among the frameworks to understand the conceptualization of computerized work practices they provide. Through the des-

cription and analysis of the authors using the frameworks I will examine how their analyses provide some clarification regarding computerization as well as how the questions pertaining to computerization raised by these authors have contributed to clarify organizational dynamics.

I. THE EMERGENCE AND MAIN CONCEPTS OF THE THREE APPROACHES

The motivation of authors using the three chosen approaches was closely tied to the questions that were surfacing in the computerization literature regarding the nature of work practices as well as the technological and sociological dimensions of these practices.

First, the work of Giddens (1984), which had already been transposed to organizational studies by the beginning of the 1980's, was identified by several researchers as an interesting framework for either explaining how the implementation of similar technologies can lead to different organizational outcomes (Barley, 1986; Poole and DeSanctis, 1990) or integrating the technological and sociological perspectives that had been examined separately up to that point in computerization studies (Orlikowski, 1992). Apart from Barley (1986), who was a precursor of this work, many of the authors associated with this first stream of research wanted to use Giddens' framework to answer Fulk & Steinfield's (1990) call to search for new conceptual frameworks to deal with computerization.

Second, Lucy Suchman's situated action perspective, launched in 1987 by the publication of *Plans and Situated Action*, proposed an alternative to traditional approaches of designing technology. The alternative was based on a conceptualization of human activities that differed from the traditional rational approaches. Lucy Suchman's work has been very influential and became one of the founding approaches of the Computer-Supported Cooperative Work (CSCW) movement. Numerous authors have been inspired by her work to examine various phenomena, including the design of technology and the evolution of work in technological settings. Her framework was also prominent in the recent emergence of the *workplace studies* movement grouping researchers interested in developing a better understanding of work practices (Heath, Knoblauch and Luff, 2000; Luff, Hindmarsh and Heath, 2000).

Finally, distributed cognition, like structuration, was identified as a framework with the potential for bridging the gap separating technological and sociological approaches to computerization (Rogers and Ellis, 1994; Rogers, 1993a; Rogers, 1993b). One of the major factors contributing to the emergence of distributed cognition was the difficulty of explaining human activities in the computerization literature (Salomon, 1993).

Structuration, situated action and distributed cognition each deal in their own way with questions regarding the nature of human activities in computerized settings. Let me briefly describe these approaches and compare their similarities and differences.

I.1. Giddens' Structuration

In his structuration theory, Giddens attempts to reconcile two traditionally opposing approaches in the social sciences: phenomenology and structuralism (Giddens, 1984). His framework links the action of individuals with social institutions. More precisely, he focuses on the process by which individual actions and institutions are mutually constituted.

In his view, human beings are knowledgeable actors. They exercise a reflexive control over the flow of their daily activities, activities out of which emerge patterns of interaction. Reproduced over and over again in time and space, these patterns of interaction characterize the social system give rise to structural properties. As such, structural properties are simultaneously the medium for and the result of human action: they create the framework which guides action, but their very existence is predicated on the production and reproduction of the patterns subtending them. This mutual influence between actions and structural properties, which Giddens refers to as the duality of structure, is a central element of structuration theory. Structuration can thus be defined as the process by which structural properties are produced and reproduced in time and space within the duality of structure.

According to Giddens, social practices are also based on the mobilization of rules and resources. He defines rules as techniques or procedures lying at the heart of social practices. For their part, resources which, with rules, underlie social practices fall into two categories: allocative resources and authoritative resources. Allocative resources are those which enable the transformation or control of objects, while authoritative resources make it possible to control or command people.

Organizations are social systems which rest on the interplay, described by Giddens, between social actors and social institutions. The presence of technology in the organizational system is believed to influence the production and reproduction of social practices. It is the series of relationships between technology, action, social interaction and social institutions that incited authors to draw upon Giddens' structuration theory to study computerization in organizational settings (Orlikowski, 2000; Orlikowski, 1996; DeSanctis and Poole, 1994; Poole and DeSanctis, 1992; Orlikowski, 1992; Orlikowski, 1991; Barley, 1986). These relationships were examined from different angles. For example, the intervention of technology in the production and reproduction of the social system interested authors like Poole and Orlikowski. On the other hand, Barley studied the characteristics of the social system and its influence on the appropriation of technology by workers in various organizational settings.

I.2. Situated Action

In her work, Suchman attempts to gain a better understanding of human action to support computer designers in the development of technologies. She focuses on the relationship between actions and the circumstances under which they are conducted to un-

derstand how humans orient and make sense of them.

Action is also at the heart of Suchman's concerns in her *situated action* approach (Suchman, 1987). She extends the study of action to interaction, arguing that coherence and mutual intelligibility of action are attained through human communication. Suchman is critical of the rationalist approach, adopted by most computer designers, which maintains that action unfolds according to a plan. In this approach, the mutual intelligibility of those engaged in action stems from a mutual recognition of an intention which is decoded on the basis of the plan. Intention is understood by virtue of common conventions and shared understandings enabling the linking of behavior and intention. Technology can take part in action since, like humans, it is interactive, it manipulates symbols, and it sets plans in motion.

For her part, Suchman argues that plans are no more than rationalizations preceding or following action. She defines action as an emergent process that adapts to the contingencies of context. To illustrate her situated approach to action, she describes a canoe going through rapids. Before or after going through the rapids, a canoeist can rationalize the action as a series of steps corresponding to a plan. While navigating the rapids, however, the canoeist only reacts to the water currents he or she is faced with. Since action is defined as a function of its context, the intelligibility of action stems from the link between action and context, and not from shared conventions. In this approach to action, technology is one of many elements of the context having an influence on its unfolding.

This relationship between actions and their circumstances is the focus of Suchman's research. She notes that we are usually unaware of the circumstances under which we conduct our daily activities, and that we become aware of them only when something goes wrong. Suchman uses Heidegger's concept of *breakdown* to designate situations in which we are confronted with a problem. Since awareness of the context is heightened during breakdowns, Suchman uses these situations to study the relationship between the material and social dimensions of context. For example, in a recent study (Suchman, 1996), she examined the occurrence of a routine problem: the stairs used to help the passengers off a plane were stuck. As the incident occurred, in the workplace, she analyzed glances, body positions, body alignments, verbal exchanges and the manipulation of artifacts. Using this fieldwork, themes presented in *Plans and situated action* are investigated more fully. She discusses the mutual intelligibility of actions, the mobilization of material and human resources to deal with the breakdown, the relationship actors have with their contexts, and the social dynamics of everyday activities. In her analysis, technology figures as one of the artifacts contributing to the accomplishment and mutual intelligibility of actions (Suchman, 1987, 1990, 1993, 1996).

I.3. Distributed Cognition

Like Suchman, researchers interested in distributed cognition study the material and social conditions under which actions take place. Their goals differ, however. They want to expand

the notion of cognition, traditionally defined as solitary mental activity. They do so by dissolving the boundaries of the human body to conceptualize cognition as a series of interactions among media located inside and outside the individual's skin.

In this framework, human action is based on the ability of human beings to integrate the various elements of the context in which they function (Hutchins, 1995). This relationship between humans and their context in the accomplishment of daily activities is the object of study. The context is defined as a set of structures of material or social origin, from which individuals draw the information necessary to undertake action. As such, cognition is *distributed* to the extent that it draws on a variety of structures external to the human body.

The social and material dimensions of cognition have been studied in a parallel fashion by researchers such as Cicourel (1990, 1994), Heath and Luff (1994, 1996), and Norman (1988). The examination of distributed cognition I propose is based on work by Hutchins, however, since it simultaneously takes into account the material and social aspects (Hutchins, 1983, 1990, 1994, 1995). In a series of studies conducted in different settings using a variety of technologies, Hutchins examines the relationships between humans and their environment during the accomplishment of their daily activities. He draws on Marr's (1982) work on human vision in developing his approach. Hutchins argues that elements of context create, transform and propagate representations. This process, which he calls *computation*, explains, in his view, how artifacts and social interactions are the primary supports of human activities (Hutchins, 1995).

Typically, studies based on this approach take the form of field work in which researchers examine how individuals in a given context interact with one another and with artifacts to conduct their daily routine. Hutchins (1995, 1996), for example, has conducted his research on a ship as well as in a plane cockpit.

I.4. Similarities and Differences among the Approaches

A common concern for action emerges from the approaches we have reviewed. The authors move away from a description of action which finds its roots in an abstract logical structure of statements. In such a framework organizations are defined as a set of interconnected routines which are symbolically encoded information orienting action. This rationally-based logic is still popular in organizations, and is described by Sachs (1995) as "organizational explicit". Instead, structuration, situated action and distribution cognition define action in relationship to the context in which it unfolds.

The relationship between action and context varies from one approach to the other. For example, structuration emphasizes the mutual influence between action and context. Context simultaneously constrains and emerges from actions. The recognition of this mutual influence differentiates structuration from situated action and distributed cognition, which primarily reco-

gnize the influence of context on human activities.

The authors using these three approaches also characterize context in different ways. Since structuration was borrowed from sociology, context is described as a social system in which technology mediates interaction. For Suchman, context is understood as that which is immediately available to humans involved in action whether it is material or social. The local dimension of the context is crucial. Finally, Hutchins wants to extend cognition outside the human brain, so his definition of context includes all elements outside the human body. More specifically, he recognizes individuals as being involved in interaction with artifacts and other human beings in the accomplishment of their daily activities.

Although each approach has its own take on what constitutes context, two common elements emerge. Firstly, they all focus on computerization, so technology, as an artifact among other things, appears as one common element of context. Secondly, the authors all recognize human interaction as being part of context.

The authors working with structuration, situated action and distributed cognition share numerous preoccupations. They offer an alternative to the rational and abstract process usually associated with human action by focusing on the context in which action takes place. Even if the definition of context varies from one approach to the other, the authors all view context as constituted through the interactions humans have with each other as well as with artifacts, such as technology. I will pursue my analysis by examining more thoroughly how technology and social interaction are defined in each of these frameworks and explore how these conceptualizations provide new avenues for computerization research.

II. THE TECHNOLOGICAL DIMENSION

The authors reviewed all share an interest in conceptualizing the social and technological dimensions supporting actions in computerized contexts. They offer a conceptualization of technological artifacts and also study its design and use in social contexts. To avoid confusion among the various types of computer artifacts, I adopt a definition of technology that encompasses artifacts of differing levels of technical complexity. In this light, we can compare the way in which each of these approaches presents technology and its relationship to human action.

II.1. Technology as social and material artifact

Technology is not described as such in Giddens' structuration theory. Researchers who base their work on this approach have developed their own way of integrating this concept. Within this framework, technology is understood in terms of two dimensions. Firstly, it is considered as a social artifact triggering changes in social dynamics. Secondly, it is viewed as a material artifact enabling and constraining action. Authors vary in the emphasis they give to these two dimensions.

Barley (1986) favors the social dimension of technology. He attributes

to technology the status of a social object, whose meaning is defined in its context of use. He writes: "from the point of view of a theory of structuring, technologies are better viewed as occasions that trigger social dynamics which, in turn, modify or maintain an organization's contours" (1986:81). Barley notes that the evolution of work practices following the introduction of a new technology can be explained by the contextual logic characterizing the work group.

Orlikowski (1996) concurs with Poole and DeSanctis (Poole and DeSanctis, 1990; DeSanctis and Poole, 1994) in defining technology as "a set of constraints and enablements realized in practice" (1996:69). By offering such a definition, Orlikowski avoids defining technology either as a material or social artifact. She believes computerization is a material and social phenomenon. In earlier work, Orlikowski draws on Giddens in speaking of *the duality of technology*, arguing that technology is both the result of and the medium for action (Orlikowski, 1992). She maintains that technology is a social construct resulting from human action and the structural properties of the organizational system. She simultaneously acknowledges that technology is used for action, and thus contributes to the production and reproduction of the structural properties of the organization. Moreover, she postulates that the interpretation of technology is flexible. That is, technology has material characteristics, the uses and meaning of which vary according to organizational context. Unfortunately, at the empirical level, she has had some difficulty in illustrating this flexibility, and thus in demonstrating that the use of technology is constructed by its users.

Like Orlikowski, Poole and DeSanctis recognize the social dimension of technology. But they differ from her in their insistence on the material features of artifacts and in their attribution of a technological spirit. The features and spirit of technology constitute a structural potential upon which workers draw to generate social patterns of interaction. Structuration in this context becomes "the act of bringing the rules and resources from an advanced information technology or other structural source into action" (DeSanctis and Poole, 1994:128). The system's features allow the user to gather, manipulate and manage information in certain ways. For example, features take the form of voting procedures in groupware assisting workers with decision-making processes. On the other hand, the spirit is defined as values and goals supporting the structural features of technology. For example, certain voting procedures can be associated with a democratic spirit.

The challenge in the application of structuration theory to computerized contexts lies with defining technology. Authors relying on Giddens' theory to explain computerization thus adopt different positions with regard to the social and material dimensions of technological artifacts. Barley relies exclusively on the social dynamic of the work unit within which technology is introduced, while for Orlikowski, as well as for Poole and DeSanctis, technology is a physical artifact with distinct properties, the design and uses of which are socially constructed. These

authors all recognize technology as having a social dimension. This might be attributed to the fact that they are working with a sociological framework, but we will see in the coming sections dealing with situated action and distributed cognition that the social dimension of technology remains an important theme, even in these approaches.

II.2. Technology and Local Interaction

Initially developed by Suchman (1987), this approach seeks an alternative to the conception of technological artifacts advocated in the cognitive sciences. In the traditional approach, technology is viewed from a rationalist model of action, in which action flows directly from a pre-determined plan. Technology is attributed properties similar to those of human beings: a degree of interactivity and the ability to communicate intentions, thereby enabling it to contribute efficaciously to action.

Suchman's research seeks to refute this attribution. She concludes her analysis with a field study of the interaction between two individuals and a computerized photocopier. The two humans have the same expectations of the machine as they have when interacting with other humans. However, whereas access to a representation of the situation enables human beings to detect wrong interpretations and to remedy them, technology has no such access, which creates an asymmetry between the parties involved in the action. Even though designers attempt to create a context of interpretation of action on the basis of their own ideas of the model user, their definition is necessarily a limited one. It is for this reason that trivial errors, which would normally be corrected in the conversational stream between human beings, can rapidly lead to an impasse.

Suchman thus tries to move away from a definition of technology as something which simulates human abilities, and toward a conception more in line with her own action model. In her view, action unfolds on the basis of local interactions with elements of the surrounding environment, in the same way as the Micronesian navigators studied by Hutchins set out to sea without maps: they orient themselves only by reference to features of the natural environment, such as islands and stars (Hutchins, 1983 in Suchman, 1987). In this framework, elements of the environment are the effective supports of human action and interaction. And technology, which is just another artifact, is like one of the elements orienting action. Unfortunately, Suchman's subsequent work studies the social dimension of interaction, and abandons the role of artifacts in action.

II.3. Technology as a repository of knowledge

Like Suchman, Hutchins refuses to believe that technology simulates human mental activity. He argues, rather, that it is an artifact like any other, guiding human action through its ability to create, transform and propagate representations.

Hutchins defines artifacts as repositories of knowledge constructed in durable material form. The knowledge integrated into them comes from the

accumulated knowledge of successive generations of human beings. For example, ocean maps are drawn representations based on an incalculable number of observations made by navigators over the centuries. An artifact is thus a material object linking lived experience to multiple, more-or-less coded representations, extending from the most elementary ocean map to the numbers and letters representative of latitude and longitude. These multiple representations, as well as the syntax governing the relationships among them, are crystallized in the material composition of the artifact. Reality is thus translated into superimposed representations, codes and more-or-less-visible rules of syntax for users who manipulate the resulting material object. Consequently, Hutchins concludes that an artifact simultaneously constrains and enables action through its physical attributes and the representations it offers.

To use Hutchins' vocabulary, artifacts become tools when they are used to create, transform or propagate representations. The totality of available tools is then combined to constitute a repertory of constraints and enablements having an influence on the power of action of the human beings using these tools. Hutchins refers to this interdependence of tools in the context of a given activity as the *ecology of tools*.

Inasmuch as Hutchins' objective is to extend cognition beyond human cerebral activity, the material dimension and its influence on the way action is understood takes on a singular importance. Hutchins moves away from a view of artifacts as simulating the mental processes of human beings, and situates human abilities and tools in a relationship of complementarity.

II.4. The Various authors' views of the technological dimension and their implications

Structuration, situated action and distributed cognition advocate studying the social and material dimensions of technology. Let me examine these two dimensions with a view to seeing how they are articulated in each approach and how they contribute to explaining organizational phenomena.

The authors reviewed tackle the social construction of artifacts at two precise stages of computerization: design and implementation. With the exception of Barley, who does not discuss technological design, they all view design as a social construction. Hutchins and Orlikowski provide an in-depth study of the contribution of various social actors to the design process. Hutchins maintains that design is based on a crystallization of knowledge from many individuals over time. Hutchins stresses the temporal dimension of the chain of interactions and draws out the progressive, iterative character of design. Orlikowski views design as the result of mutual influence among the various actors involved in the process, though also between these actors and the structural properties of the groups they represent. She thus places more emphasis on an extended spatial frame of the interactions to see how various individuals belonging to different professional groups and, indeed, of different organizations take part in the design process.

With regard to implementation, all the authors acknowledge that uses of technology are socially constructed. With the exception of Barley and Suchman, they all define use in terms of the material characteristics of artifacts. Though they strive to describe the complex dynamics underlying organizational life on the social level, with respect to the material level, descriptions of artifacts and other objects mobilized in action are rarely, except in the case of Hutchins, studied in an in-depth manner. Finally, regarding the constitution of the material context, Orlikowski and Poole and DeSanctis acknowledge in their conceptual framework that technology is one of many elements that can contribute to structuration. However, they never discuss other objects that might affect this process.

These approaches and their propositions regarding the conceptualization of technology offer interesting alternatives for many researchers studying computerization. Materiality, which is rarely considered in computerization studies, becomes an important dimension of work practices. Without resorting to technological determinism, many of the authors I reviewed recognize that the characteristics of the new technology and its interdependence with the existing artifacts constituting the context must be considered to grasp organizational members' potential to undertake action in a given environment. More specifically, Hutchins and Suchman even suggest that we must alter our usual understanding of technology as an artifact that transforms to one that creates and propagates representations. Concretely, this means that the study of the computerization of work requires that we move beyond the potential or the characteristics of the new technology to examine its articulation with the other elements of the material context. Methodologically, this position entails the study of work while taking into consideration the whole set of tools necessary to perform it. It also involves an understanding of activities as they unfold in their everyday settings composed of tools and colleagues in order to grasp their interdependence and their complementarities.

Furthermore, all the reviewed authors insist on the importance of considering the social dimensions of technology. The design and use of technology is framed as a social process in which many members of the organization come together. The next section will further examine the interactional dynamic conceptualized in the three chosen approaches.

III. THE INTERACTIONAL DIMENSION

In this section, I will explore the interactional dimension of action by looking at how social interactions are conceived in each approach.

III.1. Interaction as the link between individual and institutional realm of actions

Giddens' structuration theory tackles a problem abundantly discussed in sociology, namely, the link between individual action and social institutions. Giddens uses the concept of *modality*

to bridge these two levels. In order to facilitate his analysis, Giddens (1984) divides the structural properties of institutions into three dimensions (signification, domination, and legitimation), which are paralleled to what he defines as the three dimensions of interaction (communication, power, and sanction) (see figure 1).

As for the modalities, they enable actors at once to orient their actions and to reproduce and transform the structures. Although, at least in principle, the modalities enable the linking of these two levels, the operationalization of this concept remains problematic (Conrad, 1993).

This difficulty in integrating action and structural properties has led several researchers to concentrate on a single dimension of the social dynamic. For example, Poole and his colleagues focused on local interaction between individuals and technology as a structural entity. While the institutional dimension does appear in their theoretical model, the empirical data supporting the framework consists of undergraduate students performing a task, which means that the subjects share no tradition, no past, and no institutional context linked to the task. Traditions, past decisions, culture, and institutional context impinge on the structurational process. The institutional context and all its ramifications in daily interaction are difficult to grasp in Poole and his colleagues' empirical work. For her part, Orlikowski (1992) succeeds in conceptually integrating the series of relationships linking the local and institutional levels, but her empirical research does not sufficiently refer to interactions as they occur in a given context to be able to explain the emergence and reproduction of structural properties.

Barley avoids this problem by using the notion of *script* to link individual actions and structural properties:

> While the presumption of sequentiality enjoins researchers to oscillate from one realm to the other, it provides no analytic or empirical fulcrum for pivoting between the two realms. However, such a mechanism can be found in the notion that scripts link the institutional realm to the realm of actions. Scripts are outlines of recurrent patterns of interaction that define, in observable and behavioral terms, the essence of actors' roles. As manifested in the flow of behavior, scripts appear as standard plots of types of encounters whose repetition constitutes the setting's interaction order (1986:83).

Using scripts, Barley examines how the advent of technology initiates new exchanges that modify or reinforce existing structural properties. A similar approach is adopted by Orlikowski (1996). In addition to integrating discursive exchanges, as Barley had done, Orlikowski also considers interactions with technology in describing the organizational reality following computerization. The integration of interactions between human beings and technolo-

structure	signification	domination	legitimation
(modality)	interpretive schemes	facility	norm
interaction	communication	power	sanction

Figure 1: The duality of structure (Giddens, 1984).

gical artifacts adds depth to her analysis, but as she herself notes, "[m]ore research is needed to investigate how the nature of the technology used influences the change process and shapes the possibilities for ongoing organizational change" (1996:90).

III.2. Interaction as the basis for mutual intelligibility

Lucy Suchman subscribes to a current of thought which sets itself apart from traditional sociology. She feels that traditional sociology is normative and rests on a description of social reality, which she describes as "[an] objective world of social facts, or received norms, to which our attitudes and actions are a response" (1987:54). Rather, she draws on authors such as Blummer (1969), Mead (1934) and Garfinkel (1967), who argue for reversing the relationship between social norms and actions put forward by normative sociology. Instead of responding to norms and objective structures, these authors argue that humans construe social reality. She bases her exploration of this reversal more specifically on ethnomethodology, arguing that:

> the notion that we act in response to an objectively given social world is replaced by the assumption that our everyday social practices render the world publicly available and mutually intelligible. It is those practices that constitute ethnomethods. The methodology of interest to ethnomethodologists, in other words, is not their own, but that deployed by members of the society in coming to know, and making sense out of, the everyday world of talk and action (Suchman, 1987:57).

The mutual intelligibility of daily practices is an important issue in ethnomethodology, one that Suchman retains for her own research. Instead of associating the mutual intelligibility of actors with the existence of shared meanings stemming from normative social structures, Garfinkel (1967) advocates looking at how human beings attribute intention and rationality on the basis of the specific conditions of action. Since no logic or general rule can be applied to understanding the meaning of actions, it is, rather, the precise circumstances of actions that enable individuals to create meaning.

Suchman has difficulty in forging a link between the social and material dimensions of interaction. With the exception of an empirical study presented in her *Plans and Situated Action*, she has neglected interactions with technological artifacts and their contribution to the realization of practices. Though Suchman initially wanted to make computer designers aware of a new view of action, the model she proposes remains difficult to operationalize.

III.3. Interaction as the circulation of representations and the construction of meaning

Once again, Hutchins uses his concept of *computation* to explain the interactional dimension of human activities. He argues that computation is a much more useful concept for explaining interdependence among human beings accomplishing activities than for explaining human mental activities (Hutchins, 1995).

Social interactions intervene at two levels in the computation cycle. Firstly, social interaction, like interaction between humans and material artifacts, allows representations to be created, transformed and propagated. Concretely, social interaction can support any of the steps in the computational cycle. Secondly, social interactions allow the coordination of the different steps in the computational cycle. Hutchins maintains that computational dependencies are at the source of social dependencies.

Hutchins' understanding of coordination through interaction is similar to the view developed by Suchman. He believes that the coordination of activities taking place through interaction cannot be fully explained by knowledge integrated in the mind of an individual or by a set of institutionalized rules to be followed. Rather, this knowledge is created intersubjectively by the members of a work unit. In consulting one another, unit members continually adjust themselves to the context's frequent unanticipated exigencies. A common understanding of the situation emerges from these interactions superseding any prior individual understanding.

This joint construction of knowledge in daily conversations and through other forms of interaction such as mutual surveillance allows the group to attain flexibility and solidity. As such, with little difficulty the work unit can deal with the absence of a crew member, an accident, or the integration of a new crew member.

In Hutchins' model, human interactions enable the execution and coordination of the various steps of the computational cycle. This coordination serves to circulate representations and jointly create meaning among crew members. A relationship of complementarity is established between the material and social dimensions of human activities.

III.4. The various authors' views of the interactional dimension

Interaction, as a foundation of the social dynamic, is at the heart of each approach. The authors reviewed define interaction as an intersubjective construct. Notwithstanding this shared vision, interaction is defined differently in each approach. For the followers of Giddens, interaction is the constitutive element of social systems, and has three dimensions: signification-communication, domination-power, and legitimation-sanction. Suchman and Hutchins define interaction in a narrower framework, inasmuch as they only emphasize one of the three dimensions identified by Giddens, namely, signification-communication. The other two dimensions receive very little attention in the situated action and distributed cognition approaches.

Apart from their differences with respect to the importance accorded to legitimation and domination, the three approaches differ in terms of the unit of analysis each privileges. Giddens studies the social system. In research into the computerization of work, the social system to which structuration theory is applied becomes the organization. On the contrary, Suchman elects the situation, and Hutchins opts for the workplace. While Hutchins' constraint is more methodological in

nature since he chooses his unit of analysis as a function of the physical arrangement of the workplace, the difference between the units of analysis adopted by Giddens and Suchman conceals a more profound difference between the two approaches. Suchman differs from Giddens in that she is opposed to any form of reproduction or institutionalization of practices, especially with regard to explaining the meaning attributed to local interactions. For these reason, and contrary to Giddens, Suchman studies human action in a limited spatial and temporal frame.

Studies informed by structuration theory and those in the ethnographic tradition, such as situated action and distributed cognition, have nevertheless helped research into computerization break out of its impasse. To begin with, they have advocated looking at the social dynamic not as a fact, but as a construction. They have encouraged the development of conceptualization of work based on webs of interaction. This logic extended in various time frames emphasizes the processual dimension of human activities and entails that we examine work as it unfolds through these interactions in context.

Furthermore, structuration through its depiction of social dynamics allows us to see not only the impact managerial actors have on the life of organizations, but also the contribution of all organizational members in patterns of interactions, including those that emerge at a local level. Finally, in its recognition of power and sanction, and by its desire to grasp local and institutional dynamics, Giddens' theory is particularly relevant for the study of computerization in organizations. But its willingness to assess this complex process also poses important empirical problems which remain to be resolved.

III.5. The integration of technology in the interactional dimensions of computerization

Up to this point, my examination has considered the technological and interactional dimensions in a relatively independent manner, without dwelling on how the reviewed authors propose to reconcile these two facets of computerization. In this section, I will examine how the authors propose to bring together these two dimensions of human activities.

All authors view the organizational dynamic as well as the design and use of artifacts as social constructions. The simultaneous construction of technology and organization might make it difficult to study these phenomena, which, in addition to being in constant movement, depend on one another. Despite this difficulty, the recognition that these phenomena are constantly evolving has enabled researchers to move away from an overly static view of technology and organization. Furthermore, these authors have identified this problem and have proposed approaches that allow researchers to simultaneously consider the influence of artifacts and social interaction on human practices.

Suchman is inspired by distributed cognition to define the place of artifacts in human activities. At the end of

her book, she invites the reader to consult the early work of Hutchins in order to explore a conceptualization of artifacts that might be compatible with her definition of situations (Hutchins, 1983). The two approaches see the material and the social dimensions of human activities as interdependent. Hutchins explains how material and social resources are intertwined through the different steps of computation. The creation, transformation or propagation of representation can either be supported by artifacts or social interactions. Both concur about the computation process. While Suchman's view of artifacts is drawn from distributed cognition's early studies, she does not formally develop her conceptualization of the relationship between material and social dimensions of human activities. At a cognitive level, these approaches allow us to grasp how work activities rest on a common state of information created and sustained through interactions between workers and their environment. By manipulating objects, by exchanging words and glancing at each other, workers construct and maintain a state of knowledge that allows them to conduct their activities collectively.

If this cognitive level shows us how interactions among humans and with artifacts become the fabric of human activities, the place of social and material interactions in the production and reproduction of rules and sanctions remains unclear except to recognize that material artifacts do modulate human interactions. Within the structuration framework, Poole and his colleagues as well as Orlikowski choose to frame technology as a set of enablements and constraints, or more precisely as having a structural potential that simultaneously influences local actions and institutions. The multiple human practices resulting from computerization rest on the enablements and constraints integrated in the technology as well as by the actualization of the technological potential in the specific context in which it is implemented. Although different propositions have been formulated, none of them really help us conceptualize technology or other elements of the environment which also contribute to shape the structuration process. This ambitious research program leaves many unanswered questions regarding the place of technology within the constitution of social systems.

Orlikowski has tried on two occasions to reconcile structuration with 'situated approaches' to overcome some of the challenges posed by Giddens' framework (Orlikowski, 1996; Orlikowski, 2000). In her first attempt, she chose to develop her view of organizational transformation by using Giddens' notion of structuring (1984), Weick's (1993) improvisational metaphor, and insights by Suchman (1987), Hutchins (1995) and Lave (1988) with regard to situated practices. As discussed earlier, Suchman relies on ethnomethodology (Garfinkel, 1967) to investigate the local circumstances of interactions, which conflicts with Giddens' framework which also recognizes that social interactions are shaped by institutionalized social properties emerging from previous interactions repeated in time and space. Furthermore, distributed cognition conceptualizes artifacts as material entities structuring actions (Hutchins, 1995), which violates

the spirit of structuration as it was defined by Giddens (1984).

Though promising, her subsequent study (Orlikowski, 2000) based on the combination of structuration and situated cognition (Lave, 1988), also has some problems. Orlikowski is captivated by the relationship between individuals and their contexts described by Lave. Lave bases her situated cognition theory on the belief that people's knowledge cannot be fully captured in laboratory settings, but must be examined in the everyday, contextualized activities within which humans interact. She extends Lave's reasoning:

> Lave has argued for the value of focusing on "cognition in practice" rather than "cognition in the head". Similarly, the practice lens I am proposing here focuses on emergent technology structures enacted in practice rather than embodied structures fixed in technologies (Orlikowski, 2000:408).

One of the problems faced by this transfer from situated cognition to structuration is that the structure of human knowledge is a different order of reality than the structures of technology. Although the conceptual transfer is attractive, Orlikowski spends little time discussing its implications.

The three frameworks described in this text are difficult to reconcile. Still, structuration, situated action, and distributed cognition have succeeded in reframing the computerization problematic by exploring the material and social character of technology and by recognizing organizations as webs of interactions. The next section will describe more precisely the contributions of these approaches and the research avenues they open.

IV. CONTRIBUTIONS, LIMITS AND RESEARCH AVENUES

The contribution of these frameworks to computerization needs to be assessed according to different criteria. First, I will discuss the implication of these conceptualizations for organizational members confronted to computerization in organizational context. Second, I will present the conceptual contributions and limitations of these approaches.

IV.1. Contributions of the research for organizational members

The approaches described in this text offer practicians a new framework for understanding computerization. From situated action and distribution cognition we can formulate the following recommendations:

IV.1.1. The successful integration of technology relies on its compatibility with the situatedness of work

The arrival of a new artifact contributes to the redefinition of the work environment. The interdependence among the artifacts as well as the web of social interactions supporting work are reorganized to integrate the new artifact. The sources of information mobilized by workers are altered and the actions undertaken in that context can be modified. The possibility of increasing the effectiveness of work within organizations greatly depends on the configuration of information sources offered to workers in that en-

vironment, the vision they offer and the competence of workers to act upon it. The approaches I have described, and more specifically distributed cognition, reveal that computers can do more than transform data, they can also create and propagate representations of the work process that change the possibilities workers have for performing their work. Most importantly, they show us the importance of considering the interdependence of material artifacts among them and with human interactions to successfully manage technological change.

IV.1.2. The successful integration of technology relies on its compatibility with the social, collaborative character of work

By the 'social, collaborative character of work' is meant that individuals use social interactions to conduct, coordinate and make sense of their activities. They rely on various forms of interactions to become aware of the state of work of others around them. Work does not occur in a vacuum; people working in the same office have a responsibility to construct and maintain a shared state of information. In particular, the coordination of work on which its successful accomplishment depends is greatly favored by a regular updating of collectively-shared information. Efforts to introduce and integrate a new technology must consider this collective dimension of work.

Distributed cognition and situated action have allowed us to understand the material and collective dimensions of work at a very local level. Structuration also enlightened our understanding of social dynamics at a broader organizational level. This framework leads us to formulate the following recommendation:

IV.1.3. The implementation of technology is influenced by social dynamics at two levels: a local level by organizational members using technology; and at an organizational level by the influence of already existing patterns of interactions

This recommendation suggests that the result of technological change emerges from the confrontation of institutionalized patterns of communication, power and sanctions with new local interactions that might alter the existing social properties. Too often neglected, local interactions in context play an important role in the outcome of the integration of technology in organizational settings. An analysis of this local level of interaction forces us to consider how work and its environment are actually produced and reproduced by everyday exchanges among workers. If managers have some control over the success of technological change, the outcome is also negotiated with workers manipulating technology in their everyday settings.

IV.2. Contributions of the approaches at a conceptual level

The introduction raised a series of questions regarding the nature of work

to which the selected approaches have provided interesting answers. I will address them by examining a set of propositions emerging from this literature.

IV.2.1. Work is a situated practice which needs to be understood as it unfolds in its context

This first proposition, presented by Suchman and her followers, offers an alternative to traditional rational approaches to work within organizations identified by Sachs (1995). These authors move away from a rational vision of work based on a series of variables and a set of steps to define work as a process in which the worker-context relationship plays a crucial role. This processual and contextual logic helps us understand the variety of patterns found in the empirical data described in the computerization literature. More interestingly, it offers a different vision of work understood as a pattern of interactions among organizational members and artifacts found in their environment.

IV.2.2. Computer technologies are artifacts, among other things, which when integrated into their environment, contribute to enabling and constraining actions

This proposes a conceptualization of technology inspired by the three described approaches. Technology is now reconsidered in conjunction with the other elements of the context. For example, distributed cognition allows us to overcome what Kling (1991) had identified as an important problem in organizational literature dealing with computerization. Kling (1991) noted that labels such as "the computer system", often used in the literature, tend to neutralize technical differences between the different systems This lack of recognition of technical characteristics prevents researchers from fully understanding computerization and the integration of a new artifact within existing material and social organizational settings. The multiple constituents of environment become the key to understanding the accomplishment of work practices.

As mentioned in the introduction, I explored various facets of organizational dynamics and computerization. My first two propositions dealt with our understanding of organizational dynamics sustaining technological change while this last one will consider the contribution of computerization to organizational studies.

IV.2.3. Organizations are constructed through social interactions mediated by material resources

While the vision of organizations as a social construction has been investigated by many researchers, the place of material entities has long been overlooked. Studies of computerization and the conceptualization of technology as material artifacts proposed by authors such as Suchman and Hutchins raises the broader issue of materiality in organizations. These authors provide partial answers regarding the cognitive dimension of human activities but

they also leave an interesting agenda to be explored further by others. This development in computerization studies opens up a series of questions regarding the mediation of material entities in the social construction of organization taken up by researchers in organizational communication (Taylor, Flanagin, Cheney and Seibold, 2001).

While these appraoches make many contributions, they also leave a certain number of unanswered questions. Although structuration has opened the door to a rich literature dealing with computerization, I feel that Giddens' framework makes another reading of the computerization issue possible. This second reading is more or less explicit in the work I have reviewed, and is based on an understanding of technology in terms of resource (Groleau, 2000). This concept could be an interesting starting point for further research based on structuration. Recently, DeVaujany (2000) has also proposed a new conceptual model inspired by structuration, in which the political dimension of social dynamics is integrated. This model seems promising because it takes individual and collective appropriation strategies as a starting point. He directs his attention to the factors influencing these strategies and how they contribute to produce or reproduce the social system As DeVaujany (2000) suggests, this modelization is only the first step of a research program that could evolve by the confrontation of the concepts with different case studies. Furthermore, activity theory (Engeström, 1987) could provide interesting conceptual tools to pursue along some of the lines suggested by Hutchins and Suchman (Groleau and Engeström, 2002). Activity theory is also interested in the way tools are used to perform everyday activities in a social context, but its wider definition of the context allows researchers to study how situated activities are connected to one another to shape communities, rules and the division of labor. Activity theory moves beyond distributed cognition to include investigations of contradictions, conflicts and their resolutions. This framework could lead to a richer understanding of social dynamics in organizational contexts.

Finally, like Barley and Kunda (2001), I believe that we need to pursue our work to gain a better understanding of work practices in our changing times.

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