An Examination of the Computerized Information Flow Contributing to the Mobility of Tasks in Three Newly Computerized Firms

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ABSTRACT

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Our research focuses on the mobility of tasks in newly computerized firms. Up until now, the empirical studies conducted in that field, have described a wide variety of results. The assumptions made by past researchers, concerning the nature of social relationships and the nature of technology, were reconsidered in this dissertation. To understand the reallocation of tasks in newly computerized organizations, the role of technology as a force shaping social interactions was recognized. More specifically, the informational exchange between the computer and its user was investigated, to see how it could contribute to modify the worker's potential to negotiate the execution of various tasks. We opted for an inductive approach to investigate the specificity of the computerized informational flow in various task settings. Three organizations were visited and data was collected using a fieldwork approach. The core of the data came from observations of workers accomplishing their tasks in their natural settings. Interviews were also conducted with managers, and finally, data was collected from written documentation. The analysis of the collected data led to the development of a framework clarifying computer's input in various work processes. Two categories of computerized input were identified: performatives and constatives. This categorization of the computer's input was inspired by Austin's work. This framework permitted us to argue that computers may modify the mobility of tasks by framing actions through computerized performatives, or by framing the informational environment through computerized constatives.

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I dedicate this work to my parents, Gilles and Madeleine Groleau and to my grandfather, Roméo Drouin.

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Chapter 1: Introduction

1.1 Purpose of the research

Computerization of work has raised many questions which have generated a rich literature over the past few decades. Researchers have had a wide variety of interests ranging from the impact of technology on the quality of working life (Blauner 1964; Sheppard 1971; Davis & Cherns 1975; Hull & al 1982; Guimond & Begin 1987) to its consequences on the productivity of workers (Nora Minc 1978; DeBlasis 1985; Strassman 1985).

Our research focuses on the division of labor in newly computerized organizations. Up until now, the empirical studies examining the computerization of work have described a wide variety of results (Dunlop & Kling 1991). Findings have indicated that in some cases computerization had lead to the segmentation of tasks. In other settings, computerization was associated with task enrichment.

Various explanations have been formulated to clarify the variety of results emerging from these studies. Some authors explained the empirical studies' variety of outcomes by the differences in managerial philosophies. Other authors explained the same variety of outcomes by the varying configuration of computer technologies. A final group of researchers have noted that a multitude of factors needed to be considered to explain the reorganization of work following from computerization (Attewell & Rule 1984; King & George 1991).

In our research we attempt to clarify the links between some of the factors contributing to reallocation of tasks in newly computerized organizations.

The assumptions made by past researchers regarding the nature of social relationships and the nature of technology are reconsidered in this dissertation.

In empirical studies pertaining to computerization, social relationships had often been described as antagonistic: managers opposing workers and workers opposing managers. The manager/worker relationship seemed to have been oversimplified. Furthermore, in studies conducted in the managerial philosophy stream, authors focused their research on the role of managers in the reallocation of tasks Apart from a few exceptions (Zuboff 1988; Blomberg 1988; Alter 1985), the role of workers had been overlooked in the social dynamic of the organization. We feel the lack of recognition of workers as social actors, and the simplified vision of interaction between the members of the organization needs to be reassessed.

Assumptions about technology are also reexamined. In the computerization of work literature, technology had either been identified as a determinant of the change or disregarded as a factor creating an impact in the reallocation of tasks. Authors in the technological stream focused on the technological characteristics to explain the change they observed in newly computerized organizations. Explanations based on technological characteristics such as the transformative capacity of the technology (Rule & Attewell 1991) or the configuration of the computer network (Clement 1988) were used to fit the logic of one particular case study but their application could not be extended to clarify results obtained in other organizational settings. On the other hand, authors neglecting to examine the technological characteristics used "technology" or "computers" as generic terms without really exploring the particularities of computerized tasks implemented in the studied organizations. The multiplicity of technological characteristics identified in prior research incited us to review the role of technology in the allocation of computerized tasks.

We believe more attention needs to be paid to social interactions and to technology's role in shaping them if we want to understand how tasks are reallocated in newly computerized organizations. This dissertation will be devoted to the examination of the informational exchange between the computer and its user to see how it contributes to the modification of the worker's potential to negotiate the execution of various tasks.

This research considers technology as an element playing a role in the social construction of organizations. This way of defining technology differs greatly from the definitions given to computers in prior research.

We feel the framework emerging from our research will contribute to computerization studies in a variety of ways. First, our study makes links between technology, tasks and the input required from the worker in the accomplishment of tasks in a variety of computerized settings. By doing so we try to consider the specificity of various tasks and recognize the forms of contribution which technology can make in negotiating newly computerized tasks. Second, we examine the worker/technology interaction to see how technology changes the point of view workers have of the work process in which they are involved. We believe that by understanding the computer's capacity to change the workers point of view we can better see the potential made available to them to renegotiate the newly computerized tasks.

The specificity of tasks and the informational exchange between workers and computers had rarely been examined in previous studies. By exploring these two issues, we feel our study can offer an original contribution to the field. Furthermore, we believe, the framework emerging from our empirical data could be used in further research to acquire a better understanding of the complex social dynamic going on in newly

computerized organizations. We feel that by doing this we may help bridge the gap between research isolating either the social dynamic or the technology to explain the allocation of newly computerized tasks.

In the next section, we will briefly describe the research approach chosen to meet our purpose.

1.2 Overview of the research

We chose an inductive approach to answer our research question. The goal of our study was to better understand the relationship between the forms of data integrated in technology, and task mobility in various organizational settings. To meet our goal we chose a fieldwork method.

We conducted our research in three newly computerized organizations. Our data was gathered through qualitative data collection techniques. The core of the data came from observations of workers accomplishing their tasks in their natural settings. The goal of the observations was to obtain information about the requirements of the computerized tasks, the informational exchange between the technology and its user, and the necessary input to accomplish the task before and after computerization. The information gathered with the computer users was completed by interviews performed with managers and with data collected from written documents.

The data was then used to draw an organizational map for each research site visited for our study. A comparative analysis of requirements before and after computerization for each one of the tasks was also performed, to assess the technology's input in the execution of computerized tasks.

The analysis of the collected data led to the development of a framework clarifying the technology's input in the various work processes. Two categories of computerized input were identified: the constatives and the performatives. This categorization of the computer's input was inspired by Austin's work (1962). This framework permitted us to argue that computers may modify the mobility of tasks, by framing actions through computerized performatives or by framing the informational environment through computerized constatives.

In the following section the structure of our argument will be presented. This section will describe the content and the organization of the dissertation.

1.3 Outline of the dissertation.

Our dissertation will be divided in twelve chapters which will be organized in the following way:

Chapter One of this dissertation provides a framework for the study by describing its purpose. Our research is an attempt at resolving the contradiction which exists in literature dealing with computerization and division of labor, by providing a framework clarifying the input of technology in the process. We believe knowledge of the computer's contribution to the mobility of tasks in a variety of settings can provide a foundation to elucidate the complex social dynamic following from computerization.

Chapter Two is a literature review of research dealing with computerization and the division of labor. The literature has been divided in two streams: the technological and the

sociological approaches. Issues and questions raised by these studies will also be discussed.

Chapter Three will explore the assumptions underlying previous work. Finally, the main argument of the dissertation will be presented. We will argue that to better understand the mobility of tasks following from computerization, we need to examine the nature of the informational exchange taking place between workers and technology.

Chapter Four will describe and justify the methodological approach to the research. We adopted a qualitative research approach to collect data in three newly computerized corporations. Our data was collected mostly through observations with the workers using the technology. Semi-structured interviews with managers and data collected in written documentation were also used. The treatment of data will be discussed in this chapter. Finally, methodological concerns are presented, including a discussion on my role as a researcher, the thoroughness of data collection, and internal and external validation.

Chapter Five, Six and Seven will present the data collected in each one of the three studied organizations. Chapter Five will discuss the computerization experience of graphic designers working in an advertising agency. Chapter Six will describe computerization in the purchasing department of a crown corporation. Finally, Chapter Seven will present the data collected in the newly computerized accounting and purchasing departments of a hospital.

In our research, we have adopted an inductive approach. From the data, we developed a conceptual framework which partly rests on Austin's theory (1962). The use of his theory will be described in Chapter Eight. We will refer more specifically to Austin's early work (1962) where he categorized utterances as either constative or

performative. For the purpose of our research, this categorization was adapted and applied to computer/human interaction.

The findings of our research will be presented in Chapters Nine and Ten. Chapter Nine will define Austin's performative concept in computer terms. Using data from our field research, we will show how the reality observed in the various research settings has come together in our framework, emphasizing the application of the performative concept. The pertinence of the performative concept will also be discussed in that chapter. Chapter Ten will provide a similar analysis as the one described in Chapter Nine, using the constative concept.

Chapter Eleven will describe the dynamic relationship linking constatives to performatives. Furthermore, this chapter will discuss the application of the performative/constative categorization to other organizational settings.

Chapter Twelve will conclude the dissertation. Major findings of the research will be summarized. Limitations of the present work will be discussed. Finally, future research following from the framework presented in this dissertation will be suggested in the conclusion.

Chapter 2: Literature review pertaining to computerization of tasks

The objective of this chapter is to present an overview of the literature on computerization of tasks. More specifically, we will concentrate on studies pertaining to the allocation of newly computerized tasks. The literature review will be divided into two sections. In the first section we will present the work of researchers who have attempted to explain the division of work in newly computerized organizational settings. The second section will be devoted to the examination of issues and questions raised by these studies.

2.1 Examination of the literature: the sociological and technological debate.

The organization of work and, more specifically, the allocation of tasks within the organization, has been the object of study for close to a hundred years. The increased integration of technology in the work process has generated numerous questions regarding its impact on the allocation of tasks. The conditions and causes related to the emergence of different task allocation patterns have been the object of study of many researchers for the last two decades. Researchers producing studies on the restructuring of computerized tasks have opted for two different approaches. A first group of researchers have adopted a sociological approach associating the different ways in which tasks are restructured following the implementation of technology with the managerial philosophies adopted in organizations. A second group of researchers have opted for a technological perspective, and associate the various ways in which tasks are restructured with the types of technology used in organizations.

2.1.1 The sociological approach.

One of the most influential studies on technology and its repercussions on the organization of work was written by Harry Braverman. Since its publication in 1974, his work has been used as a foundation upon which other researchers have elaborated their own theories.

In this study, Braverman drew a parallel between the structure of social classes and the structure of work within an organization; the group owning the means of production controlling the other group. He considered work allocation as based on this power relation, with the worker's energy contributing to the economic interests of owners. According to Braverman (1974), the way in which work was structured was designed to ensure the domination of managers over workers. To acquire knowledge and control over the work process, managers adopted the principles of scientific management developed by Taylor (1911). Managers monopolized the knowledge once held by the workers to redesign tasks that required no specific skills from the worker. The knowledge acquired by management increased its control over the whole work process.

Braverman believed that computer technology was used to perpetuate the domination of managers over white collar workers. Managers were able to collect, develop and store the knowledge necessary to accomplish clerical tasks with computer technology. Management reduced the necessary skills to perform those tasks to an absolute minimum. The reduction of mental skills traditionally needed for clerical tasks rendered the white collar worker as vulnerable to management control as the blue collar worker. Braverman believed that mental work was also subjected to the principles of Taylorism.

There has been much criticism of Braverman's work: Braverman's lack of recognition of the co-existence of different managerial philosophies within capitalist societies is still discussed in the literature today (Attewell 1987; Wilson 1988; Kelley 1989; Cavestro 1990). These critics argued that Taylorism was never unanimously adopted in capitalist societies. Some of them provided empirical data to illustrate that capitalist managers have delegated complex tasks to skilled workers in various contexts (Attewell 1987; Kelley 1986; Cavestro 1990). Furthermore, Braverman has been criticized for ignoring the worker's resistance to managerial control (Wilson 1988; Cavestro 1990). Finally, Braverman has also been criticized by Cavestro (1990) for his oversimplified vision of the work design. Cavestro did not believe that the distinction between conception and execution could be as clearly delineated as Braverman supposed. Using empirical data, he showed that conceptual activities occur at different stages in the execution of a task, some of which are done by the worker instead of by the manager.

Cavestro's criticism can be applied to many other concepts Braverman borrowed from Taylor. The original study conducted by Taylor at the beginning of the century involved organizations that were very different from the ones we now encounter. For example, there are now multiple levels of management between the owner and the workers making it difficult to really understand the worker-manager relationship as described by Taylor and Braverman. It is unclear which layer of management Braverman was referring to in his study. Braverman also discussed management's actions as if they were coherent, rational, clearly articulated and agreed upon by all members of management. Furthermore, his concept of knowledge also needs to be reexamined. Knowledge, as defined by Braverman, represented an objectified know-how that was lost by the individual who shared it with someone else. This seems very limited; even though the diffusion of knowledge does have an impact on the power one may draw from being its only possessor, once knowledge has been shared the potential of using it again and again remains.

Braverman also assumed that the necessary knowledge to perform tasks within the organization was entirely possessed and controlled by management. Although it might have been true in previous forms of work organization, the complexity of some tasks now requires specialized knowledge acquired outside the organization (Perrow 1986). The use of knowledge drawn from outside sources diminishes management's control.

Braverman's theory rests on two postulates. First, Braverman firmly believed that the necessary knowledge to conceive the tasks executed by the workers was controlled by the managers. Second, Braverman supposed that management's use of technology was socially determined. Regardless of its potential, technology would be implemented following the values of the capitalist ideology which he associated with Taylorism. While Braverman posited that the implementation of technology did not create any real change except in reinforcement of capitalist values, empirical studies testing Braverman's hypothesis have shown that changes in patterns of work allocation coincided with the arrival of technology. To explain their results, researchers started to question Braverman's premises, reframing the debate on the computerization of the work process.

A first stream of studies examining the impact of technology on work design questioned the unilateral enforcement of Taylorist work organization suggested by Braverman (Beirne & Ramsay 1988; , Smith 1988, Appelbaum & Albin 1989; Wood 1989). These studies showed that the variety of patterns in work organization associated with computerization came from various managerial philosophies coexisting within our capitalist society. According to these authors, managers chose a pattern of task allocation that corresponded best to their set of beliefs and values. For example, some managers felt it was a better strategy to reorganize computerized work into narrow unskilled tasks while others used the technology to redesign tasks that were more complex and required more skills. According to these authors, the variance in managerial philosophy could explain the

variance in the work structure that emerged from the implementation of computer technology.

Researchers attributing changes in work organization to managerial philosophies have had a tendency to present the alternatives available to managers as varying only in the degree to which Taylor's scientific principles were implemented. For example, Smith (1988) opposed "direct control" to "responsible autonomy" and Appelbaum & Albin (1989) opposed "algorithmic" to "robust" work organizations. According to Wood (1989), the opposition between Taylorist and non-Taylorist work organizations discouraged researchers from identifying other types of work patterns (such as Fordism).

In a study conducted in the insurance industry, Appelbaum & Albin suggested that the implementation of computer technology offered managers a variety of alternatives regarding job design and allocation of work. These alternatives were placed on a continuum ranging from "algorithmic" work organization to "robust" work organization. In the algorithmic work organization, tasks were routinized and decisions taken by workers were reduced as frequently as possible to a set of "algorithms" that could be programmed in a computer. The work process was fragmented, minimizing the data treatment done by the data entry workers. The tasks of the workers doing the data entry was automated and required low skills. In the robust work organization, workers increased their knowledge about the production process. Workers learned, developed and applied new skills. Their level of decision-making was increased. Decisions were therefore decentralized, permitting a more flexible work organization.

According to Appelbaum & Albin, task allocation following computerization was chosen by managers. Although the authors believed the decisions rested on managerial philosophy, Appelbaum & Albin recognized that the number of alternatives offered to

management might have been reduced due to the characteristics of the production process itself (i.e., need for product standardization, special skills requirement for some tasks, etc.).

Appelbaum & Albin's study is a perfect example of the type of research done by the authors using managerial philosophy to explain the changes caused by computerization. This type of study departs from Braverman's theory because it showed that managers might want to share the knowledge necessary to the accomplishment of different tasks with the workers. By focusing on the role of managers in the allocation of knowledge and distribution of tasks, however, Appelbaum & Albin and their colleagues perpetuated the belief that management possessed and controlled all the knowledge necessary to accomplish the tasks within the organization. Basically, they believed that managers had the power to implement the technology so that the level of the worker's knowledge could be minimized or maximized, regardless of the technology that was being introduced.

Appelbaum & Albin mentioned that some external constraints could reduce the choice managers had regarding the implementation of the computer technology, but it is important to note that they did not develop their hypothesis further to identify the factors that could come into play.

Furthermore, the role of workers in the implementation of a new work design was ignored by researchers who concentrated on management's philosophy to explain the repercussion of computerization.

Zuboff (1988) partly agreed with some of the ideas formulated by these researchers but focused more on the role workers played in the reorganization of the work process. She described two strategies that could be used by managers to implement technology. In

the first, computer technology could be used like the steam machines of the industrialization era to automate the production process. This alternative where managers "automate" the work process perpetuated a Tayloristic work organization. In the second strategy, computer technology could be used to increase the knowledge of workers with regard to the different steps in the labour process. This "informate" strategy led to a form of work organization where jobs were enriched and employees empowered.

Zuboff also pointed out the complexity of the process by which managers chose the way in which technology would be used involving variables such as the will of managers to control workers, the desire to maximize the firm's performance and other economical pressures. In her case studies, managers all favored an automating strategy. By choosing to automate rather than informate, the author believed managers had not used the technology to its full potential. The capacity of the computer technology to retain, accumulate, treat and diffuse information had not been fully exploited. Although Zuboff offered rich descriptions of the complex interactions taking place between managers and workers during the implementation of a new technology, she gave few examples to illustrate the informate strategy, making it difficult to really assess the resulting labour process. However, in some of the cases she described, workers appropriated the technology and the knowledge embedded within it and became active in the reorganization of the work process.

Although Zuboff recognized that the potential of technology to generate and integrate knowledge depends on its capacity, as well as on the characteristics of the task to be performed, she offered no real explanation to clarify this issue. Even now, this question remains unaddressed in the literature.

2.1.2 The technological approach.

A second stream of research has explored the potential of computer technology to explain the various forms of work organization stemming from its implementation. This second group of authors was not influenced by Braverman's work, except for Clement (1988). These researchers did take a position on the role of managers and workers in the computerization process but their argument revolved around the potential of the technology.

Clement (1988) and Clement & Gotlieb (1987) adopted Braverman's view on the management/worker relationship, but argued that technology played a major role in managers' accessibility to the knowledge base of their organizations. Although managers strove to control the tasks performed by their workers, technology did not always render the production process transparent to them.

Clement described two computer traditions. He differentiated between the impact of integrated computers and that of stand alone computers. According to him, integrated office systems - composed of terminals hooked up to mainframe computers - offered top level managers the means to extend the application of scientific work principles to workers using this technology. These managers could better monitor, gather and reallocate the knowledge needed by their workers to accomplish their tasks.

Clement presented an alternative to integrated computer systems: autonomous stand alone personal computers. Unlike the integrated computer system, the purchase of a personal computer required little planning. The lack of involvement and control exercised by top level managers over the acquisition of the technology increased the autonomy of its users. Moreover, the author believed that top managers had little control over the knowledge embedded in the personal computer technology because those computers were

rarely integrated. So the personal computer technology made it difficult for top managers to organize and monitor the tasks performed by the workers using it. This argument rests on the existence of different technological traditions which create different knowledge configurations increasing or diminishing management's access to knowledge concerning tasks being performed by their workers.

Management was also limited by the capacity of the technology to integrate the expertise needed to do certain tasks which are difficult to standardize. Although the authors did not develop this final point, they argued that workers possessing knowledge which cannot be integrated in a computer were protected from management's control. As suggested by Clement, the relationship linking knowledge, task and technology cannot be overlooked, and needs further investigation.

Rule & Attewell (1991) identified another criterion that permitted them to discriminate among the different types of technology. The goal of their study was to understand the way in which technology modified organizational practices. To differentiate the impact computers have on the work process, Rule & Attewell identified three categories based on the transformative power of the technology: highly transformative, moderately transformative and non-transformative computer applications. Transformative power was defined by the authors as the capacity of the computer to transform data. They succeeded in demonstrating that the transformative power of the technology was positively correlated with the changes in organizational practices resulting from the implementation of the technology. Computers with a highly transformative capacity such as market analysis software packages opened new lines of actions and rendered employees' action more visible than application with low transformative capacity such as word processors. The authors assumed managers strove to gain as much control over the work process as they

could. However, Rule & Attewell did not discuss the role of the worker in the reorganization of the work practice.

St-Pierre (1985) also examined the transformative power of technology but from a different angle. For her, it was essential to differentiate the technologies used in the 1960's and 70's from the ones used in the 1980's, in order to understand the different work patterns emerging from the computerization of tasks. Earlier forms of computers used in the 60's and 70's encouraged massive data entry done by unskilled operators and massive data treatment done by computer specialists. These computers led to the creation of repetitive jobs for the workers who were not highly skilled. With the arrival of micro-processors, the workers did not need the intervention of specialists to process the data. The workers could then enter, process and transmit data on their own. The micro-processor has allowed workers to broaden the scope and increase the complexity of their tasks. St-Pierre viewed computers as social actors playing a role in the reorganization of work.

Finally, the potential of technology has been described in very different terms by Alter (1985). Alter examined eight cases of computer implementation involving technology that had very low transformative power. He studied the effects of technology that store and transmit information, such as word processing. The accessibility to knowledge coming from the new configuration of data storage and transmission created changes in the way tasks were organized. For example, jobs previously done by middle managers were now executed by clerical staff who had a wider variety of tasks to perform.

According to him, the implementation was followed by a phase of resistance where change was rejected by all organizational actors. During that initial phase, attempts were made to adapt the technology to the existing work process. The daily use of the technology

revealed opportunities to reorganize the work process which led to a second phase of change. Alter recognized three types of organizational actors who played different roles in that second phase. The first category of actors, the managers, continued to resist change. The second category of actors, the innovators who vaguely corresponded to middle managers, reinvented the work process. Alter observed that innovators got more involved in the computerization of the work process than managers did. Their implication permitted them to identify new opportunities presented by the technology. Although managers resisted changes in the work organization, innovators convinced them on the basis of better productivity or democratization of the work process. The third category of actors, the operators, usually welcomed the change but lacked the power to initiate it. Finally, the author added that the reorganization of the work process depended on the willingness of the actors to accept the change provoked by the innovators.

Each of these authors focused on various technological characteristics of computers to explain the changes created by the computerization of the work process. The diversity of technological characteristics used to explain the restructuring of work made it difficult to draw clear conclusions on the impact of the technology.

Although the authors each explored a different aspect of the technology, the underlying logic remained the same: the authors attempted to identify the means by which computers changed the way knowledge, and consequently, the way tasks were shared among the members of an organization.

Their arguments revolved around the increased visibility of knowledge through technology. Rule & Attewell (1991) did not directly discuss the visibility of knowledge. Rule & Attewell described the changes they have observed in the following way:

> In all these cases, ordinary transactions by staff leave electronic records that, when properly compiled provide management with a broader view of the overall processes of the firm than would not otherwise be possible (p.142).

Although their initial hypothesis dealt with the transformative power of technology, the results obtained from their case study seemed to address the implication that integration and visibility of knowledge had on the reorganization of work. The authors referred to "the overall processes of the firm" because many tasks were integrated and made visible through the technology. In their explanation of the computerization phenomenon, Rule & Attewell seemed to share some of Clement's underlying interest in the visibility of knowledge. Rule & Attewell did not explicitly state it, but they seemed to postulate that transformative technology made procedures more explicit, and thus more visible to managers.

Beyond a common interest for the new knowledge configuration created by the technology, many differences exist in the analyses of the authors regarding the type of knowledge and the role of managers and workers leading to the reorganization of the work process.

Regarding the type of knowledge, two different views emerged. Both Rule & Attewell and St-Pierre (1985) believed that knowledge, in the form of rules or procedures - leading to what they call transformative applications of the technology - had the potential to create a new work configuration. According to St-Pierre, accessibility to new procedures integrated in the technology facilitated data treatment by workers who could now perform a wider variety of tasks with the help of the computer. Rule & Attewell focused on managerial tasks and observed that transformative applications changed the way managers accomplished their own tasks because new lines of action emerged from the technology, and transactions within the organization became more visible.

On the other hand, in his case studies, Alter (1985) observed that technology which simply transferred data from one point to the other, made knowledge visible to a larger number of organizational actors and eventually modified the division of labor among them.

A complicating factor in the evaluation of these studies comes from the different types of tasks which were examined by the authors. It seems that the tasks observed by Rule & Attewell required one type of skills while the ones studied by Alter required another type of skills. The questions raised by Zuboff and reiterated by Clement and St-Pierre concerning the nature of the tasks and the characteristics of the technology, need to be further explored, in order to understand how computers could assist workers in the execution of their tasks.

In order to explain the changes in the work process, the authors focusing on technological characteristics still had to deal with the roles of workers and managers in the organization.

From the studies described above, interesting observations can be made about the role of the various organizational members. Through observation, both Clement and Alter recognized that workers had active roles in the reorganization of the work process. Alter observed that middle managers initiated the restructuration, while Clement noticed that workers could use the technology to diminish the control managers had over their work. In her hypothesis, St-Pierre also presumed that workers played an active role in the redefinition of their tasks.

The role of managers remained almost unquestioned by the researchers. Managers were described as people seeking maximum control over their workers. Clement referred directly to the Braverman theory to describe the managers he observed. The managerial

profile depicted by the other researchers of the technological stream left little room for variation in the way technology could be implemented.

Studies on the computerization of the work process focusing on the technological factor demonstrated that different types of knowledge could be integrated in computers. The contradictory hypotheses validated in different organizational settings need to be further explored, especially to clarify the task-technology relationship. Furthermore, the results from the group of researchers concentrating on the technology itself observed ways by which workers intervened in the restructuring of work. The role of workers in the modification of task allocation was neglected by the researchers using the managerial philosophy to explain the changes caused by the computerization of the work process.

Other studies were performed to better understand the changes following the implementation of the technology (Orlikowski 1991; Baran 1987, Long 1987; Shaiken 1984; Carter 1984) but the same questions regarding the precise role of managers, workers and the potential of the technology remained unanswered.

2.2. Exploration of the issues and questions raised by previous studies.

The body of literature produced to explain the restructuring of computerized work has been subjected to some criticism. The lack of integration between the technological and managerial approaches and the simplistic depiction of technology and organizational social life have been the most recurring criticisms.

2.2.1 Integrating the sociological and technological approaches.

Authors, such as Kling (1991), have become skeptical of theories based on one dominant logic, whether it be managerial philosophy or technology, to explain the complex changes produced by the computerization of the work process. As we have presented in the literature review, two distinct and independent avenues have emerged to explore the computerization of the work process: Researchers have concentrated either on technological or sociological factors.

This distinction between technological and sociological factors framed the debate very early on. In a literature review, Kling (1980) classified empirical studies examining computers in organizations into two categories: system rationalism and segmented institutionalism. System rationalism gave the computer a central role by showing the positive role of technology and by downplaying its disadvantage or its consequences on the social life of the organization. Segmented institutionalism concentrated exclusively on the social changes coinciding with the arrival of the technology in the organization.

The need to integrate the technological and sociological approaches has been expressed by many authors (Hirschheim 1985; Kling 1991; Kuuti 1993; Rogers 1993). The way in which those two approaches can be integrated has not been clearly elaborated.

2.2.2 Definition of technology.

Besides the lack of integration between the technological and sociological approaches, Kling (1991) and Hirschheim (1985) have expressed the need to further explore both the characteristics of technology and the roles of managers and workers, in order to understand better the effects of technology in organizations.

According to Kling (1991) and Hirschheim (1985), researchers have used the terms "technology" or "computers" as general terms without really exploring the characteristics distinguishing the different types of technology implemented in organizational settings. This confusion with regard to the potential of different technologies led to contradictory results. Studies from our literature review seem to have overcome this problem, but the different technological characteristics identified to explain changes in work allocation vary from study to study. The researchers in the technological approach each focused on one technological characteristic and neglected to consider other aspects of the technology that could also contribute to explain the changes produced by the computerization of the work process. Consequently, the logic developed by Clement, Rule & Attewell and St. Pierre fit the case studies they have described, but cannot easily be extended to other concrete situations.

2.2.3 Definition of the social reality within organizations.

Furthermore, as Kling (1991) and Hirschheim (1985) have suggested, the roles of managers and workers in the redesign of the work process, also need to be developed further. Except for the work of Zuboff and Alter, the empirical studies we have described oversimplify the manager/worker relationship.

The body of research focusing on managerial philosophy departed from Braverman by questioning the unanimous application of Taylorist principles, but maintained his postulate of absolute domination by managers over workers. Although both Clement and St-Pierre seemed to suggest that workers participated in the reorganization of work, it really was in Zuboff and Alter's detailed empirical studies that the complex relationship between managers and workers became more evident. In particular, the notion of worker

resistance, neglected by the stream of researchers relying on managerial philosophy, became apparent in the empirical studies reported by Zuboff and Alter. Zuboff described a few cases where managers attempted to take full charge of the new computerized work design without consulting the workers. Management's attempt to dominate was not welcomed by workers who expressed their resistance in different ways. Zuboff explained:

> In the area of the mill where operators experienced the greatest sense of ambiguity and victimization, they fashioned their own methods of reestablishing order. ... They simply stopped performing some of the tasks for which they had formal responsibility. .... A second adaptation was to challenge the notion that exposure to data demands responsiveness. Piney Woods' managers began to notice that in most adversarial areas of the plant, operators had developed a new method of expressing their discontent. Why resort to the machine-breaking tactics of an earlier century when it was so much more elegant to simply ignore data? (p. 301).

Zuboff described other cases where workers either destroyed the equipment or simply used their technological skills to generate confusion among the managers of the newly computerized firms.

The different examples of worker resistance provided by Zuboff suggest that management's control over their workers was limited. These empirical findings corroborate Crozier & Friedberg's theory (1977):

> une situation organisationnelle donnée ne contraint jamais totalement un acteur. Celui-ci garde toujours une marge de liberté et de négociation. Grâce à cette marge de liberté, chaque acteur dispose ainsi de pouvoir sur les autres acteurs. (p. 91).

Zuboff's observations contradict Braverman's assumption, which supposed that workers were powerless in organizations evolving in capitalist societies. Braverman's assumption partly rested on the belief that workers were robbed of their skills and knowledge as they entered a corporation. Braverman, and researchers using managerial philosophy to explain the computerized division of labor, based their theories on the belief that managers control the knowledge base of their organizations.

The question of control through knowledge is especially relevant in the case of a newly computerized firm. Unlike other tools used in the past, computers have the capacity to integrate knowledge (Taylor & Van Every 1993; Zuboff 1988). The knowledge integrated in the technology can take many forms such as procedures and raw data, as Rule & Attewell and Alter have suggested.

The researchers focusing on managerial philosophy to explain the changes caused by computerization, supposed that managers fully understood the potential of the technology and possessed the necessary expertise to access the computerized knowledge. According to them, managers were aware of the knowledge integrated in the computer and reallocated that knowledge according to a form of task organization that fit their vision of the organization.

Again, empirical data presented by Zuboff suggested that managers were not always in full control of the knowledge workers used to perform their tasks. Zuboff described a specific case where managers and workers were negotiating in order to settle a labor dispute. Workers possessed the technological know-how to control the level of productivity of the newly computerized work process. They used their expertise, which was unknown to managers, in order to increase or decrease the rate of production as a means of expressing their satisfaction or dissatisfaction with the way negotiations were going. In that situation, the managers did not possess the technological expertise to understand the production process.

Braverman borrowed his concept of control through knowledge from Taylor. Although in small firms at the beginning of the century, it might have been possible to exercise control through the monopolization of the workers' knowledge, it seems that

nowadays the appropriation of knowledge by managers becomes extremely complex. Authors dealing with organizational theory such as Mintzberg (1979) and Perrow (1986) have already argued that the tasks performed by workers sometimes required knowledge acquisition from sources outside the organization which often limited the control managers had over the knowledge used by their own workers.

The complexity of the knowledge required to accomplish a computerized task and the type of knowledge integrated in the computer become relevant issues; issues which are ignored in most studies of computerized work. Furthermore, the way in which knowledge requirements vary with different tasks and the importance of tacit knowledge are hardly ever discussed in this body of literature.

Empirical studies show that managers did not always possess the necessary knowledge to fully understand the computerized work of their subordinates. Zuboff (1988) reported:

> Some managers continued to struggle with their own sense of vulnerability; they recognized that subordinates' questions could all too easily unravel the painstakingly constructed facade of infallibility to which many still clung (p. 289).

Zuboff added this quote from a manager:

> Every day I go up and look at the screens, and I ask questions, and my questions generate questions, I do lots of probing, and often I don't know the answer. Asking questions puts me in a vulnerable position. I show more ignorance than I like to show (p. 289-90).

Through their observations, both Alter and Zuboff seemed to question management's capacity to completely control the reorganization of work and discussed the way in which managers and workers constructed a new division of labor through a new division of knowledge:

> If the technology cannot shoulder the entire burden of strategic change, it nevertheless can set into motion a series of dynamics that present an important challenge to imperative control and the industrial division of labor. The more blurred the distinction between what workers know and what managers know, the more fragile and pointless any traditional relationships of domination and subordination between them will become. (Zuboff, p. 308).

> La bureautique est productrice d'une culture de l'innovation qui représente les nouvelles forces vives de l'univers de la production: c'est cet ensemble de normes de relations, de représentations et de projets collectifs qui pousse l'entreprise à se transformer, à utiliser ses techniques non comme un moyen d'assurer la permanence de ses structures mais comme celui de leur dynamique. (Alter, p. 82)

Computerization in some cases allowed a new allocation of knowledge which opened up options to different organizational members:

> Un cadre d'études: "Le chef n'est plus seul à avoir l'information, il n'y a plus de destinatoire unique... On passe plus de temps à travailler qu'à courir après des informations dites confidentielles (...). Notre travail ne peut marcher que si on en discute..." (Ibid, p. 47)

Both Zuboff and Alter offered numerous descriptions of instances where workers appropriated the technology and used it to redefine their tasks and the relationship with their superiors:

> Others had begun to discover new mechanisms of influence associated with this learning process, even as their conventional sources of influence were in decline. They had begun to see that the interpretive process itself could be a powerful vehicle for extending one's influence while encouraging learning. (Zuboff, p. 290)

> Une secrétaire: "Quand ils arrivent, ces systèmes sont vides; c'est à nous de leur trouver des fonctions... C'est comme un jeu, c'est l'artisan qui construit son meuble avec son outil"...(Alter,p. 33).

> Un cadre hiérarchique: "La télécopie, c'est gênant... Je suis obligé de surveiller ce qu'on envoie. L'autre jour, ils ont pris sous leur bonnet de changer l'ordre de priorité des travaux... Quand je suis arrivée en réunion là-bas, je ne le savais même pas". (Ibid, p. 42).

The criticism formulated by Kling (1991) and Hirschheim (1985) regarding the simplistic way in which social relations were described in studies on computerization of the work process needs to be qualified. In fact, the empirical works of Zuboff and Alter have

permitted us to question some of the assumptions, and to understand further, the complex relationship between managers and workers in an organization.

In many of the studies discussed in the literature review (Rule & Attewell 1991; Appelbaum & Albin 1989; Beirne & Ramsay 1988; Clement 1988; Smith 1988; Clement & Gotlieb 1987; Baran 1987; Long 1987; Shaiken 1984), the actions of organizational members were polarized around two types of roles: managers and workers. According to these authors, managers had the capacity to transform the organizational environment and strove to gain control over their workers. The studies focused mainly on management's actions. Workers were described as an objectified mass, subjected to management's rational and unified will. Furthermore, computers were portrayed as technology having the capacity to physically transfer a block of information from point A to point B.

Through the cases of Zuboff and Alter, we were confronted with a different organizational reality. Workers can play an active role in shaping the organization. The roles of workers and managers are complex, and produce a variety of factionized groups with different interests. The information stored in the technology leads to new ways of conceptualizing work, relationships and the whole organization itself.

A new framework considering the observations made by Zuboff and Alter will be developed in the following chapter.

Chapter 3: Re-examination of the computerization debate.

The criticism formulated about the body of literature produced to explain the restructuring of computerization work will be used to determine the orientation of our research. In the first section of this chapter, we will examine how the social reality described in studies pertaining to computerization can be reframed. In the second section of this chapter, we will try to assess the role of technology in the social dynamic, as well as identify theoretical tools which could help us structure the conceptual framework on which our research will rest.

3.1 Reformulation of assumptions made about the social reality within organizations.

The way in which workers and managers were described by Zuboff (1988) and Alter (1985) encouraged us to question the postulates of past research and to examine the social dynamic in a new light. The assumptions made by Zuboff and Alter regarding the organizational social dynamic seemed similar to the position adopted by researchers of the interpretive perspective, like Putnam (1989):

> Organizations are not monolithic entities; rather they are coalitions of participants with different priorities. Individuals negotiate their goals, actions, and meanings to achieve a common direction; but they need not abandon their different aims, they simply subjugate them to the immediate needs of the group. For pluralistic researchers, the primary unit of analysis centers on the values, goals and interaction that create and sustain coalitions. Even though dominant coalitions of powerful members make decisions that have consequences for all participants, lower level coalitions can be politically potent and exert direct influence on managerial actions. (p. 37)

The recognition of organizational members as actors shaping their own reality had been scarcely discussed in the literature pertaining to the division of labor in newly

computerized settings. A few studies using those postulates were identified in other related areas of computerized studies.

One of the seminal works resting on these postulates was carried out by Suchman (1987). Through an ethnographic observation, Suchman was able to better understand how tasks were constructed by the different organizational actors in contextualized situations.

More recently, authors concerned with systems development have continued to explore the way in which people, technology, work requirements and organizations were understood (Bannon 1993; Hughes et al 1992). Hughes et al attempted to pursue Suchman's research, by using an ethnographic research scheme to explore the social organization of air traffic controllers, in order to design a technological tool that fitted their specific needs. The authors had described the division of labor as: "the separation, individuation and combination of activities is accomplished in an accountable way through a collectively developed, negotiated and evolving knowledge." (p. 117).

De Terssac (1992) based his work on similar assumptions. He wrote: "l'entreprise fonctionne désormais sur une pluralité d'acteurs; son efficacité dépend de la capacité de mobilisation de leurs ressources et de leur combinaison." (p. 264). His interest lay in the autonomy of workers, especially those who used computer technology to accomplish their tasks. De Terssac believed that computers, like managers, offered incomplete rules which forced workers to develop a parallel system permitting them to accomplish their tasks.

Basically, De Terssac assumed that workers were active social actors. Workers were given prescriptive rules which had to be supplemented by their own set of rules in order to have a production process that worked. The set of rules developed by workers

(named 'execution rules' by De Terssac), was constructed by the workers themselves. A common frame of reference, on which the execution rules rested, was elaborated despite the divergent interests workers may have had: "l'accord qui permet l'élaboration d'un compromis au sein du groupe d'exécution est une construction sociale élaborée sur la base d'intérêts multiples" (p. 265)

The limits of prescriptive rules naturally reduced the authority managers could exercise over the tasks executed by their workers. According to De Terssac, managers were conscious of the shortcomings of the rules they prescribed but they were also aware that any attempt to fully control the actions of their workers would lead to resistance. Although managers felt they had to express their authority, they also needed to obtain the collaboration of their workers. De Terssac observed this tension between domination and cooperation in different work settings:

> le chef de salle a autant intérêt à maintenir le rondier dans un rapport de subordination pour éviter d'être menacé dans son poste, qu'à lui faire partager ses décisions pour bénéficier des informations qu'il détient et des savoir-faire qu'il accumule... Le chef de bloc a tout autant intérêt à définir un territoire de travail et un espace de décision d'où il exclut son adjoint, qu'à lui permettre de s'approprier ce territoire et de s'impliquer dans l'espace de décision, s'il veut s'assurer de la contribution de son adjoint et le moment venu, de la possibilité de lui demander de réaliser des tâches qui ne lui sont pas attribuées officiellement. (p. 265)

This need to obtain cooperation forced managers to negotiate with workers in order to have a production process that ran smoothly.

The negotiation process in which organizational actors participate took two different forms in the studies of Hughes et al and De Terssac. Both studies discussed the negotiation that took place between organizational actors of similar hierarchical status. These workers built a common referential system that facilitated coordination of the different sections of the production process. De Terssac also described the negotiation that

went on between workers of different hierarchical levels. He discussed the fragile equilibrium between domination and cooperation which had to be maintained.

Although both studies were founded on the assumption that the division of labor implied a negotiation involving organizational actors who were motivated by different interests within a computerized context, neither of them really considered the input that technology could have in the negotiation process. The workers possessed different expertise which must be coordinated, but how technology altered the way knowledge was allocated, and how tasks were organized, was not explored. Hughes et al considered the point of view of the designers while De Terssac demonstrated that the shortcomings of the technology obliged organizational actors to join forces.

The case studies described in the researches of Zuboff and Alter illustrated that organizational actors from all levels of the hierarchy used the technology to redefine their tasks and their relationships with one another, but the authors offered little explanation regarding the type of data integrated in the technology that triggered the negotiation process. Zuboff presented different types of technology without exercising any kind of discrimination among them.

Although the research described in this section recognizes the role of workers as organizational actors shaping their reality, little work has been done within that context on the use of technology to reshape the division of labor.

3.2 Reconceptualization of the role of technology in computerization studies.

In the previous section we have described studies pertaining to computerization founded on a vision of social reality which recognized organizational members as actors who had a hand in shaping the organizations. These studies dealt with the design and shortcomings of the technology without really assessing the input of the technology in the way tasks were reallocated.

The way in which computer software packages affect the interaction of workers performing their tasks could be explained using Taylor's recent communication theory of organization (Taylor 1993; Taylor & Van Every 1993). Taylor claimed organizational members defined themselves and the reality in which they evolve through interactions. Two levels of interactions were identified: texts and conversations. Texts refer to the macro level of communication. Texts embody the system of meaning guiding the actions of organizational members. Texts take the form of objectified and decontextualized systems of representation[1]. Conversations refer to the micro level of communication within organizations. Conversations were defined as interactions in which "participants exchange something of value (such as information) while simultaneously instantiating a relationship linking the two (or more) interactants" (Taylor & Giroux 1993, p.5). Conversation takes the form of face to face interaction between organizational members. It is a set of synchronized interventions building an interconnected flow of exchange.

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[1] According to Taylor, text can also be referred to as an individual system of meaning constructed by individuals to make sense of their reality. In our analysis we will use the definition of text as the objectified and decontextualized system of meaning, to discuss the implications of the computerized text objectified in a computer software.

The differences between text and conversation are important to grasp. First, texts are objectified while conversations are not. Because of that, individuals have a subject/object relationship with text, while they have an intersubjective relationship in conversations. Since text is objectified, it faces little temporal or spatial constraints and can be used to disseminate meaning at an organizational level. Because of their volatile and ephemeral nature, conversations, on the other hand, are used to disseminate meaning at a more restricted level. To explain the relationship linking text and conversation, Taylor & Giroux used Ricoeur's distanciation concept:

> Distanciation is achieved when discourse, or conversation, passes from the stage of being realized as an event to being understood as meaning, from interaction as flow of talk to interaction as narrative.... What was intersubjective to start with has now become the object of a subjective knowing - an eventual theme for future communicational exchange... It is the meaning of an event and not the event itself that can be inscribed in a text. (p.15)

The movement between conversation and text is dialectical. The meaning of conversations is integrated in text. The production of the text in turn produces a new conversation which will eventually be integrated in a new text, and so on.

Returning to computerization, Taylor used the text concept to describe computer technologies (Taylor 1993; and Taylor & Van Every 1993). The computer software package could be defined as an objectified system of meaning guiding organizational members in their actions and in their vision of organizational reality. If we accept defining computer software as text, as Taylor did, then the text/conversation dynamic could be used to see how organizational reality is constructed through interactions emerging from the computerized text. Since workers construct their organizational reality through interactions, we can assume the text/conversation framework could also be used to assess the reconstruction of computerized tasks among organizational members.

At this point, it would be interesting to apply the text/conversation theory to concrete settings, but we believe more conceptual work needs to be done to identify what is in the computerized text. This dissertation will be devoted to the identification of what constitutes the computerized text to better understand how it can contribute to modifying the allocation of tasks in various computerized settings.

If we believe that the integration of a new computerized text may contribute to changing the organizational reality in which it is implemented, we need to examine what is in the text to assess how it can affect the interactions of the organizational members. Our assumption, then, would be that the content of computerized texts will affect the social dynamic ensuing after its implementation. That assumption rests on Taylor's theory and on the result of previous studies which have described a variety of results which we think partly rests on the difference in social dynamics within organizations, but which could also be partly explained by the characteristics of tasks and the properties of technologies implemented in the various organizations.

Up until now, research pertaining to the content of the computerized text seems limited. Zuboff (1988) used the electronic text metaphor in her study. According to her, electronic texts were composed of textualized information pertaining to activities, systems of events and the organization of work. She did not, however, concretely analyze the constituents of the electronic text used by her subjects. She assumed that:

> The automating capacity of the technology can free the human being from a more comprehensive, explicit, systemic and abstract knowledge of his or her work made possible by the technology's ability to informate. (p. 181)

In Taylor's framework, texts and conversations were mediated by language. Speech act theories were used to demonstrate that beyond words, individuals using language performed actions; however, the potential to accomplish a variety of actions through linguistic communication has not been explored in computerized settings.

The approach we are proposing differs from previous studies on the computerization of tasks. We share with the authors from the technological stream an interest in technology but we don't see technology as determinant of the change occurring in newly computerized settings. We conceptualize technology as an instrument setting boundaries of social interaction between organizational members by means of the informational content it makes available to them. Our dissertation will focus on the informational exchange between technology and its user, to see how data integrated in the computerized text is made available to its user, and potentially provide some form of input in the execution of computerized tasks.

We believe the nature of the computerized text varies with the type of tasks which are computerized, so our research design will integrate the examination of a variety of computerized texts to see how, in different settings, data stored in the computerized text may contribute to rendering tasks more or less mobile.

We recognize the importance of the social dynamics of the organization, but unlike the authors of the sociological stream we recognize the role of technology in that dynamic process. Even if our study will not clarify the complex social dynamics of the organizations, we feel our study and the framework it presents can contribute to explaining the contribution of technology to organizational actors negotiating the allocation of tasks in various organizational settings. By recognizing the role of technology in the social dynamics of organizations, we will alleviate some of the difficulties faced by researchers relying exclusively on technology or social dynamics to explain the changes experienced in newly computerized settings. We believe our work fills a gap in the literature. It offers a different point of view on technology and makes it possible to conceptualize technology as a social force having an impact on the evolution of the organization.

Chapter 4: Methodology.

In the previous chapter, a research framework was developed. The framework emphasized the need to study the forms in which data was integrated in the computerized text, in order to better understand the potential to renegotiate tasks among organizational members after implementation. The input of computer technology was evaluated by comparing task requirements before and after computerization. To fully capture the potential offered by the computer technology, we decided to do a comparative analysis of the technology's input in different newly computerized work settings.

In this chapter we will first describe the approach we have chosen to investigate the research questions presented in previous sections. Second, we shall describe the criteria which guided us in the choice of research sites. The third section of the chapter will present the research design, in which we will discuss the data collection techniques and the procedures used to treat the data. The final section will address our methodological concerns.

4.1 The research approach.

As stated in the previous chapters, the goal of this study was to better understand the relationship between the forms of data integrated in technology and task mobility in various organizational settings.

The approach we have chosen to explore the forms in which data was made available to computer users is a field work-based data collection method. Other approaches, such as an intensive study of keys, commands and functions integrated in software packages could have been useful to address our concern, but the need to explore

tasks in concrete organizational settings and to capture the evolving knowledge of workers seemed essential. The organizational setting provided a context for tasks which permitted us to better understand the requirements needed to accomplish the work. Furthermore, the field work made it possible to observe how workers interpreted and integrated the information provided by the technology in the accomplishment of their daily routines.

Within the field work approach a wide array of methods could have been used to collect and treat the data. We opted for qualitative methods. Many reasons motivated our choice. Past studies based on qualitative methods performed by Alter (1985), Barley (1986), Suchman (1987) and Zuboff (1988) have provided detailed descriptions of the reality which made it possible to see the complexity of the computer/user interaction in concrete settings. Furthermore, it has been recognized that the isolation of variables has not lead the researchers to any productive answers in the field of computerized work (King & George 1991). We believe a quantitative approach would have forced us to isolate variables and limit our view of the computerization phenomenon. The qualitative approach permitted us to see how, in conjunction with the other elements of the context, technology could render new paths of actions possible. Finally, we believe qualitative methods permit us to be faithful to the assumptions we had made about organizations and their members. Since we postulated that members of the organization construct their environment through interactions, it became extremely important to see how the knowledge integrated in the technology fueled this interaction. To capture the pattern of interactions as they occurred, we needed to be in the field.

The collection of data pertaining to the accomplishment of tasks was done through observation. Observation permitted us to capture the interaction between the computer and its user, as it happened in the work environment. Since we wanted to compare the input of workers in the work process before and after computerization, workers were asked

questions during observation about past practices, as their tasks unfolded. We are aware of the limit imposed on us when workers had to recall and verbalize information about prior tasks. To overcome this problem, we often encouraged workers to fetch documents previously used to perform tasks prior to computerization. We believe this process helped the worker recall and contextualize prior tasks. Furthermore, it permitted us to question the workers more precisely.

The need to conduct data collection in contextualized settings and to adapt to the routine of workers in the accomplishment of their tasks, made us choose a strategy of observations and unstructured interviews to obtain data pertaining to the execution of tasks, instead of other data collection methods such as questionnaires or structured interviews. For data concerning the history of computerization within the organization, semi-structured interviews were used.

More details regarding the collection of data and the combination of methods used to capture all the necessary data regarding the organization and its members, will be provided in the section on research design and procedures.

4.2 The research sites.

Since our theoretical framework suggested that knowledge integration varied with the type of tasks and technology used, it became important, for this study, to visit different work settings. In this section, we will discuss the criteria which guided us in the choice or our research sites and the approach we took to enter the chosen organizations.

This study selected three organizational sites with significant differences in their work processes.

The first research site was an advertising agency, which will be referred to as the "agency" in the remainder of the study. Among the various working units of the agency, we chose the graphic design department, composed of three graphic artists and one coordinator. The graphic designer's tasks were to prepare artwork to be reproduced on various media such as newspaper ads, pamphlets, posters, pins and T-shirts.

The second research site was a crown corporation, which will be referred to as the "council" in the remainder of the study. The purchasing department of the council was selected for this research. The department had a total of ten employees, which included the director of the unit. The employees purchased inventoried and non-inventoried goods, using various processes ranging from telephone orders, to calls for tenders. The accounting and inventory tasks were performed in separate departments which were not visited for this study.

The third research site was a long-term care hospital, which will be referred to as the "hospital" in the remainder of the study. The following tasks were performed within the financial services of the hospital: accounting, purchasing, inventory management and remuneration. During this study, we observed the workers executing accounting, purchasing and inventory management tasks. The accounting unit was made up of five employees performing tasks such as the management of accounts receivable, accounts payable and the preparation of financial statements. The purchasing unit was made up of four employees. The employees of that unit performed purchasing and inventory management tasks. The purchase processes used in the department were telephone or written orders[1]. The employees of the purchasing unit acquired inventoried and non-

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1 The responsibility to purchase goods over a certain amount was given to a special purchasing committee.

inventoried goods. Inventoried goods, such as stationery and bandages, were stocked in a warehouse within the hospital.

The three research sites offered us a broad variety of tasks to study. Although purchasing tasks were found in two of the three research sites, the nature of the purchasing tasks differed in the two organizations. The purchasing staff of the council acquired mostly goods which were not inventoried while the purchasing staff of the hospital ordered mostly inventoried goods. The difference between the two work processes was the level of product standardization which naturally had an impact on the computerization process. Having purchasing tasks in two organizations gave us the opportunity to compare how the studied tasks were performed in two different environments. Apart from the examination of purchasing tasks in two organization, the variety of tasks in the selected research sites provides an interesting corpus to analyze the technology's potential to support the computer user in the accomplishment of various tasks.

The research questions formulated in this dissertation partly emerged from some of my previous empirical work. Through the years, I studied five newly computerized work processes which influenced me in the type of work settings I wanted to observe. More precisely, I wanted to examine tasks which involved a lot of data processing, such as accounting tasks and tasks which involved a low level of data transformation, such as purchasing tasks. It seemed that computerization affected both types of tasks, but no explanation in the literature could clarify the phenomenon. So, I decided to choose organizational settings which would allow me to compare and analyze tasks with varying levels of data processing.

The time period between the implementation of the technology and our visit of the organization became another important variable in the choice of the research sites. The

concept of time becomes critical when organizational change is studied (Bryman 1988). Empirical studies by Alter (1985) and Zuboff (1988) have shown us that the reorganization of the work process took time, because the potential of the technology really showed once the workers started using the technology. Furthermore, organizational members often resisted change in the first few months following the implementation of the technology (Alter 1985). Based on the previous experience of researchers (Alter 1985; Zuboff 1988; Lefebvre & al 1987), a period of at least eighteen months was believed to be reasonable to have the workers familiarize themselves with the technology. On the other hand, the time period between the implementation and the data collection cannot be too long, because we need to collect specific data from workers on the structure of work prior to computerization. Periods varying from two to three years separated the implementation of the technology from the data collection in the visited firms.

The collection of data took place in the fall of 1993 and the winter of 1994. Two to three weeks were spent in each of the organizations.

The time lapse between the implementation of the computer technology and our visit stayed within the desired boundaries. At the agency, the three graphic designer software packages in use during the study[2] were implemented between the end of 1990 and January of 1992. In the council's purchasing department, the purchasing software package was made available to the workers in July of 1992. Finally, the accounting section of the financial software package was implemented in October of 1990, while the purchasing section was introduced in October of 1991.

Members of the management team in each of the organizations were initially contacted by telephone to negotiate the possibility to do research within their firm. I

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2 The agency was visited in November 1993.

subsequently presented the research design during an initial interview with the workers' supervisors. The director of purchasing at the council agreed immediately at the end of the initial interview, while the managers from the agency and hospital took some time to consult with their workers. In both organizations, the workers unanimously agreed to participate in the research. Their participation was confirmed, by their manager, a few days after the initial meeting had taken place.

At the council and the hospital, specific employees were initially selected by the managers to take part in the research. The selection of the employees had been based on the manager's interpretation of the requests I had formulated in the research design document presented during the initial interview. Whether or not they had been selected to participate in the study, the workers involved in the working units where the research was conducted became aware of my presence and spontaneously approached me to learn more about the project and offered their collaboration. The group of employees involved in the research at the council and the hospital was broadened to the point where, eventually, I had free access to all workers[3]. At the agency, I was given free access to the workers from the moment I entered the organization.

The physical arrangement influenced the data collection practices. For example, data collection was facilitated at the agency because the three graphic designers shared the same room. First, I could take down notes on the conversation taking place among workers. Second, even if I focused on one worker at a time, I remained attentive to what the two other workers were doing and sometimes questioned them on the tasks they had just accomplished while I was observing their colleague. At the hospital and the council, workers each had their own separate offices. This forced me to focus on the activities of

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3 Actually, the possibility for discussion with one of the workers at the council was denied, because his status in the department was under revision.

one worker at a time. To understand the synergy of the financial services and purchasing department, I took some time to walk around the office and examine the exchange between various group of workers.

In the next section, research design and data collection in the three research sites will be discussed. Issues regarding the integration of the researcher in the various organizations will be discussed in the last section of this chapter.

4.3 The research design and procedure.

As mentioned in the introduction section of this chapter, the goal of this research is to collect and analyze data on the integration of computer information in the performance of daily tasks in various work processes. In section 4.3.1 we will describe the data collection techniques, while in section 4.3.2 we will discuss the data treatment.

4.3.1 Data collection

For this research, we have opted for a qualitative approach combining various techniques of data collection: observations, interviews and analysis of documents.

Observations of workers in their natural work environment constituted the most importance source of data. Observation consisted of sitting beside the worker, examining the procedures taken to accomplish the various tasks, and asking questions about the tasks that were being performed. Themes taken from a task analysis model (Carlisle 1986) have been used to guide the observation work. The themes were: the sources of information used to perform the task, the training and qualifications necessary to accomplish the task,

the initiation and termination of the tasks, the procedures, the level of standardization of the input, procedures and the output, the usual problems encountered during the accomplishment of the task, the performance assessment, the means by which tasks were coordinated, and the perception the worker had of his or her task in relationship to other tasks. Apart from these themes, questions were asked to obtain information about the execution of tasks prior to computerization.

The presence of the observer was negotiated in various ways with the worker. The typical comment workers had when observation started was: "You are not going to watch me all day, are you?" My usual response was to explain what the research was all about and ask them a few questions to get them talking about what they did. Once my presence was accepted, I asked the workers to verbalize the actions they were engaged in, as much as they could. I interjected once in a while to have more information about past practices, to demand clarifications, to validate my perceptions, or to ask the worker to teach me how to perform certain operations in order to have more details on the computerized task. The possibility of obtaining data, either by watching the worker execute the tasks or by asking questions about the execution of the tasks, permitted me to create some redundancy. This allowed me to validate the information coming from the worker.

The observation period varied in time, depending on the complexity of the task. The time spent with a worker varied from half a day to two days and a half, with an average of close to two days spent with each worker. At the agency, it was impossible to have a set time spent with each of the workers, since the workers shared the same space and I often moved from one worker to the other during the day. During observation, I respected the workers' schedules by showing up and leaving work at the same time they did.

A total of 14 workers were observed for this study. Among them, three worked at the agency, four at the council and seven at the hospital. Informal discussion with other workers also provided data which was used during analysis.

Data pertaining to the management of visited firms was collected during semi-structured interviews conducted with managers of the visited organizations. Semi-structured interviews had been designed to collect information on the following topics: the work process of the firm, the computerization history of the firm, the work organization of other firms in the industry, the past and actual work organization, the reasons why the work was reorganized or not, and management's familiarity with the knowledge required to perform the task.

These interviews took place with the workers' supervisor on the first observation day. At the agency, the interview took place with the coordinator of the graphic designer department. At the council, the director of purchasing department was interviewed upon my arrival in the organization. Finally, at the hospital, the director of financial services greeted me by answering my questions on the first morning of my visit. The interviews lasted between one and two hours.

In each of the visited organizations, a closing interview was scheduled with the workers' supervisors. The same managers were met before and after the observation, except in the case of the agency. At the agency, the final interview was performed with the marketing vice-president because he seemed more aware of the reasons justifying management's decisions regarding the implementation of technology and the organization of work.

The themes discussed during the closing interview were based on the data collected during observation. For example, during the observation period at the council the following issues came up: the segmentation of the information in the software, and the loss of knowledge of clerical clerks who moved from a job centered on the preparation of the purchase orders to a job centered on the management of the supplier's file. The manager's perception of these issues and other issues which came up during observation were discussed during the interview. The closing interview in the various organizations lasted from one to three hours.

Apart from semi-structured interviews conducted with managers, the opportunity to discuss the computerization process with computer specialists was grasped, when possible. At the agency, an interview was organized with the chief of computer services, and at the council an interview was carried-out with the director of the programming team who developed the software. The length of each of the interviews was approximately an hour.

Finally, the third source of data for this research was printed documents. The documents were either printed material describing the organization, or reports and manuals linked to the use of computers. The information from the computerization process was used to generate questions addressed to either computer users or their supervisors.

The availability of printed material varied from organization to organization. The agency only had reference manuals and textbooks describing the functions of the computer software packages. At the council, apart from the annual report, documents made available to me were those pertaining to the goal of computerization, the benefits incurred by computerization, and the software user's manual. The user's manual was especially useful in identifying all the computer commands integrated in the software package. This made it possible to review all of them with the employees. Finally, at the hospital, documentation

about the organization was made available to me. Manuals on the use of the software package existed but the managers told me they were of no use because they were wordy and complex. So, they were not consulted for this study. To replace the complicated documentation accompanying the software package, the chief of financial operations had written a printed document explaining the use of the accounting section of the software. This I consulted during observation.

4.3.2 The treatment of data

The data collected from the various sources was recopied and organized to produce a map of each of the organizations and to create a comparative analysis of the various tasks executed before and after computerization.

First, the notes taken during observation were organized in three categories: field notes, methodological notes and analytic notes (Burgess 1984). The field notes were notes taken on situations, events and conversations in which the researcher participated or witnessed. The field notes contained details about the conditions under which these events took place; such as the participants, the activity, the tools used to perform the activity, the location, and the time. Apart from the contextual information, notes were taken down about impressions such as actual observations, transcripts of conversations and behaviors. The second category of notes was methodological notes. They entailed personal comments on the research process, including personal reflections about what was going on. These notes allowed me to reflect on my presence in the work settings and the impact it had on the research. Finally, analytical notes were preliminary analysis notes which helped me identify recurring themes and patterns. These notes guided me during observation and became crucial in the analysis of my data. The analytical notes also provided the material upon which the final interviews conducted with managers were based.

Observation notes were recopied on a regular basis during the field study to fully capture the richness of the data during transcription.

Second, interview notes were transcribed, either from audio recordings or notes taken during the consultation. At the council, interviews were recorded, while extensive notes were taken during the interviews conducted with managers from the agency and the hospital. The interviews from the council were transcribed verbatim by the researcher, by listening to the tape-recorded conversations and entering them into the computer. The transcription of the other interviews was done shortly after the interviews were conducted, with the help of the notes.

From the notes obtained during observation, interviews and consultation of written documents, an organizational map was sketched for each of the studied firms. The map contained the description of the work process before and after computerization, information concerning workers, and characteristics of the organization. The compilation of data on an organizational basis started while I was still in the field. This permitted me to identify gaps in data collection, and to formulate questions generated by collected data. A summary of data collected on an organizational basis is presented in chapter 5, 6 and 7 of this dissertation.

The goal of our study was to see how computerization changed the input of data from the worker, due to the input made available to the worker through the computer in various task settings. After having gathered our data for each of the tasks observed on an organizational basis, the requirements before and after computerization were identified and compared, to assess the differences. The themes employed during observation were used again to examine the variations among tasks before and after computerization. Two logics

emerged from the data. Efforts were made to reconcile the two logics in one coherent framework. After a few attempts at developing a framework, Austin's theory (1962) was adapted to explain the two logics emerging from the computerized text. In chapter 8, we will explain Austin's theory and the modifications we have brought to it. The application of the framework to the data will be presented in chapters 9, 10 and 11 of the dissertation.

4.4 Methodological concerns.

Qualitative research relying on field work raises questions regarding the integration of the researcher and the validity of data (Bryman 1988). These issues, as well as other concerns, will be discussed in this final section of the methodology chapter.

4.4.1 The researcher's integration in organizational setting.

The quality of data obtained in the field work depended very much on the cooperation and trust obtained from the workers I observed. So, I tried to become aware of signs denoting either trust or mistrust from observed workers, in order to maximize the quality of the relationship I had with them.

The relationship I had with computer users was initially mediated by managers with whom I had arranged my stay in the organizations. Management's presence in the early stages of my research in each of the organizations, could have made me look like management's ally watching the worker's task on management's behalf.

At the agency, the strong antagonistic relationship between graphic designers and managers could have led graphic designers to become suspicious of me. To overcome the graphic designers' insecurities about my observations, I accepted their unorthodox work

style without questioning it. For example, the workers came in at least half an hour late every morning and took up until two hours for lunch. I followed the exact same schedule coming in at the same time or later in the morning, so as to not make them feel that they were late and I was waiting for them. When I did arrive earlier, I would go to a coffee shop and reappear after they had started working. One day, one of the graphic designers felt compelled to explain that, regardless of the time they come in, they worked hard. To reinforce the comment, I told them I had noticed the long hours they spent at the office in the evenings to make sure the job was finished by the end of the day. The trust they had in me grew to the point where they felt at ease, in my presence, to make comments about the agency's management's style of which they disapproved.

The observed workers at the agency were intrigued by my research. I explained to them early on that the goal of my research was to see how computerization had changed the ways they performed tasks. After a few days, they were especially curious about my notes. Sometimes, I left my notes on a desk while I was absent from their office, so they could glance at them while I was gone. I thought that the possibility of seeing my notes would incite mutual trust. Actually, my notes became a joking matter among the workers. When one graphic artist made a mistake, another artist would ask me if I noted down the mistake, or would dictate to me what I should be taking down in my notes.

I believe a good relationship was established with the graphic designers during observation. Various signs of integration appeared during my stay. I had lunch with them on a daily basis. Various topics, ranging from work to intimate relationships, were discussed over lunch. During my stay, the graphic designers would occasionally use the lunch period to introduce me to informants they thought could be of interest to me for my research.

The trust I shared with the workers was only questioned once, after one of the workers saw me talking with a senior manager at the end of the day on the sidewalk. When the issue came up in the office the following morning, I closed the door of the office, shared my findings with the workers, and reassured them by telling them that data about how tasks had changed since computerization was the only information I would communicate to the managers. Their unorthodox work practices, and their comments regarding the agency's managerial style, would not be discussed with managers. This intervention reestablished the trust with the workers.

At the council and the hospital, the relationship between management and the workers was not as conflictual as the one observed in the agency. Still, during my stay in the organizations, trust had to be established with the observed workers.

At the council, the first observed worker was an agent who had been the pilot of the computerization project. She was very receptive to the idea of having a researcher examine the computerization process. She was also the informal leader of the working unit. I believe her enthusiasm for my research project encouraged the other workers to adopt a positive attitude towards me.

Still, two workers felt uneasy about the observation process. The first worker felt uncomfortable because he did not know the computer commands very well. During observation, he avoided using the computer until he had to consult it to retrieve some information. At that point, he got lost in the computer system and had to call for some help. The worker was totally embarrassed, so I left his office to diffuse the awkwardness of the moment. Once the problem had been solved, I came back to see the worker. I emphasized the need to obtain information about non-computerized work and past

practices, which were topics he was very familiar with. It put him at ease and encouraged him to open up.

In the second instance, one technician told the director that the idea of being observed made her extremely nervous. She was afraid that she could not meet my expectations. While I was observing other workers, I approached her and chatted with her on a few occasions. While we were chatting, I discussed the goal of my research with her. As well, I opened up to her, sharing impressions and feelings. We got to know each other better and the anxiety she had about me diminished. Finally, she agreed that I could spend one day with her. At the end of the day, she kept repeating that being observed was not as bad as she had expected. She even invited me to come back to her office as often as I would like. She formulated that invitation numerous times during my stay. The information she transmitted to me ended up being very useful, as she had worked in the department for eight years prior to computerization. Also, she was very knowledgeable about the software package.

The end of the observation period at the council corresponded with the beginning of the Christmas holiday, so the workers spontaneously invited me to join their party. Being invited to their party was an honor, as well as a sign of the good relationship I had established with them during my stay.

The dynamic at the hospital was a bit different than those of the two other research sites. The staff from the hospital often greeted trainees, so they were used to having outsiders going around asking questions. Although the offices of the workers were all physically separated from one another, I got to meet all the employees in the first two days of the observation period, because the employees invited me to join them on their coffee and lunch breaks. During those times, workers gossiped openly about everyone in

financial services. They also frequently teased each other. They even used me to tease each other. For example, they would advise me not to plan too long a stay with one or the other because of his or her uneasy personality. They ended up teasing me about my watch which kept breaking down during observation. The workers would make fun of me because I could not repair it myself and had to require the help of one of the hospital workers to get it working again.

During observation at the hospital, the workers were generous, providing me with many details. They would repeat operations, making sure I understood the process correctly.

The collaboration and commitment obtained from the workers in the organizations gives me confidence in the data I collected from them. I feel that there was full disclosure. Furthermore, the data provided by workers was cross-checked with the written documents.

4.4.2 The thoroughness of data collection.

The quality of the relationship established with the workers during the observation periods, is not the only issue raised by the chosen method of data collection. The observation of working practices exemplified knowledge integrated in the computer functions used by the workers, but what about the underlying knowledge of computer commands, overlooked by the workers? In order to assess the knowledge integrated in computer software, I needed to review all the possibilities, including those that were infrequently used by workers.

To overcome this problem, instruction manuals of the examined software packages were studied and the use of computer functions not frequently used were discussed with the workers.

At the council, unused computer functions were discussed with the pilot project member who had participated in software development. Unclear explanations about some computer functions, and functions which had not come up during observation, were explored with her. She demonstrated in front of me some computer functions which I had not seen performed during my field work.

At the hospital, the instruction manual was not used, because its complex organization and language rendered it inaccessible, even to workers familiar with the software package. So with each of the workers using the computer, I reviewed the computer functions one by one, using the computer menu as a guide. I asked questions about the use of various commands, who used them, when and why. Sometimes I even encouraged them to activate the commands, just to see the results. If the functions were relevant to their work, but were not used, I tried to find out why the worker overlooked them. The workers reviewed with me the section of the software package pertinent to their tasks. The review session conducted with each worker often overlapped, since the tasks of many workers were interconnected. This method permitted me to better explore the potential of the technology.

At the council and at the hospital, the computer functions were explored using these methods, but at the agency the situation was more complicated.

The graphic designers could not explain, in any way, some of the computer functions integrated in the software packages they were using. They never used these

functions and could not relate to them. I consulted numerous books on these software packages and found two graphic designers who had a better understanding of the software's potential. I conducted interviews with these two workers, in order to fully comprehend their use of the technology.

Data was accumulated through these discussions of computer functions. A set of computer functions was often described by more than one worker. This permitted an assessment of interpretive differences between the workers. These differences in the perception became the basis for further questions. For example, I would offer a description suggested by one worker to another worker, and ask for comments.

In each one of the research sites, a method was found to obtain an overview of computer functions, in order to better appreciate the potential of each of the software packages. A review of the functions integrated in the software packages was deemed necessary, since all the computer functions were not used on a regular basis by the worker operating the computers. The method to capture the potential of the computer varied from site to site. The variety of methods used can be explained by the varying characteristics of each organization. We believe this particular form of data collection enriched our view of the technology, and contributed to a more adequate analysis.

4.4.3 Internal and external validity.

Finally, internal and external validity of the research will be discussed in this last section of the chapter.

Since information collected through observations and interviews was inevitably subjected to my interpretation of the situation, case studies were sent to the studied

organization, in order for the descriptive accounts to be read and corrected. No major corrections were suggested by the participants. This validation method permitted me to make sure that the findings were based on a reality which corresponded to the work experience of my subjects.

Other case studies found in the literature were used to validate the findings emerging from the dissertation. Cases were examined which both described the computerization of tasks similar to the ones observed for the dissertation (Groleau 1991a), and related the integration of technology in task settings which differed greatly from our sample (Alter 1985, Taylor & Van Every 1993). We believe the capacity to extend our findings in other computerized organizational settings greatly strengthened our argument.

In Chapter 11, we will present the validation of our findings, through the use case studies provided by other authors.

Chapters 5, 6 and 7 will offer a description of the tasks and organizational settings in which the research was conducted. The data analysis chapters will follow from there. Chapter 8 will describe the explanatory framework that emerged from the collected data. Chapters 9, 10 and 11 will present an analysis of the data using that framework.

Chapter 5: Computerization of the graphic design department of an advertising agency.

The information gathered at the graphic design department of the advertising agency will be presented in four sections[1]. Section one will present a short description of the organization. Section two will describe the conditions under which the computer system was acquired. Section three will explain the work process of the graphic designer of the agency before and after computerization. Finally, section four will provide a few concluding remarks on the case.

5.1 Description of the corporation.

The organization described in this case study is an advertising agency which was founded in Montreal in 1979. The agency is owned by three partners. At the beginning, the wives and other family members of the three partners were hired to work for the agency. The wages were low and the hours long. During the study, seventy full-time employees worked for the three partners, among whom only a few family members remained.

As the firm had a low degree of formalization, it was difficult to draw an organigram to illustrate the links between the various work units. Instead of describing the corporation as a rigid structure, it is easier to present the clusters of activities which co-existed within the firm. The firm had five clusters of activities: accounting, marketing, creation, graphic design and administrative services.

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1 The names of the workers have been changed to preserve confidentiality.

The study focused on the activities of the advertising agency and, more specifically, on the graphic design activities of the agency.

Samuel, the first graphic design artist, was hired in 1984. Prior to his arrival, the graphic design work had been given to an outside firm. The managers were dissatisfied with the constraints imposed by the production of the graphic work by an outside firm. For example, when the layout arrived at the advertising agency, it was checked by a few employees and returned for modifications. The modifications took a lot of time and were not always done to the satisfaction of the managers. This dissatisfaction prompted them to hire a graphic artist and have the layout produced within the agency. According to managers, hiring a graphic artist would increase the flexibility and control over the graphic work which was prepared for the clients.

A second graphic design artist, Phil, was hired in 1989 and a third one, Brenda, was hired in 1991. Three graphic designers were employed at the agency at the time of the study. The graphic designers worked under Denis' authority. Denis was the middleman between the graphic design artists and the rest of the corporation. He received the requests for work, dispatched and supervised the work. Denis reported to Peter, the marketing vice-president.

5.2 The acquisition of computers for the graphic designers.

Computerization of the graphic design department occurred at the end of 1990. Before the acquisition of computers and software packages for the graphic design department, the president, Alex, required the preparation of a report indicating the costs, the training requirements, and the benefits associated with computerization. Based on the report, the three partners decided to computerize.

In 1990, computers and two computer software packages were acquired. One of the software packages could assist graphic designer in the execution of editing tasks, while the other was an illustration software package. Finally, a third computer software package was purchased in 1992 to touch up the visuals, such as logos and pictures.

Each of the graphic design artists were provided with a computer equipped with three different software packages. Each software package accomplished a different set of duties, which we will now describe[2]:

1. The editing software, Editall[3], offered the potential to manipulate text and pictorial units. Editall also permitted the operator to create texts by selecting the typesetting, the size and the color of the letters composing the text. On the other hand, pictorials could not be created with this software package, though the text and pictorial units could be grouped and manipulated together. For example, the operator could decide to group all the titles as if they were one unit and with one simple command choose for that unit the size and the color of the letters.

2. The illustration software, Freedraw, permitted the operator to create pictorial units. Although Freedraw could also be used to cut and paste elements together, the strength of this software was the potential it offered to create all types of visuals. With the software, the operator could draw and color visuals. A variety of standard geometrical forms were already memorized in the software package, but the operator could also create whatever

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2 Through the case study, the potential of the software package will become more concrete with the use of examples. Furthermore, a list of all the computers command for each one of the software packages is available in the appendix.

3 The names of the software packages in the case study have been changed.

kind of drawing s/he wished. Colors could be used to fill any part of the drawing. Freedraw differed from Editall in a number of ways. First, Freedraw could be used to create visuals and to color them. Editall could not be used to color part of a visual. Second, Freedraw could be used to organize letters in more sophisticated designs than Editall. For example, if you wanted to arrange your text in a circle, you would have to use Freedraw because this operation could not be done with Editall. Finally, though text manipulation could be done with both software packages, Editall was much more effective in that area.

3. Phototouch was a software package used to touch up and process visual or textual units such as pictures and logos. For instance, with this software package, part of the visuals could be covered or figures from pictures could be detached from their background. These operations were mostly used to correct or alter the content of photographs. The software package could also be used to create certain visual effects through the use of filters.

The arrival of each new computer software packages was followed by training sessions designed so the workers could get used to the new tools. The training sessions were the standard courses offered by the software manufacturer. They were followed by the graphic designers, Denis, their coordinator and Brian, the computer expert of the agency. Brian insisted on following the courses because he thought it would provide him with the necessary knowledge to help out the designers when they started using the various software packages.

The president had always felt dissatisfied with the work of the graphic designers. He was disappointed with the performance of the workers -- their productivity and the end product they delivered prior to computerization. The president was hoping that the acquisition of a computer system would improve the designers' performance, but it did not,

according to him. For the president, computerization ended up being an additional source of dissatisfaction, because the company had to constantly invest more money in the computer system, without really seeing any type of improvement in the graphic work.

Denis, the coordinator of the graphic design department, was hired in 1992 to replace the previous graphic coordinator, who had no experience with the computer technology. Management was hoping that by hiring Denis, they could have better control over the work done by the graphic designers. During the final interview for this study, the marketing vice-president and the president of the agency expressed their lack of control over the work done in the department, even though Denis had been hired to ease that communication problem.

Soon after his arrival, Denis modified the organization of work by asking to receive all the requests for graphic work on a printed form which he had produced. The graphic designers viewed the request sheet developed by Denis as an attempt to control them, but agreed to follow the procedure because they appreciated having written specifications which clarified the work expected of them. During an interview, Peter explained that the form designed by Denis had helped graphic designers know what was required of them, but he also thought graphic designers needed more information about the project they were working on, in order to diminish the tension and avoid problems.

Apart from the tension with the managers, the graphic artists were quite satisfied with the implementation of computers. In a discussion, Samuel explained to me that he could never find the words to communicate the enthusiasm of working with computers. Computers had facilitated his life by shortening the time delay to produce a visual and by offering him an array of possibilities which were not previously available to him. Based on their experience, all three graphic designers believed that the technical knowledge, as well

as creativity, were necessary to do a good job. According to them, the technology could integrate the technical knowledge, but could not replace the need to develop visual organization skills.

5.3 Computerization and the work process.

The information gathered during the two weeks I spent observing the graphic designers will be organized in three sections. Each one of the sections will correspond to one step in the preparation of a mechanical. A mechanical is "a camera-ready pasteup of artwork. It included type, photos, line art, etc. all on one piece of artboard" (Pocket Pal: A Graphic Arts Production Handbook, 1979, p.187). Mechanicals are used to produce posters, prints on T-Shirts, ads or any other variety of printed material. In the upcoming sections of the case study, the preparation of mechanicals before and after computerization will be described in the four following steps: designing a layout, grouping the elements to produce the mechanical, pasting the elements on the artboard, and producing the mechanical.

5.3.1 Designing a layout

This section of the case study will describe the first step of the work performed in the graphic design unit: the design of a layout. A layout "is a drawing or a sketch of a proposed printed piece" (Ibid., p.185).

Prior to computerization, a set of specifications was given to the graphic designer, and from that a draft of the visual was created. The draft of the layout was produced by designers who used their expertise to organize the requested graphic elements in a visually harmonious manner. To come up with the draft, designers played around with the

elements; for example, using the photocopy machine to reduce a picture, a logo, or pencil in the text and organizing the items in various patterns to see the effect. Designers usually drew sketches of visuals on their drawing tables.

The quality of the draft and time spent on the design depended on the budget available for the requested visual. For example, for an ad, Samuel the graphic designer with the most experience, spent about 5 minutes producing a pencil sketch of the proposed ad. For a color poster, the draft would be more sophisticated and would require days. The designer used crayons to show the impact of the chosen colors. The lettering would be more precise and the logos would be photocopied and placed appropriately. Before taking a decision on a visual which would require a big expense, the managers required a draft that was as close as possible to the final product.

The graphic artists were constrained in the design of the layout by the choice of elements they could include in the final version of the layout. The general policy of the agency prevented them from using the services of outside firms to prepare their final visual document. The tools they had were a camera which could reproduce, enlarge, or reduce visuals. For the lettering the graphic designers used lettering sheets from which they scratched the letters they needed.

One of the differences between before and after computerization, which seemed important to the graphic designer, was the access technology offered to a greater number of elements to prepare the layouts. For example, a standard editing software package offered the potential to use 200 fonts. Furthermore, the computer operator could transform pictures, color them, use filters to change the texture of visuals, and see the results right away.

The capacity of the computer to transform visuals offered graphic designers more alternatives, but also facilitated the production of the layout.

The transformations desired in the mechanical could be tried out during the preparation of the layout. In terms of designs, the transformative capacity of the computer, and the possibility to see the transformation right away, helped the designers to explore different possibilities. For example, Brenda worked on the Christmas card. While she was preparing her draft, she tried out different color combinations, various filters and she played with contrast and brightness of the visual. Each time she selected a new combination, Brenda saw the results of her choice appear on the computer right away, and decided whether she wanted to carry out further changes on any aspect of the visual. She worked at it until she came up with a combination which created a visual which pleased her. She printed the layout and showed it to the managers.

Sometimes the graphic designers selected what they felt was the best among the different layouts they had produced that day, as Brenda did. Other times, the graphic designers presented the managers with a variety of layouts to have them pick the one they preferred. Prior to computerization, the preparation of various alternatives was very time-consuming and rarely done.

The quantity and the quality of layouts had changed since computerization. The designers made it clear during the observation that the computer helped them generate more alternatives, but the quality of the draft had also changed. Instead of pencil drafts, the drafts prepared by the designers were of superior quality. In the case of ads, which were the less expensive visual products, the graphic artist designed and realized the ad simultaneously. The end product was not a draft but a complete ad with all the correct elements included in the design. In the past, the designing, choosing and pasting of

elements used to be done in three clearly separated steps of the process. Now they were integrated with the help of the computer. This integration happened only in the production of ads, because they were black and white, and because the graphic elements in the computer used to design the ad were of such good quality that the printed product could be sent as is to the newspaper[4].

Since computers were given to the graphic designers, managers felt that their graphic artists spent less time creating and more time on technicalities. During the interviews, the president and the marketing vice-president said that since computers were implemented, the graphic artists did not spend as much time exploring the different visual organizations as they used to. The graphic artists argued that, on the contrary, computers offered more potential and more opportunities to play around with the various graphic elements which permitted them to be more creative. According to Samuel, the graphic software packages could help produce the visual but the quality of the visual depended on the decisions taken by the operator. Managers thought workers were less creative, while graphic designers felt that they could better use their creative talents with all the technical support they had acquired. The contradiction, here between managers and graphic designers, was difficult to resolve, but the integration of the designing and production steps could be a potential answer to the managers' feelings.

This disagreement on the way designing tasks evolved since computerization was a great source of tension between management and workers. Since computerization, managers who were already critical of the graphic design section admitted that they became even more demanding in that area. The design of the layout had always been a sensitive

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4 The company still did not own a color laser printer when the study was done. When color drafts were presented, the graphic designers either invited the decision-makers to look at the color arrangement on the computer screen, or used crayons to color the draft.

issue for managers at the agency. Two reasons may explain management's sensitivity to creativity. First, the president's father was a graphic artist, which made the president extra critical of any layout that was produced within his firm. Second, the design is really the only aspect that can be criticized by a non-expert, because to assess the quality of the typesetting or any other technical aspect of the layout requires an expert in graphic design.

The way designing tasks were distributed among graphic designers changed prior to my arrival at the agency. Designing was considered a prestigious task by the managers of the agency. Traditionally, designing tasks were only given to newly arrived graphic artists, after they had accomplished many months of technical work. The bargaining power and respect the graphic artists had with the managers depended on their designing talent. The managers considered Samuel to be the most talented designer of the group. Because of this talent, Samuel got the most glamorous projects.

Up until June of 1993, all three workers of the department regularly received designing tasks. Over the last year, Phil had designed one poster, a few t-shirts and many album covers. In June of 1993, Brenda, who had done only small designing tasks, was demoted to the status of a technician. Designing tasks were taken away from her. Brenda felt she had produced good designs, so to fight back against the dishonor associated with the demotion, she developed her computer skills and became the phototouch expert.

Although she did not design layouts anymore, she made her presence valuable and indispensable, by becoming the only graphic artist to understand the phototouch software. The phototouch software was complex, so she invested many hours in learning it. Each time a photograph needed to be modified, she was asked to do the job. Of all the graphic artists, she possessed the computer with the most power, because phototouch required a lot

of memory. By developing this expertise she evened out the power relationship with her colleagues.

5.3.2 Grouping the elements to produce the mechanical.

From the moment the layout was approved, the necessary elements to produce the mechanical were gathered.

In the days prior to computerization, this process meant that the letters forming the text were identified, and scratched from the lettering sheet to form the words required on the visual. Pictures were found and examined to make sure that the quality was good enough to be reproduced. Logos of the different companies were located.

All the visual elements were kept in paper files. The elements were either photographs, logos or letters taken from lettering sheets. All the graphic elements existed in paper form. The elements were easily gathered by looking through the files. Once all the elements were identified, calculations had to be made in order to reduce or enlarge every graphic element to the size needed for the mechanical. The texts, pictorials and logos were reduced and enlarged with the help of the camera[5].

The graphic elements used by graphic designers could be classified in two categories: lines and continuous tones. The lines are graphic elements made up of lines such as typography, diagrams, and pen or ink drawings. The continuous tones are graphic elements containing a variety of tones such as photographs. The continuous tone visual had to be transformed into a visual made up of a series of dots of various sizes, before they

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5 The camera used by agency's graphic artist was standard. The camera could only modify the size and the contrast of black and white visuals.

were reproduced by any kind of printing process. The size of the dots depended on the printing process which was chosen. Prior to computerization, the transformation of a continuous tone visual to a series of dots was done with the camera. A halftone filter was put in front of the lens to perform the transformation. Since computerization, a halftone visual was produced by selecting a computer command corresponding to the halftone chosen for the picture.

Each time one of the graphic elements was reproduced with the camera, its quality was diminished. Originals had to be kept safely, because after two generations, the visual lost enough of its quality so as not to be used anymore. The quality of the graphic element determined whether or not the material would be used to produce the mechanical. If the graphic element was not of sufficient quality, the graphic artist had to either replace the visual, or redesign a layout with that additional constraint.

Specialized firms offered different services to create sophisticated visual effects. As we have mentioned previously, the graphic artists of the agency did not usually have enough financial resources to benefit from the services of an outside firm. The collaboration of outside firms was required in the production of color material, but besides that only a few exceptions were tolerated.

With the arrival of computers, many procedures changed; among them was the way in which data was filed and organized. In the manual system, the graphic elements were on paper, whether they were photographs, logos or letters. With the computer system, visuals were digitized and stored in computer files. The digitalization of visuals was performed with the use of a scanner. A scanner is like a photocopy machine, except that it digitizes the information placed on it. The quality of the digitized image depends on the quality of

the equipment but it can also be adjusted by choices made by the operator[6]. For example, the scan offered different exposure times and various resolutions.

According to the graphic designers of the agency, the organization of the computer files brought two problems which were intertwined: the visibility of the material and the organization of documents.

Visibility of pictorial elements stored in the computer became a problem for the graphic designers. In the manual system, you could identify the visuals you needed, by flipping through paper files. Since the arrival of the technology, the searching process had changed. With the computer system, graphic artists had to identify and search using descriptive names for each graphic element. One logo may have many variations which were recognizable visually, but which became more complicated to recognize when described in name. For example, one of the companies which works regularly with the agency had brought several versions of their logos which were are all identified under the company's name in the computer files. To search for the right logo, graphic artists had to look in each one of the computer files. Naturally, a better organization might alleviate that problem, but still, the passage from paper documents to computerized documents changed the outlook the worker had on the graphic elements.

Compared to the manual system, the computer system had the advantage of offering the possibility to enlarge or reduce a document or part of a document. In the manual

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6 The agency first purchased a scanner which was used only to facilitate the production of mechanicals by specialized workers producing films which were subsequently used to print the material. The first scanner digitized visuals but the quality of the visual stored in the computer was mediocre and could not be used to produce a mechanical. The scanner was used to show the specialized workers producing films the exact position of every element constituting the mechanical. The first scanner was replaced by a more sophisticated machine offering a better quality of reproduction which permitted the graphic designers to produce mechanicals at the agency.

system, for every graphic element, calculations had to be made in order to organize the elements of the layout accordingly to the design. Each ratio was calculated and fed into the camera. The result of the enlargement or the reduction was seen only when the picture was processed. With the computer system, the graphic elements could be enlarged easily without calculations. By using a computer command, the element could be enlarged or reduced at will. Instead of calculating the percentages of enlargement or reduction, as it used to be done in the manual system, the graphic artist pointed on the screen with a mouse to indicate the desired size of the visual. The change in size usually resulted from a series of incremental decisions based on the results seen on the screen.

Graphic elements, as well as the whole mechanical, could be enlarged or reduced with the computer. Changing the size of the whole document, not current practice in the manual system, had certain advantages. For a document of an important size, the reduction function permitted the graphic designers to have an overview of the whole document. On the other hand, enlargement permitted the operator to assess the quality of the visual and to touch it up if necessary.

The capacity to enlarge and touch up visuals rendered them more usable. In the manual system, the visual had to be as pure as possible. Touch ups had to be done by outside firms. Hardly any graphic design shop had the necessary material to touch up graphic elements. With the computer, graphic elements could be enlarged and corrected if needed with one of the software packages. For example, during observation, Brenda had to use a company's logo which was not available. She looked carefully at the lettering used in the logo, chose a font that was close to the one used by the company and retouched some of the letters to make the lettering similar to one on the logo. In the manual system such a job could not have been done. The camera could have enlarged up to 400%, but that would not have been big enough to touch up the letters. Furthermore, the quality of the end

product would have been mediocre because of the high number of reproductions necessary to arrive at the final logo.

The corrections which were made possible through the use of the computer technology multiplied the number of visuals available. The software packages used by the graphic designers at the agency had the potential to change the color, the contrast, the brightness, the resolution, the texture of a part, or a totality of a graphic element, including photographs. Special tools were integrated in the software to detach part of a picture and reproduce it or modify it. The computer technology also offered a series of filters which permitted the modification of a visual.

Prior to computerization, the skills to transform or alter visuals were possessed by experts working in specialized firms. Now, the procedures were translated into computer commands and made accessible to all graphic designers who acquired the software. More concretely, the computer software packages used by graphic designers at the agency permitted them to integrate tasks once performed in photolithography shops, as well as tasks performed in typesetting shops.

The use of photolithography software caused problems for the graphic designers I met at the agency. Before computerization, all they had to do was send the graphic material and describe the desired end product. With the computer, the graphic designers had to do the transformations themselves, by choosing a series of computer commands. In some cases the transformations were easy. For example, the use of a halftone filter was a simple task, but reproducing a pattern became more difficult. The graphic artists using the software had to make decisions on the way visual data was transformed, without possessing the professional experience of specialists who used to perform those tasks in outside firms.

The commands were numerous and acquiring experience required a lot of time. Among the three graphic artist working at the agency, Brenda was the only one who really invested the necessary energy to learn the software. Still, almost every time she used it she had to call a computer expert friend of hers, or a technician in a printing shop, to get additional advice on the use of the software. For the purpose of the study, other graphic artists were consulted and all seem to agree on the difficulty of using photolithographic software packages.

In the case of typesetting tasks, the appropriation of the expertise was simpler. Prior to computerization, when graphic designers sent a job to typesetters, they had to indicate the font, the size and the color of the lettering they desired. Now, the graphic artist took decisions using their knowledge of the fonts, of the sizes and the colors to obtain the desired result. Books were available to show the outlook of fonts and sizes. The typesetter executed the jobs according to the demands of the designer. With the computer, the graphic designers could easily enter the choices regarding font, size and color, and from there obtain the end result previously given by the typesetter.

The only thing that differentiated computer typesetting and professional typesetting was the respect of certain conventions, such as the number of spaces left after a period and so on. According to Samuel, to the eyes of an amateur, these differences go unnoticed, but to a typesetter these differences really differentiate the amateurs from the professionals.

All three graphic artists working for the agency executed typesetting tasks with their computer, but only Brenda performed the photolithographic tasks with the computer.

The computerization of the graphic work had also changed the relationship between the person requesting a visual and the graphic artist. Text entered in the computer through a word processing software could be transferred to the computers of the graphic department, and used by the designers. Workers used their word processor and arrived with a diskette possessing the desired text. Not only did it save a step in the production process, it reduced the risk of typographical errors; it also permitted workers and designers to share both typographic knowledge and a common vocabulary to talk about fonts and sizes of letters.

5.3.3 Pasting the elements on the artboard.

When finally all the elements were gathered, graphic designers pasted them on the artboard.

Prior to computerization, pasting up was performed once all the elements had been enlarged, reduced or underwent any other kind of transformation. In the case of color visuals, the elements were pasted on a piece of cardboard or on pieces of transparent paper overlaid on each other. Lines were drawn on the artboard to determine the boundaries and to facilitate the pasting up operations. Drawing tables were equipped with rulers which helped designers draw the necessary lines. Knives and wax were used to cut and paste the elements.

The arrival of computers and graphic software packages changed both the medium used to paste elements and the way in which tasks were performed.

Elements were displaced and organized with the help of computer commands. The computer had commands which replicated manual operations. For example, the computer

program used by the graphic artist of the advertising agency had icons such as a hand, a knife which they use to move and cut elements. The movements were made possible by the use of a mouse connected to the computer keyboard. The pasting job required a lot of dexterity in the manual system. For example, while cutting or drawing a marking line on the layout, the hand movement had to be regular and the instrument flawless. With the computer, the regularity of the movement was guaranteed, and pasting could be done over and over again without damaging elements on the artboard, until the desired element was well positioned.

Some other computer commands offered operations which were previously unavailable in the manual system. For example, by using the magnifying command, the operator was able to reduce or enlarge the view of the document window. This facilitated the placement and alignment of small visual elements. Another computer command made the marking lines and signs disappear -- an operation that could never be done in the manual system.

According to the graphic artists of the agency, pasting was certainly the most mechanical task they had to accomplish. They believed computerization rendered pasting tasks easier and more accessible to workers who were not familiar with graphic work. Actually, within the firm, two computer experts with no graphic work experience, regularly helped out the graphic artist by performing pasting jobs. For example, Denis, the coordinator of the graphic design department, had no training in graphic work but possessed a solid computer training which was sufficient to accomplish pasting jobs. When the graphic artists were overloaded he performed some of the pasting jobs by himself. The same phenomenon occurred with Brian, a self-taught computer expert with no graphic work experience.

Computer technology facilitated the pasting operations. According to the graphic designers of the agency, managers became aware of the increased facility provided by the technology to change the positions of elements on the artboard which constantly required changes. Before computerization, managers often demanded changes when the graphic designers were finalizing their mechanical. In those days, it was often difficult to accomplish changes because of time constraints. Computer technology facilitated the reorganization of the end product in a very short time span. The graphic artist got very frustrated each time a change was requested. Graphic artists at the agency did not understand why decisions regarding the content of the visual were constantly reevaluated during the process. On the other hand, managers did not see why graphic designers opposed every change since technology facilitated the capacity to alter visuals.

5.3.4 Producing the mechanical.

The preparation of the mechanical required a series of different tasks which varied depending on the characteristics of the desired visual. Prior to computerization, mechanicals for black and white visuals were completed by the agency workers most of the time, while mechanicals for color visuals were prepared by print shop workers.

We will compare the necessary operations to produce mechanicals, and then see how those operations have been integrated by the technology.

Prior to computerization, the mechanical was produced by using the camera to take a picture of the artboard, once the arrangement of elements corresponded to the desired outlook. The lines separating the elements sometimes showed on the final picture, so the graphic artist used a special paint to whiten those lines. The mechanical was either sent to a

newspaper if it was an ad, or to a print shop if films[7] needed to be made to print visuals on a poster, T-shirt, etc.

For simple black and white visuals, graphic artists undertook all the necessary tasks to produce a mechanical, with the help of the camera. For complex black and white or color visuals, the production process required a few more steps. If some element integrated in the black and white visual could not be transformed with the camera, the graphic artist sent an incomplete mechanical accompanied with the missing elements and instructions on the desired outlook and position of those elements to a print shop. The mechanical was then finalized by the workers of the print shop, who possessed more sophisticated cameras.

Color visuals were more complicated, because the camera used at the agency could not reproduce color visuals. In this case, graphic artists sent the printers a layout with the color elements which needed to be enlarged, reduced, transformed and pasted on a cardboard, in order to produce a mechanical. Apart from the layout which indicated the position of the elements, specifications pertaining to the desired colors needed to be given by graphic designers. Printers and graphic artists share a standard system to designate color. To facilitate the production of the mechanical at the print shop, graphic designers often sent a black and white visual, to which they had added colors with their crayons in order to illustrate the desired outlook of the final product.

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7 In this case study we assume that films were produced at the print shop since the graphic designers dealt with printers who took care of producing the films. We are aware that in many cases the production of the films and the printing process was undertaken by two different firms. It is important to note that whether films were produced at the printers or not, graphic designers prior to computerization did not have access to the knowledge and machinery to produce films.

Computerization not only modified the process by which mechanicals were produced. It also contributed to a change in the division of labor between the graphic designers of the agency and print shop workers.

In the computer system, the end product was a mechanical presented either as computer printout or as a computer file stored in a diskette. Mechanicals produced with a camera and mechanicals produced with a computer printer were somewhat similar, since they were both visual representations of the graphic designer's work presented on a piece of paper. The use of computer technology completely changed the production process. The camera used in the manual system to produce mechanicals was hardly ever used at the agency. The adjustment of contrast, halftone and size, previously done with the camera, were performed with computer commands. The computer had the advantage of showing right away on the screen the outlook of a modification, whether it was in size, contrast or halftone filters. In the manual system, the changes were not immediate, because the camera produced a picture which needed to be processed. Furthermore, the elements issued from the photographic process had to be pasted on the artboard before the transformation was made visible to the graphic designer.

The computer technology also produced outputs in the form of computer documents stored on diskettes. Computer documents prepared with the help of graphic design software packages differed on several points from the mechanical prepared in the manual system.

First, with the computer software packages, the graphic designers were able to transform and position all the elements on the mechanical. Prior to computerization, the limited capacities of the camera required the graphic designers to have print shop workers transform and paste elements in order to finalize the mechanical.

Second, with the computer software packages, the instructions regarding the coloration of visuals were not necessary anymore. Colors could be attributed to the various areas of the visuals by the computer operator. Furthermore, with a color screen, the computer operator could see right away the outlook of the chosen color combination. Still, a problem arose with the use of graphic software packages to produce color visuals. The colors on the computer screen were not the same as the printed colors. The colors on the screen were made visible through emitted colors, while colors printed on paper were visible through reflected light. Emitted colors appear to be lighter than reflected colors, so the graphic designers had to adjust the chosen colors accordingly.

Third, prior to computerization, once the elements were pasted and colored according to the instructions, the mechanical was photographed in the print shop with different color filters. The end product was a series of four film strips used to print the color visual. The process by which different color films were produced is called color separation. With the computerization of graphic work, color separation was done in the computer. For each color chosen by the operator, the computer determined what appeared on each one of the films. When the diskette arrived at the print shop, it was put in a computer, and from the information on the diskette color films were printed. The computer command required to print film was similar to any print command, but instead of printing the visual on paper it was printed on celluloid film. The series of film produced from the computer was subsequently used to print the visual on paper or on any other chosen medium.

There was always a certain degree of insecurity when the diskette was sent by the designers of the agency to the print shop. Normally, the visual appearing on the screen should be the printed visual, but many factors which were not well understood by the

graphic designers could intervene in the process. The graphic designers lacked the professional expertise of the printer, so each time they sent a diskette to a print shop, Brenda, the graphic artist most familiar with the various software packages, called the printer to make sure that nothing would go wrong. She described the visual and explained the procedure that was used to record the document on a diskette, giving information such as the colors and the software package used to work with the document.

During my stay at the agency, a few mistakes did occur to justify that insecurity. For example, Brenda produced a document which was supposed to be partly black and white and partly colored. On the screen, the black and white section was colored and she could not find the command to make the color disappear. She called the printer and explained to him the set of commands she had used. The printer told her that it was normal for the computer to show the black and white section with color, but that color would not be printed in the final version. She sent the diskette to the printer. When the material was printed, the portion of the visual that was supposed to remain black and white was colored. Brenda was very upset.

5.4 Conclusion

This case study described the computerization of the graphic design unit of an advertising agency. The agency hired three graphic designers who used three different software packages. The software packages could perform editing, illustration and photolithographic tasks. The computer technology and the software packages had been implemented between 1990 and 1992.

The arrival of the new technology modified both the ways graphic designers performed their tasks and the division of labor between them and print shop workers.

First, the software packages gave graphic designers the potential to perform tasks which had been traditionally executed by specialized workers in print shops. Preparing films, transforming and processing visuals were specialized tasks made accessible to them. The activation of computer commands to obtain the desired visuals guided the worker in the execution of these new tasks. Furthermore, the worker was helped in the execution of specialized tasks by the visibility of the visual resulting from the transformation. Still, some of these tasks were difficult to perform, since graphic designers lacked some of the expertise possessed by specialized printers.

Second, the potential to cut, move and draw over and over again made it possible to produce various design alternatives and to change the sequence in which previous tasks had been performed.

Third, previous operations such as reducing, enlarging or producing halftone visuals became much easier with computers. The worker's input to produce these tasks was reduced. Calculations and the manipulation of the camera were replaced by the activation of computer commands. Most of the transformations produced by graphic designers with the computer technology were instantly made available to them on the computer screen. This guided them in the execution of their work.

Finally, there were some difficulties associated with the performance of previous tasks with computers. For example. storing and retrieving visuals became more complicated because of the need to attribute names to every element kept in the computer system.

Chapter 6: Computerization of the purchasing department of a public corporation.

The data collected from the observations, interviews and the written documentation will be presented in four sections[1]. Section one will present a short description of the organization. Section two will describe the conditions under which the computer system was acquired and developed. Section three will explain the purchasing process of the public corporation, before and after computerization. Finally, section four will offer a short summary of the computerization experience described in the case.

6.1 Description of the corporation.

The second research site was a public corporation founded in 1921 which had its general headquarters located in Montreal. At the time of the study, the firm hired approximately 2000 employees, among whom 1000 worked at headquarters. The corporation was ruled by a board of directors composed of nine individuals chosen by the Quebec Government.

The board of directors selected a general manager to overlook the operations of the firm. Six vice-presidents worked under the authority of the general manager. Each of the six vice-presidents had their area of expertise which were: sales and marketing, human resources, public affairs and administrative services, finances and information systems, and finally, distribution and engineering.

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[1] The names of the workers and of the software package have been changed to preserve confidentiality.

The purchasing department, the object of our study, operated under the public affairs and administrative services vice-president. It is unusual for a purchasing department not to be under the authority of a financial expert. Beverly, the director of the purchasing department, had come up with a few hypotheses to explain why she reported to the vice-president of public affairs and administrative services. First, it may be because the purchasing department was under constant scrutiny due to the public nature of the corporation. Second, it may be because the other vice-presidents already had a heavy load of responsibilities. The vice-president of finances and information systems already controlled many of the firm's resources, while the public affairs and administrative services vice-president did not have as much power. Finally, it may be because the president considered the purchasing department as an administrative service.

Whatever the reason might be, the vice-president of public affairs and administrative services was not strongly committed to the operations of the purchasing department. This left the director of purchasing with a lot of leeway.

The director of purchasing managed a team composed of nine workers. A chief of operations overlooked the daily operations of the department. Three purchasing agents and two technicians received the purchasing requests, processed them, and ordered the goods and services. The clerical support was provided by two clerks and one secretary.

Employees of the purchasing department did not have any specialized training. The training varied greatly from employee to employee within the department, partly due to the corporate policy favoring internal hiring. The knowledge necessary to be functional in the purchasing department was learned with experience. Even if Beverly was satisfied with the performance of her employees, she believed that employees hired outside the corporation

with either a university degree or previous experience in purchasing, could bring new blood to the department.

The director was very much appreciated by her employees. Most of the workers met during the study expressed their gratitude towards her for increasing their autonomy and for providing a humane work atmosphere. Since her arrival, she had implemented the technology and alleviated the purchase policy, which had facilitated everybody's work.

6.2. Computerization of the department.

The computerization of the purchasing department occurred in July of 1992[2]. The implementation of technology was orchestrated by the director Beverly, who had arrived in the department in 1991. Beverly had been working at the council since 1979. She was formally trained in accounting at university, and was appointed to the purchasing department because of her customer-based approach. At the time, the purchasing department was then facing a productivity problem which had tarnished its reputation within the council.

To solve the problem, Beverly suggested that the work process be computerized. At the council, the cost of computerization was usually justified by the number of jobs abolished by the technology. Beverly wanted to computerize the department without abolishing jobs, so she prepared a financial document demonstrating that the money invested in the technology could be recuperated through savings resulting from more professional purchasing practices. Beverly's computerization proposal was accepted.

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2 Prior to that date, the purchasing department had access to computers with word processing software packages and had a small computer which was used to calculate the amount of money corresponding to the purchase orders treated in a month. The technology implemented in 1992 computerized the tasks pertaining to the production and management of purchasing orders.

The search for the right computer system began. The standard purchasing software available on the computer market posed a problem. These software packages integrated the accounting and purchasing operations. At the time, the council's accounting department was already computerized. Furthermore, the council had a long-term plan to design a computer system that would integrate all the operations, so it was useless to spend a lot of money on a system that would only be used two or three years. The purchasing department consulted the council's information system department to see if the technology they needed could be designed within the firm. The computer experts agreed to develop a software.

The software package was developed with the help of an employee of the department. Among the employees of the department, there was one purchasing agent who had enough experience with computers, so the pilot job was proposed to her and she accepted it. The software was designed based on the description of the tasks provided by the pilot. The director and chief of operations were also consulted. Finally, after numerous months of negotiation, the software package was implemented in the department.

The employees of the department learned to use both the software and hardware in a day-and-a-half-long training session that was given jointly by the pilot and the computer analyst. After the training session, three computers were installed. The director strongly suggested to her employees the importance of experimenting with the software. She had even budgeted overtime in order for them to use the technology. During the week-long experimentation phase, few employees spent time trying out the computer. After the week had elapsed, agents were asked to enter all incoming purchase requests in the computer. Out of the three computers, one was given to the clerks, and the two others were placed together in an office where purchasing agents had to go to enter and treat their data.

Two problems arose. First, the agents were uncomfortable with the technology. The agents kept consulting the pilot because "data had disappeared". During the first month, the pilot spent a lot of time assisting her colleagues entering and treating data with the computer. Second, the computers were in a remote area and agents had to leave their desk to work with the computer. If a supplier called and asked questions about a purchase, the agent had to check on the computer -- if a computer was available at that time -- and then return to his/her desk to pursue the conversation with the supplier. After only one month, the computer department of the firm realized that something had to be done to ease the work of the agents. They updated some old computers and offered them to purchasing, so that each of the agents could have his/her own computer. The number of computers had been limited due to budget constraints. Eventually, the old computers were replaced. Each employee had their own computer on their desk.

The goal of BUY, the software package developed for the purchasing department was to assist the workers in preparing purchase orders[3]. It was divided into six units:

- Unit 1 was used to produce, search and print purchase requests.
- Unit 2 was used to produce, search and print price requests.
- Unit 3 was used to produce, search and print purchase orders.
- Unit 4 was used to produce a variety of lists containing information on purchase orders.
- Unit 5 was used to organize and produce lists containing information pertaining to suppliers and potential bidders.
- Unit 6 was used to prepare lists pertaining to orders[4].

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3 The appendix contains a full description of the software package used by the purchasing department at the council.

4 Some of the lists produced with the commands of unit 4 could also be produced with the commands of unit 6.

The data stored in the computer was not only used by the employees of the purchasing department, but also by the workers controlling budget, and by the workers receiving and paying bills.

Beverly felt that computers had increased the quality of the service in the department, but she felt the technology did not really change the way she managed the department.

In the next section we will describe the work process of the purchasing department.

6.3 Computerization and the work process.

The ultimate goal of the purchasing department was to order the goods and services needed by the employees working for the council. To do this, employees filled request orders which were subjected to a series of approvals from within their own department and from the accounting department. The number and level of approbations depended on the amount necessary to purchase the required goods or services. Once the requests were approved, they were sent either to the purchasing department or to one of the two warehouses where inventories of stationery and technical goods were kept. If the goods on the request order were not kept in inventory, the order was forwarded to the purchasing department.

For the purpose of the case study, the process will be broken down into three different steps. In section 6.3.1, we will describe the method used to distribute the purchasing request forms among the employees. In this first section we will define the two main types of purchase orders: the firm orders and the blanket orders. Section 6.3.2 will

explain the tasks involved in processing a firm order, while section 6.3.3 will describe the tasks involved in processing a blanket order.

6.3.1 Distributing the purchasing requests among the employees.

The need to acquire goods and services at the council was communicated through a purchasing request form. On the purchasing request form, there were the following: the name of the person who filled the request, the date, the delivery address, the desired date of delivery, the budget code, signature lines for approbation, and the description of the desired merchandise. Prior to computerization, the purchasing requests were forwarded directly to Vincent, the chief of purchasing operations. With the arrival of the computer technology, the secretary received the purchase requests. She opened a computer file and entered all the information on the request form except for the description of items. Since computerization, the clerks or the secretary intervened at the beginning of the work process by entering the identification of the requesting department and the description of the first item on the order in the computer. This task did not exist in the manual treatment of purchase order. Once the data was entered in the computer the secretary stamped the request and gave it to Vincent. Vincent then dispatched the purchase requests.

Prior to computerization, two categories of worker in the department had the mandate to transform purchasing requests into purchasing orders : the purchasing agents and the technicians. The purchasing agents managed the purchasing requests for which a supplier had to be found. These requests were called firm orders. The technicians managed the purchasing requests under blanket orders. Blanket orders were contracts which linked the corporation with one supplier for goods which were frequently purchased. For example, a blanket order was made for stationery goods. Concretely, it meant that a supplier was chosen to provide stationery goods for the whole year to the

council. An estimate of the goods purchased in a year was prepared and sent to the suppliers bidding for the contract. The purchasing agent took care of the process which led to the selection of a supplier. Once a supplier had been chosen, the technician received the requests regarding stationery throughout the year. Technicians forwarded the requests to suppliers and kept written records of transactions. Blanket orders were made to replace frequent purchasing order being made to one supplier.

Since computerization, the division of labor between purchasing agents and technicians remained the same, but the way in which each group performed their tasks was altered by computerization. In section 6.3.2 we will discuss the impact of computerization on the production of firm orders by purchasing agents while in section 6.3.3 we will discuss the impact of computerization on the production of blanket orders by technicians.

6.3.2 Managing firm orders

Purchasing requests requiring the identification of a supplier were processed by purchasing agents[5]. Agents each had their own area of expertise[6]. The sectors attributed to each agent were reallocated on a yearly basis to make sure agents had the necessary experience to deal with a variety of situations.

On the purchasing request forwarded to agents, Vincent wrote the name of the agent, the purchase method to be employed and a four digit number representing the industry code under which the suppliers for the desired good or services could be found.

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5 Purchase requests below $10,000.00 were sometimes processed by technicians.

6 Vincent was also an agent so besides allocating the purchasing requests, he treated some of the requests. He usually kept the complicated cases.

The sole purpose of the purchasing department was to centralize purchases so that suppliers were chosen by a neutral party, the agents. The tasks of the agent were broken down in three steps: determining which corporations were invited to bid, preparing the documents accompanying the invitation to bid and selecting the supplier, and preparing a purchase order.

A section will be devoted to each step involved in the preparation of a firm purchase order.

6.3.2.1 Determining which corporations would be invited to bid.

The selection of supplier was done in two steps. First, a group of corporations was selected to submit their bids regarding the desired goods and services. Second, a bidder among the group was selected to fulfill the order. In this section we will discuss how the group of suppliers chosen to bid was determined.

Prior to the arrival of the purchasing software, the names of potential suppliers were registered on a computer which was mainly used by the accounting services. The information on the list was not kept up to date so the information regarding the suppliers was often erroneous or repetitious. For example, a company could either be entered under ABC Construction Cie. or Construction ABC Cie. The computer system contained the names of over 4000 suppliers. On top of this, a pile of forms filled out by suppliers wanting to be considered for bids had not yet been treated by the clerks. Some of them dated back to more than two years. The use of the computer was compulsory for the selection of suppliers that would be invited for a purchase over $50,000. The inaccuracy of computerized data would often cause problems. For example, the documents inviting companies to submit bids would often come back because their offices had moved and no

notice had been sent to correct the old address. The opening of the bid often had to be delayed and revised because of such difficulties.

Prior to computerization, the agents did not consult the computer to select the suppliers for bid solicitation over $200,000 or under $50,000. Obviously in public tenders, an ad was published so all were invited to submit a bid. In the case of purchases lower than $50,000, the agents usually consulted the file from the year before and searched through their cardex to pick other potential bidders. The agents each kept a cardex where the names and telephone numbers of potential bidders were kept.

Since 1992, the agents have gotten rid of their cardexes and relied exclusively on information contained in the new purchasing software. The data transfer from the main computer to the software package used in the purchasing department was a complex operation. The clerks were freed of numerous clerical tasks with the arrival of computers, so they took charge of the operation. The list which originally contained about 4000 suppliers was reduced to 2500 firms.

Now the agents consult the computerized supplier's list to pick the companies who will be invited to bid on any kind of purchase. The list was organized by industry code. The code corresponding to the kind of required purchase was entered by the agent and a list suggested of potential suppliers. The sequence in which the list of suppliers appeared on the computer screen favored a rotation of companies invited to submit bids. The first two companies at the top of the list were the suppliers who had been chosen for the last two contracts. Among the rest of the suppliers, the company which had not been invited to submit bids for the longest amount of time appeared third on the list. The agent was supposed to follow the sequence proposed by the computer to select the companies invited

to bid on a contract. The agents did not always follow the sequence because the companies grouped under the selected industry code might not all offer the desired goods or services.

The variety of ways in which the information regarding suppliers could be organized and printed was much greater since the arrival of the new software package. Before the arrival of BUY, compilations required a lot of time and energy. With the implementation of the new software, corporations could be organized using more discriminating variables such as industry codes which helped the selection of eventual bidders.

The involvement of the agents in the creation of the supplier's file diminished over time. When the agents started to consult the purchasing software to select bidders, they were allowed to update the data in the supplier's file. This right was removed when the list of suppliers became more and more accurate, after which only the clerks modified the data in the supplier's file. If agents wanted to communicate a change of address, for example, they filled a form and gave it to one of the clerks who entered the change. The number of workers entering data related to suppliers was reduced in order to insure standardization, which rendered the system functional. Clerks updated the list once every year by calling up all the suppliers. Increasingly, agents turned to the clerks when they had any kind of questions regarding the computerized list of corporations willing to be suppliers.

Much of the time saved from the clerical tasks had been invested in updating and managing the supplier's computerized file.

The reorganization of the supplier's file revolved around an anecdote which Susan, one of the clerks, shared with me. One year the president sent Christmas messages to all the suppliers wishing them to have a nice holiday and reminding them that the employees of

his corporation could not accept gifts from suppliers. About one third of the Christmas messages came back because of a change of address, and many suppliers called the president telling him that they had not provided goods for the corporation in a long time. The president was embarrassed and strongly suggested having the list of suppliers revised. Susan had already had the initiative to do it when Beverly came up with the suggestion.

The computerized supplier's file had become Susan's pride and joy over the years. She had invested a lot of time keeping it up to date. Susan refused to share the data entry tasks with Julia, the temporary clerk, because she was afraid that she might foul up the system which took so much time to untangle.

Susan asked the union to upgrade her job to a higher level clerical job. Her request rested partly on the responsibilities linked to the management of the supplier's file.

6.3.2.2 Preparing the documents accompanying the invitation to bid and selecting the supplier.

Once the companies invited to submit their bids were selected, a set of various documents were prepared to describe the desired products and services for the selected firms. Their bids were registered in order to compare them and select the most competitive one. The procedures to obtain bids from the selected companies varied depending on the price of the purchase[7]. Each purchase method differed in their procedures, but in this

[7]The policy stated that: For a purchase under $5,000.00, the suppliers are solicited by telephone. The suppliers supply the prices for the goods or services over the phone. This method will be referred as "telephone invitation to a telephone bid" during the rest of the case study.

For a purchase between $5,000.00 and $10,000, the suppliers are solicited by telephone. The suppliers must send a written bid and forward it to the

section we will discuss the basic operations common to all the purchase methods used at the council and how they were affected by computerization.

Before and after computerization, the information pertaining to the desired purchase was communicated through the purchase requests which were forwarded by the chief of operations to the agents. The advent of computerization meant agents had to complete the computerized request file, which had been previously opened by the secretary or by one of the clerks. When the agents opened the computer purchasing file, the purchase request had been partly entered in the computer by the secretary or one of the clerks. The agents needed to add the description of the requested items[8]. The advent of computerization meant that agents had to learn to use the keyboard in order to enter the description of requested items in computer files. Although in certain work settings, such as the insurance industry (Groleau 1991a), the use of the keyboard created a barrier which became almost insuperable, in the case of the agents the change seemed well accepted. For example,

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purchasing department either by fax or messenger. This method will be referred as "telephone invitation to a written bid" in the rest of the case study.

For a purchase between $10,000 and $50,000, a written invitation to submit bids is sent to suppliers. Suppliers must return their bids using the standardized documents sent by the purchasing department. A specific date is set for the reception and *opening the bids. Suppliers are not invited to the opening of the bids. This method will be referred as "written invitation to a written bid" during the rest of the case study.

For a purchase between $50,000 and $200,000, a written invitation to answer a call for tender is sent to suppliers. Again standardized forms are sent to suppliers but they are more elaborate then the written requests of the previous category. On a set date, bids are opened publicly in the litigation department of the corporation. This method will be referred as "tender for selected suppliers" during the rest of the case study

For a purchase over $200,000, an ad is published in various newspapers to invite suppliers publicly to participate in a call for tender. Again, the bids are opened publicly in the litigation department of the corporation. This method will be referred as "public tender" during the rest of the case study.

[8]If the number of items was high, the agents sometimes required the help of the clerks to do the entry of the item descriptions.

Carolyn, one of the agents, believed that by entering the descriptions and the prices of each item in the computer, she familiarized herself with the order which eventually facilitated the bid analysis. Not all agents agreed with this point of view.

The process by which price requests were prepared was formalized with the advent of computerization. For example, in the case of telephone invitation to a telephone bid, prior to computerization the agent wrote on a piece of paper the name of the companies and their bids in order to compute, compare and select a supplier. With the advent of computerization, the bids were entered in the computer. To produce the computerized price request, the agent transferred the information from the purchase request in a new computer file. The bids were registered in the computer file. Totals were tabulated by the computer and a printed sheet presenting the bids was printed from the machine.

The same phenomenon was observed with telephone invitations to a written bid. Prior to computerization, the agent prepared a hand-written description of the required items from the purchase request and sent it to the selected companies. Again, with the arrival of the computer, the information from the computerized purchase request was used to produce a price request. A blank price request was printed and sent to each of the companies invited to bid. When the bids were returned, the agents entered the prices submitted by each of the companies and evaluated the bids. Once a company was chosen a purchase order was prepared.

Written invitations to written bids, tenders for selected suppliers, and public tenders differed from the two previous methods because they necessitated the preparation of a legal document with various clauses which was sent to the companies invited to bid. The document contained clauses dealing with issues such as the delivery of goods, option to

renew the contract, etc. It also included a section where companies were asked to write the price they proposed for each item of the order.

Over the years, two software technologies had facilitated the preparation of the written invitations to submit a written bid: the word processor and BUY.

The word processor facilitated the production of the written documents explaining the conditions of the contract and the request for bids. The word processor also helped clerks in the preparation of the final report, once the supplier had been selected. The report was made up of the names of the companies submitting bids and the amount they had bid.

BUY changed the way agents worked with the bids. Prior to computerization, the agent looked over each proposal received from bidders, transcribed the n on a sheet of paper, and multiplied the price with the quantity of each item to make sure that the amounts on the proposal were correctly computed. After the advent of computerization, agents received the bids and transcribed the price of each item in the computer. The computer automatically multiplied the price with the quantity and showed the total. Once all the prices were entered and totals tabulated by the computer, the agent printed out the computerized price requests to analyze the bids. Once the most competitive bid was chosen, a table describing the bids was prepared by the agents and produced by the clerks.

The agents believed that the computerization of price requests diminished the volume of computations they had to perform in order to verify the bids submitted by the potential suppliers. The agents always printed the computerized price requests to evaluate the bids and select a supplier. They believed the way in which price requests were presented one by one on the computer screen prevented them from having an overall picture, which they obtained by putting the printed price requests side by side.

6.3.2.3 Preparing a purchase order

Regardless of the purchasing method needed, the purchasing transaction always concluded with the production of a purchase order.

Prior to computerization, once the purchase was confirmed, the agent copied on a sheet similar to a purchase order form, the name of the supplier, the description of the goods, and the prices that they agreed upon. The clerk received the complete file, including the details of the bids, the purchase request and a hand-written form prepared by the agent, which had to be typed on a purchase order form. In previous years, purchase orders would accumulate and temporary help had to assist the clerks with processing the orders[9]. Once the purchase orders were typed, the form and the entire file were returned to the agent, who verified the accuracy of the order. Once the purchase order was approved, the agents gave it back to the clerks, who dispatched the copies and kept two copies in the department: one for the supplier's file and one for the order file.

Since computerization, once a supplier was selected for a purchase, the agent prepared the purchase order. The purchase order was created from the price request of the selected supplier. The computer transferred the information from the price request in a new document which became the purchase order. After the transfer, the operator did not need to add any more information. The purchase order was ready to print. The agent gave the newly printed purchase order to the clerk, who forwarded copies to the appropriate individuals.

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[9]One of the clerks, who was an employee sent for temporary help from department to department in the corporation, recalled that she once came in the purchasing department to help the clerks with purchasing orders and typed purchase orders day after day for three weeks in a row.

Computerizing the production of the purchasing orders saved time for the agents and the clerks. Agents did not have to hand-write and verify the information given to produce the purchase order. Instead of delegating the production of the purchase order to the clerks the agents produced their own purchase order by transferring data from the price request to a purchase order file.

Beverly, Vincent and Caro'yn all seemed to agree on the fact that computers saved time spent by agents on clerical tasks. During the initial interview the director of the purchasing department openly said:

> Ce dont les gens se plaignaient le plus quand je suis arrivée c'est de ne pas faire de la qualité, de ne pas faire de suivi auprès de leurs requéranst, si le produit est arrivé, s'il est conforme. Maintenant ils font ça. J'estime qu'ils se déplacent plus aussi, ils vont plus chez les fournisseurs, ils vont plus chez les requérants, ils font plus de recheche, de travail... ils vont passer plus de temps lorsqu'ils vont faire un contrat parce qu'avant ils avaient pas le temps de faire ça, ils reprenaient le dossier de l'année d'avant, ils faisaient de la retranscription.

The time saved by the agent was used to better adapt the invitations to submit bids to each different situation, and to do more research in order to better understand the needs of the requesting parties, in order to have more competitive bids. During observation, I saw different examples of agents investigating products, such as glasses and natural gas, in order to have the best purchase possible.

When I asked employees how computers had changed the work in the department, they spontaneously responded that clerks were mostly affected by computerization since they no longer had to type documents such as purchase orders.

Prior to computerization, clerks were kept busy typing documents prepared by the agents and technicians. They typed purchase orders, tables summarizing the bids received for a tender, and written documents inviting the companies to bid. These documents were

often long. They included information such as instructions on the preparation of the bid, a specimen of the contract which was the object of the bid, and general conditions organized in clauses. The arrival of the word processor had alleviated their work greatly, but BUY liberated them even more because the purchase orders were produced by the agents, with the help of the computers.

Helen, one of the technicians of the purchasing team, had worked as a clerk eight years ago in the purchasing department. She agreed that computerization had reduced the clerks' workload but she noticed an important change in information available to clerks before and after computerization. To illustrate her point, she described the data available to her as a clerk in the pre-computerized work process. She typed the purchase orders, but also received and consulted the file which accompanied each order. In the file, she browsed through the price request, the purchase requests, and all the other documents which made her understand the decision taken by the agent. The visibility of the work process helped her to understand the decisions involved in the production of a purchase order, and permitted her to answer many questions regarding purchases over the phone, instead of transferring the calls to the agents. She said that some of the information she knew from the days when she was a clerk became very pertinent when she was promoted to technician. Helen believed that the clerk's job was much more interesting prior to computerization, because all the steps necessary to produce a purchase order were visible to the clerk.

Helen's experience led us to think that experience gained through the clerk's manipulation of data was lost when computers were integrated in the work process.

Furthermore, accessibility of data was affected by computerization. During observation, agents and clerks relied heavily on paper files and very rarely consulted their

computer files. When asked to justify their actions, Carolyn admitted that information in computer files was difficult to access. Many computer commands needed to be activated to obtain information which used to be presented side by side on some paper forms.

Even if the information in the paper files was not organized in the same way as in the computer, the computer presented certain advantages in the way it compiled information. Before the arrival of BUY, compilations required a lot of time and energy. With the arrival of computer technology, agents, suppliers, industry codes, types of orders, status of orders, and time period were used as discriminating variables to produce a variety of lists such as: list of non-completed purchase requests, list of purchase requests by agents, list of purchase requests by department, list of purchase orders per supplier, list of purchase orders by agent, list of purchase orders in a numbered sequence, list of purchase order by industry sector, list of suppliers by industry codes, list of suppliers in alphabetical order, and list of purchase orders for a given time period.

6.3.3 Managing blanket orders

Up until now have I described the process by which firm orders were negotiated. In the case of blanket orders, a company was selected to supply designated goods for a given time period.

Blanket orders were useful because they amalgamated many small purchases which would have needed to go through the normal purchasing process. The agents evaluated the needs for certain products and services, invited the companies to bid, and selected the

supplier for blanket orders. The technicians took it from there[10]. The technicians received and processed the purchase requests which required goods negotiated through blanket orders. Technicians transformed purchase requests in partial orders. Partial orders were similar to purchase orders, except that the technician did not need to negotiate with the suppliers, because all the conditions of the purchase had already been set in the blanket order.

The criteria Vincent used to attribute blanket orders to either one of the technicians were the workload and the expertise of each one of the workers. Specific sectors were assigned to each of the two technicians. For example, Helen got blanket orders for construction material, car and truck mechanical parts, and office supplies, while Lee got the blanket orders for lighting equipment, industrial equipment and maintenance services.

When the technician received the purchase request, the quantity and description of the products were already identified. It was up to the technician to complete the document with the prices of the requested products, in order to process the order.

The technician's job was to process partial orders. The technician had to prepare a written document on which the quantity, description and price of products appeared. That document was used to order the good or services with the supplier, to verify the supplier's bill by the accounting department, and to keep a tab on the budget by the requesting department.

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10 The technicians managed 75% of all the blanket orders. The other 25% was managed by agents. Apart from renewing contracts for blanket orders managed by technicians, all agents have a few blanket orders to manage. Computerization did not have an impact on the way blanket orders were distributed among agents and technicians, according to the employees of the department. Since most of the blanket orders were processed by technicians in the text, the technicians will be designated as the workers processing blanket orders in the purchasing department.

Prior to computerization, when the order was placed by the technician, the prices were checked with the supplier and entered on multicopied request forms, where the requesting department had already written the quantities and descriptions of the desired items. Then, the white copy of the request form was sent to the supplier. The yellow copy was sent to the accounting department in order to verify the exactitude of the bill. The blue copy was sent back to the requesting department, in order for them to keep a tab on their expenses and the erosion of their budget. The remaining pink copy was filed in the purchasing department.

With the arrival of BUY, the procedures used to treat requests related to blanket orders had changed. Before handing in the purchase requests to technicians, the chief of operations gave the requests to clerks who entered data from the document in the computer. The clerks entered information, such as the supplier's name, the requested delivery date, the name of the requesting department, and the description of the requested items. This information was taken directly from the form. Then, these forms were forwarded to the technicians.

First, the technicians consulted the computer files to make sure that no transcription mistakes had occurred in the transfer of information from the form to the computer. Afterwards, the technicians searched for the prices of the requested items. Once the prices were agreed-upon with the suppliers, they were entered in the computer. The technicians updated the computer document by indicating the prices, taxes and total. Then, the document was printed and photocopied by the technician. Photocopies of partial orders were forwarded to the supplier and the accounting and requesting departments of the council.

Each blanket order was negotiated based on a precise amount of money which had to be spent by the requesting department during the period indicated in the contract. The department requesting the goods or services through a blanket order had to keep a tab of the money spent, to make sure that it respected its budget. The technician also kept a record of the expenditures associated with each blanket order, but the responsibility of managing the budget rested upon the requesting department.

Prior to computerization, the requesting department collected the blue copies of the request form and computed the expenditures recorded on them. The technicians did the same. Because of all the paper work, the technicians' files were not always up to date. Some partial orders were processed while the budget had already been totally spent, because the departments frequently neglected to compute their expenses. When departments did not respect their budgets and technicians were unaware of it, employees from accounts payable would notify the technician in charge of the blanket order, who would in turn advise the requesting department. The requesting department had to fill a special form to authorize the necessary budget to cover the discrepancy.

With the arrival of the new software package, the department received a photocopy of partial orders. They still had to compute the expenditure recorded on them to stay within the designated budget. On the other hand, the computers helped the technicians to keep track of the expenses recorded for each blanket order. Once the partial order was confirmed by the operator, the computer added the amount of the partial order to the other expenses related to the blanket order. Then the technician could print an updated list of the expenses pertaining to the blanket order created by the computer, which listed the amount of all the partial orders, the total expenses, and the provisions left.

According to technicians and the chief of operations, the computerization of blanket orders changed the relationship between technicians and the requesting department. The requesting department used to have problems keeping all the partial order copies, and could not clearly identify which part of their budget was spent and what was left of it. With computerization, the responsibility of keeping track of the budget shifted from the requesting department to the purchasing department. The requesting department relied on technicians to advise them when their budget was running low. Requesting departments were aware that the computer kept tabs on what had been spent and what was left in the budget, so many of them have dropped their attempts to keep track of both their budgets and blanket order renewal dates. The computer kept tabs for each blanket order, and a special computer command allowed the technician to print a list of blanket orders which needed to be renewed within the next few weeks.

Computerization of partial orders facilitated the follow-up done by technicians on blanket orders, but it also brought many inconveniences, according to Helen. First, the technicians had to check all the information taken from the purchase request and entered in the computer by the clerical staff. This step did not exist previously because the purchase request was sent directly to the technician. From there, the technician wrote on the request the information which was needed to process the request. Second, prior to computerization the quantities, descriptions and prices for the requested products were written on a multicopied form. With the advent of computerization, the computer-printed version of the partial order had to be photocopied in order to transmit the information regarding the partial order to the supplier, the accounting, and requesting departments within the council. According to Helen, two steps have been added to the old work process: the verification of data entry and the production of photocopies for the accounting and requesting departments.

6.4 Conclusion

This case study described the computerization experience of the purchasing department, composed of nine individuals working under the supervision of a director. The software package used by the workers was developed within the firm and implemented in July 1992.

The computerization experience of the purchasing staff affected the procedures followed to prepare firm and blanket purchase orders.

In the case of firm orders, the software package contributed to help ease the selection of the bidders and the preparation of the purchase orders. The computer's capacity to store and organize the name of eventual suppliers according to various criteria rendered the selection of bidders easier for agents. The preparation of purchase orders which previously required the help of the clerical staff was now wholly undertaken by agents. Although they had to enter data in the computer to process the order, agents were relieved from the duties of performing tabulations and constantly preparing and verifying documents previously typed by clerical staff. The only disadvantage agents identified was the impossibility to have all the information pertaining to the purchase process on one screen.

The management of blanket orders by technicians was also transformed since computerization. The responsibility of controlling the budget had shifted from the requesting department to the technicians. With the advent of computerization, technicians could easily compile data on partial orders, rendering much easier the budget verification. The arrival of the technology also required the technicians to perform more clerical tasks.

Chapter 7: Computerization of the financial services of a hospital.

The data collected from the observations, the interviews, and the written documentation will be presented in four sections[1]. Section one will describe the characteristics of the organization. Section two will present the conditions under which the computer system was implemented. Section three will explain the tasks accomplished in the financial service before and after computerization. Finally, a short summary of the case will be offered in section four.

7.1 Description of the corporation.

The research was conducted in the financial services of a hospital located in Montreal. The hospital was founded at the beginning of the nineteenth century. It closed and reopened after renovations in 1956. The hospital housed two hundred and eighty patients requiring long term medical care. About 600 employees worked for the hospital[2].

A board of directors composed of doctors, professionals and managers managed the hospital. They decided the orientation of the institution, controlled the budget, looked over the projects, checked to see if rules and procedures were properly followed, and designated a general manager. The general manager supervised the daily operations of the hospital. Four departmental managers reported to the general manager: the medical care manager, the clinical and professional service manager, the human resource manager, and the financial and technical service manager.

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1 The names of the workers have been changed to preserve confidentiality.

2 Only 10% of the staff accomplished administrative duties.

The manager supervising financial and technical services controlled a wide variety of activities. The technical services included workers assigned to cleaning, maintenance, communication and security. The financial services included workers assigned to data processing, remuneration, purchasing, accounting and budgetary assistance for the hospital patients. The mandate of financial services was to plan, coordinate, and control the activities related to budgets, acquisitions and remuneration. Twelve employees were hired to perform those duties.

To assist him in his work, four years ago, Lawrence, the manager overlooking financial and technical services, created a new position: chief of financial services. This position was filled by Nancy. She was a university graduate who had specialized in accounting. Previous to her studies, she had had many years of work experience in clerical accounting jobs. Nancy was asked to take over the financial services and was given the mission to computerize and reorganize the financial services.

7.2 The acquisition of computers by the financial services at the hospital.

The board of directors had decided to computerize the financial services. Lawrence was ready to accept computerization, but he did not want to supervise the implementation of the technology. Nancy had previous experience in the implementation of accounting software in another health institution, which made her a good candidate for the job. Although when Nancy arrived at the hospital the decision to computerize had already been taken, the choice of the software supplier was still uncertain.

Apart from her mission to computerize the financial services, Nancy had to overcome a few hurdles when she arrived at the hospital. First of all, the hospital was known for its strong and vindictive union. Nancy realized that the employees' attitude was

to strictly follow their job descriptions. Second, the employees working in financial services had all been at the hospital for more then twenty years[3]. They formed a tight group. Finally, computerization seemed threatening to many of the employees.

Nevertheless, Nancy adapted to the group quite well. She introduced computers smoothly and supported her staff fully during computerization. She answered all of their questions and developed special tools, such as a procedure book, to make sure that the workers could function well. She was also able to identify problems within the service and solve them. When the employees described her during observation, they underlined the respect she had for them. The employees appreciated the autonomy she gave them.

Financial services were computerized in two steps. First, the accounting and remuneration services were computerized in October of 1990. Second, the purchasing department was computerized a year later. The purchased software was a standard package. The operations integrated in the software were divided into five satellites: remuneration, accounts payable, purchasing, inventory, and the general ledger. The specific tasks carried out with each of the satellites will be clarified in the case study[4]. The workers of the financial services each had a terminal on their desk.

7.3 Computerization of the work process.

The financial service of the hospital broke down into three working units: remuneration, purchasing, and accounting. A computer technician and an accounting technician also worked under Nancy's authority.

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3 Except for one employee working in the remuneration department.

4 A list of all the computer commands for the satellites under study are available in the appendix.

Our study will focus on the activities of the purchasing and accounting departments. In the following sections, the work process of the two departments visited for the study will be described.

7.3.1 The purchasing department

Four employees worked in the purchasing department. Unlike the other departments in the financial services, the purchasing department had its own supervisor who managed the unit and reported to Nancy. Three employees worked under John's authority: Paul, the storekeeper; Felicia, the clerk; and Joseph, the warehouse attendant.

Except for food and medication, all the requests for goods and services were sent to the purchasing department of the hospital. The employees of the purchasing department received the purchasing requests, processed them, delivered the goods or services and forwarded the information from the request to the accounting department. From there, the accounting clerk paid the supplier and reported the transaction in accounting ledgers.

The work performed in the purchasing department revolved around two tasks: managing the inventory and producing the purchase order. Frequently-requested goods were kept in inventory, while others were ordered on an ad hoc basis.

Computers arrived in the purchasing department in the fall of 1991. The implementation of the computerized inventory management system will be described first. It will be followed by the description of the preparation of computerized purchase orders.

7.3.1.1 Managing the inventory

The inventory was composed of frequently requested goods, such as stationery and pharmaceutical goods. Two workers managed the inventory. Joseph, the warehouse attendant, took care of the physical arrangement of the goods in the warehouse, which included receiving goods and preparing their distribution. Paul, the storekeeper, helped Joseph two days a week, but his main duty was to keep written records of the incoming and outgoing goods. Computerization changed the way in which written records were kept, but had little impact on the physical organization of the warehouse, so we will concentrate on Paul's tasks.

Prior to computerization, each product in the inventory had its own card. In the upper part of the card, Paul wrote the name of the product, its code, its description, its suppliers and their phone numbers[5], the product and client numbers for each supplier, and the price of the product. In the bottom part of the card, Paul kept track of the orders he had made; he wrote the date and the number of items ordered, the price, the reception day, and the number of items ordered during one year. The only form of compilation was the number of items ordered on a yearly basis.

The computer document replicating the product card offered twenty-eight information fields for each product. In addition to the information from the product cards, the computerized document contained data such as the quantity of products kept in inventory, the minimal and maximal stock, the point of purchase, the suggested quantity of goods to order, the average price and more descriptive data for each of the products stocked in the warehouse.

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5 Up to six suppliers were identified on the product card.

Moving from the card system to the computer system required a lot of work, which was why the purchasing section of the software became operational almost a year after the accounting section. Twenty-eight fields of information had to be filled for each of the products contained in the warehouse.

Most of the information in the product file came from the Regional Center of Services and Goods[6] catalogue. The product's name, its code, its supplier, the dates, and terms of the contract linking the supplier to the Center were taken from the catalogue and written in the computer. Prior to computerization, the information was merely kept in a binder. John, the supervisor of the purchasing department, referred to the binder to choose the supplier for a product in inventory.

According to Paul, although the computer increased the speed of many operations, the data needed to register a new product was voluminous and required more time than it did prior to computerization. He believed, however, that this disadvantage was outweighed by many benefits which we will describe later.

John, the supervisor, established and entered into the computer the minimal and maximal stock, the point of purchase, the suggested quantity of goods to order for each of the products.

The quantity of products on hand, as well as the average price in the computerized product file, were made possible because of the computer's capacity to compile the outgoing inventoried products.

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6 The Regional Center of Services and Goods is a governmental institution which centralizes the purchasing process, by selecting the suppliers serving organizations such as hospitals, and other corporations controlled by the government.

The products retrieved from the inventory were registered in the computer. Through informational exchange between the computer and its user, the number of retrieved items was registered simultaneously in various computer files, such as the inventory file and the product file. John believed that the arrival of technology and the need to report product retrievals reduced the loopholes in the system, and forced the employees to be more precise in the execution of their daily tasks. This was especially true in the case of inventory retrievals, which were not noted before, but were now written down and used for budgetary purposes.

Product arrivals as well as retrievals created a cascade of computer operations altering various computer files. When merchandise was delivered at the hospital, Felicia or Paul searched for the purchase order in the computer and indicated what goods had been received. Data concerning the quantity of goods contained in the warehouse, the average price[7], and the quantity of goods ordered in the product files were automatically adjusted. Prior to computerization, receptions were only indicated on the product card, and apart from a yearly consumption profile no other form of compilation was performed with the data.

The number of items on the shelves was always available through the computer. It simplified the ordering process, since Paul could now easily see which products needed to be ordered from the computer file[8]. Furthermore, the availability of the warehouse content

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7 The computer updated the average price each time new products were received at the hospital. For each product, the computer computed the average cost of the product based on the various prices which had been paid for that item. The average price was difficult to calculate prior to computerization because with each new order, the price and quantity of items needed to be added to the old prices and quantity of items on the shelf before being computed.

8 We will discuss the order process further in the next section.

played a part in modifying the inventory verification practices. The data in the computer was used to check the stock in the inventory once every period[9]. Paul selected a group of items and made sure that the number of items on the shelves corresponded to the number indicated in the computer. If the quantities did not match, he looked at the transactions made during the period to make sure that he hadn't made any transcription errors while he was entering the number of items received or retrieved. Prior to computerization, the items on the shelves were counted yearly, and thus sources of errors were difficult to identify.

According to Paul, the computer increased the availability of data and allowed more flexibility in data organization. Prior to computerization, the data was organized on a product basis since each product had its own card. Information was available on previous orders and suppliers for a given product. The computer could still provide that information, but the data retrieved could now be organized in a variety of ways. The computer could produce the following: lists of users for a given product, lists of products consumed by one user, lists of products requested by a user on a period or yearly basis, lists of suppliers, and so on. Since computerization, the criteria used to organize the compilation of data varied greatly.

7.3.1.2 Preparing purchase orders.

The employees of the purchasing department took care of all the purchase orders, except for the ones requesting food or medical drugs. About 2,350 orders were treated annually in the department. More than two thirds of those orders were processed with the computer. Purchase orders were processed manually for acquisition of property, for hourly wage work contracted with an outside firm, or for maintenance work.

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9 A period lasted 28 days and there were 13 periods in one year.

In the case of inventoried goods, purchases were systematically treated with the computer. In this section, we will discuss the computerization of tasks relating to the purchase of inventoried goods.

Prior to computerization, Paul toured the warehouse every Monday morning, in order to take note of its content. He reported his findings to John, who ordered the necessary products. The purchase orders were typed and sent to the suppliers by Felicia.

Since computerization, Paul prepared the purchase orders for the goods which needed to be acquired, with the help of his computer on Monday mornings. As we have discussed in the previous section, for every product in inventory, the computer maintained a product file indicating the purchase point, the minimal and maximal stock, and the quantity of product stocked in the warehouse. With one computer command, Paul activated a computer search which used the information in the product file to prepare a list of items which needed to be ordered.

The computer produced a report identifying the items to order. Each report contained the product number, the description, the quantity of the product in the warehouse, the point of purchase, the minimal and maximal stock, the difference between the quantity on hand and the maximum stock, as well as the quantity of retrieved goods during the period and during the year.

Paul would then select the products he wanted to order using certain computer commands. The computer produced a second report showing the names of the suppliers, the product numbers, the quantities of products in the warehouse, the order points and suggested quantities of products to order.

From the information presented in the second report, the computer could produce the corresponding purchase orders. Paul preferred to prepare the purchase orders himself because he did not trust the computer enough to have it type the orders automatically without his intervention. Furthermore, Paul liked to browse around in the warehouse to see if more then one product could be purchased from a supplier. He knew, for instance, that paper tissue was supplied by the same company as paper cups. Before he ordered the paper tissue he looked to see if the paper cups were close to the purchase point; if they were, then he ordered them as well. Paul said that by combining purchases like this, it was possible to save money on deliveries because some suppliers charged for them.

After having selected the products which needed to be ordered, Paul prepared the purchase orders. He selected the correct command and a computer screen with about twenty information fields appeared. The computer screen was very similar to the old printed form which used to be filled-out by Felicia. Even if the form itself essentially remained the same as before, preparing the purchase order was now easier. For example, as soon as the supplier's code was entered in the computer, the name. address and telephone number of the supplier automatically appeared on the computer request form. The same phenomenon occurred for product codes.

Multi-colored copies of the computerized purchase order were produced. Two copies stayed within the purchasing department, one copy was forwarded to the requesting department, and a final copy was stapled to the reception slip and sent to the accounting department. The distribution of purchase order copies did not change with the advent of computerization, but the accounting department now had the purchase information in the computer, as well as on paper.

The computerization of purchase orders facilitated the compilation of data. Since computerization, every department of the hospital received a report describing all the purchase orders that had been produced for that unit at the end of each period. The managers used the information to budget and control the expenses of their employees. These reports, and the potential to create better consumption profiles, contributed to decentralizing budgetary planning.

At the end of each period, Paul prepared a set of written reports, which were kept for accounting purposes. He printed the purchase orders, as well as the receptions and the retrievals made, from the inventory. He also followed a mechanical procedure to close the transactions for that period.

With the help of the computer, Paul undertook the multiple steps leading to the production of a purchase order, and thus felt that the responsibility of purchasing inventoried products rested solely on him, often forgetting the computer's contribution to the process. According to John, the responsibility to purchase inventory goods was given to Paul because the point of purchase, the maximal and minimal level of stock were integrated in the technology which simplified the buyer's decision. Prior to computerization, the purchase decision was taken by John who knew the point of purchase of each item by heart .

Felicia's job had not changed much with computerization. She continued to prepare purchase orders[10], answer the phone, open the mail, receive the delivered goods, as well as receive and dispatch orders requested from the employees. During the time spent in the

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10 She prepared fewer purchase orders than prior to computerization since Paul took care of the purchase orders of inventoried goods during that time.

hospital doing this research, discussions were going on about promoting Felicia from senior clerk to storekeeper of non-perishable food products.

The decision to promote Felicia was complex because it involved many other issues such as John's retirement, a possible merger between the hospital and another health institution, and the reorganization of the food services department. Nancy believed that computerization was a factor in her decision to promote Felicia. Felicia was already familiar with the computer inventory system. Furthermore, Felicia did many of Paul's tasks when he went on vacation. Nancy believed the computer software could aid Felicia in performing her new tasks. These tasks would include opening product files with information from the Regional Purchase Center, preparing purchase orders, buying the goods, and registering the reception and retrieval of the goods in inventory.

The hierarchical work organization of the purchasing department seemed to be moving closer to a territorial work organization, where each of the workers managed the purchases for one type of product. Prior to computerization, John purchased all the goods ordered through the department, Paul managed the inventory, and Felicia attended to clerical tasks.

7.3.2 The accounting department.

The accounting department of the hospital employed two clerks. One clerk dealt with the accounts payable, while the other dealt with accounts receivable and beneficiary accounts.

The work process of the accounting department was partly computerized; accounts payable was computerized in the fall of 1990. The treatment of accounts receivable was

supposed to be computerized, but the arrival of computers was delayed because the accounting clerk responsible for these accounts left on maternity leave. Many health complications prevented that employee from coming back to work, so accounts receivable had still not been integrated onto the computer system at the time of the study[11]. Each patient in the hospital had an account, very similar to a bank account, from which money could be deposited and retrieved. Patients had set hours in which to make their financial transactions with the accounting department. The patient's accounts were managed on an independent computer system that was not integrated with the rest of the hospital's financial operations, so it will not be considered for this study.

This part of the case study will focus on the computerization of accounts payable. Accounts payable were treated by a clerk, named Claire, who had been working in the accounting department of the hospital for the last twenty five years.

Claire's tasks consisted of:

- receiving and filing the purchase orders,
- receiving and filing the bills from suppliers,
- matching the bills with the purchase orders to see if the information on one coincided with information on the other,
- scheduling bill payments,
- preparing cheques to pay bills,
- verifying bank accounts to make sure they contained enough money to cover the cheques, and
- filing cheques and paid bills.

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11 January 1994.

Managing the bills and payments required keeping written records of every transaction she made. Those were evidently made according to accounting conventions in different auxiliary ledgers used by Claire. The financial data written in these ledgers were subsequently used by the chief of financial services to produce financial reports.

To study the way in which accounting tasks were computerized, the work process will be broken down in three steps, each of which will be described in the following sections. The first step consists of matching and treating the information on purchase orders and bills. The second step consists of preparing cheques to pay the suppliers. The final step is the preparation of financial statements.

7.3.2.1 Matching and treating the information on purchase orders and bills.

Claire's work began with the receiving of purchasing orders and bills. Purchasing orders arrived from three departments in the hospital: the purchasing department, the pharmaceutical department, and the food services department. She collected purchasing orders and bills until they could be matched with one another. Once a purchasing order was matched to a bill, Claire verified if the price and the content of the purchase were exactly the same. If they differed, she returned the purchasing order with the bill to the individual who had produced the purchase order to clear up the situation. Once there was a match between the purchase order and the bill, Claire was ready to prepare a written record of the transaction.

Before the arrival of computers, she had to transcribe the information from the purchase order and the bill in three separate ledgers. First, she posted the information in a ledger composed of fourteen columns. In this ledger, she wrote the name of the supplier, the budgetary code, the bill number, the purchase order number, the rebate, the taxes, and

the totals. The budgetary code was not written on either document so she had to know which expense corresponded to which budgetary code. Furthermore, the totals on purchase orders were not calculated, so she had to calculate and add up the taxes to make sure the amount on the purchase order corresponded exactly to the amount on the bill. If prices written on the bill and on the purchase order differed significantly she sent both documents to the person who placed the order with the supplier. Second, she transcribed the information from each bill in another ledger, in which she indicated the date of payment. Third, she wrote the transaction in debit and credit terms in computerized general ledger forms which were processed in a computer firm, in order to produce the hospital's financial statements.

According to Claire, the problem with these types of tasks was the potential to make mistakes when numbers were transcribed over and over in different ledgers. To verify that no mistakes occurred while transcribing the data, she compared totals from one ledger to another to make sure they were all identical.

The computerization of the foods services, purchasing and accounting departments changed the way in which bills and purchase orders were processed. Most of the purchase orders were computerized. Of the three purchasing points in the hospital, only the pharmaceutical department did not employ computerized purchasing orders.

For these non-computerized purchase orders coming from the pharmaceutical department, Claire had to find the budgetary code corresponding to the expense. Claire also had to compute the totals of the purchasing order and verify the total for each item to make sure that no mistake had been made either in the bill or in the purchase order. Once these operations were performed, she was ready to use the computer to complete her tasks.

The information required to prepare the computerized accounting documents for non-computerized purchase orders was similar to the one previously used in the auxiliary ledger: supplier code, bill number, purchase order number, date written on the bill, date of payment, total, rebate, federal and provincial taxes and finally, the total. The information was processed through an informational exchange in which Claire entered some data and activated computer commands to jointly process the data with the computer. Before processing the data, Claire printed what was called a transaction journal that replicated the data she had entered in the computer on a printout. The activation of computer commands permitted the integration of the data in forms similar to the auxiliary and payment ledgers used prior to computerization. She then moved on to the registration of purchase/bill data in the general ledger. The command initiated the transformation, which was displayed on a printout produced after the operation.

For the preparation of accounting documents in the case of a computerized purchase order, the operations were similar, but the participation of the computer operator was reduced. This was because the purchase/bill information had already been registered in the computer by the purchasing department when the merchandise was received. Nevertheless, Claire had to make certain that the information on the screen corresponded to the information on the purchase order and bill, before she transformed the data with the help of the computer. She entered corrections if necessary. Again, the information confirmed by the purchase order and bill was printed, verified and reported in the auxiliary, payment and general ledgers by means of a series of computer commands.

Whether the clerk was dealing with computerized or non-computerized purchase orders, the operations performed by the accounts payable clerks had been simplified. Instead of organizing and writing data in three different ledgers, the computer was able to move the information around to produce the appropriate accounting notations.

The sequence of computerized operations to process information was compulsory. The accounting operations we have described up until now were presented to the computer operator as a sequence on the computer screen. The operator could not jump from operation 1 to operation 3. The computer refused to perform operation 3, if operation 2 had not been completed.

The first step of the accounting process was now completed. The information from the bills and purchase orders had been written in the various ledgers. In the manual system, the sheets from the ledgers, the general ledger forms, and the bills were sent to the chief of financial services for authorization. Each bill and each ledger sheet was signed by the clerk's superior. In the computerized system, the documents still had to be approved. Claire sent Nancy the journal of transactions, the general ledger transactions, along with the bills for payment authorization.

7.3.2.2 Preparing a cheque to pay the bill

Once the bills, written reports, and ledger sheets had been signed by Claire's superior, they were ready for payment.

Before the arrival of computers in the accounting service, Claire knew when to prepare cheques by referring to her payment ledger, as well as by consulting her files. Her files of outstanding bills were organized on a monthly basis. All the bills that needed to be paid that month were gathered together in a file.

Claire typed the cheques which needed to be paid, on a monthly basis. On the cheque stubs, she typed the number and the date of the bills that were covered by the

payment. Afterwards, she produced a hand written list of cheques that had been typed indicating the name of the supplier, the number and the amount of the cheque. Three copies of the cheque were produced. The original would go to the supplier, the pink copy was kept in a file where all the cheques were kept in numerical order, and finally, the yellow copy would be stapled to the purchase order and the bill, and put away in a filing cabinet where each supplier had its own file.

With the arrival of computers the procedure changed. To prepare computerized cheques[12], the computer dictated a series of operations which needed to be followed in sequence by the operator. They were:

1. List of eligible cheques
2. Selecting transactions
3. Deselecting transaction
4. Preliminary list of cheques to be printed.
5. Printing cheques
6. Registering cheques
7. Registration of data in the general ledger
8. Transfer to the historic of paid transactions.

In the first operation, the list of eligible cheques presented the name of all the suppliers who were due for payment at that date. The computer used the data field "date of payment", entered when the bill and the purchase order were matched, and searched through the system to identify the suppliers which were scheduled for that payment date. The list was printed and Claire looked at it to see if she really wanted to pay all those suppliers. She usually did, but there were some exceptions. For example, during observation, while looking at the list Claire remembered that one of the suppliers had a credit with the hospital because some merchandise had been returned. Using operations 2 and 3, she selected or postponed payment. In the case of a postponed payment, the payment appeared on the next list of eligibility. A corrected list of cheques was produced by the computer. After having

12 Still, about 15 cheques a month are produced manually.

printed a satisfactory preliminary list, the computer was ready to print the cheques. When operation 5 was activated by Claire, the cheques and their stubs were printed. Again the stubs contained the number and the date of the bills covered by the cheque. As previously, the cheques were printed in three copies. The original was sent to the supplier while the two copies were filed. A final list of printed cheques was also produced. While the other lists were destroyed, this list was kept and filed by Claire. Operation 7 registered the expense in the general ledger under accounts payable. The final step, operation 8, stored the information in another file. Copies printed from the computer were filed. The filing of the paper bills and the copies of the cheques remained the same as before the computerization.

In the manual system cheques were produced on a monthly basis, while in the computer system they were produced on a weekly basis. For Claire, the most remarkable change was the speed at which technology accomplished the task which previously required a lot of time. She also appreciated the fact that her task had been simplified. For example, the computer identified the suppliers who were due for payment. It also registered data in the general ledger, which previously required selecting the right accounting categories under which the transaction would be noted.

When cheques were returned from the bank, Claire took her stack of cheques and registered them in the computer with one simple operation. This computer operation permitted her to eventually print a list of cheques that were not cashed. In addition to this, she kept a manual system to register deposits and withdrawals from the various bank accounts for which she was responsible.

Claire's duties also entailed the verification of statements sent by the supplier. To make sure that the balance suggested by the supplier matched hers, Claire checked all her

files: the supplier's file, the file of bills to be paid, and the purchase orders to compile and verify the amount due to that supplier. Instead of searching in her paper files she could have checked the supplier's balance in the computer, but she preferred consulting her paper files.

Before the computers arrived, Claire was a very autonomous worker. She knew her job very well. She had had high school professional training in accounting, so when she arrived in the accounting department of the hospital, it did not take her long to get accustomed to the job. The work was already organized, and she integrated the rules that had been set for her task very quickly. Through the years, she became very knowledgeable about the accounting system. When Nancy was appointed chief of financial services, Claire showed her how the accounting service functioned at the hospital. The arrival of computers shook up Claire's self-confidence in her work. Claire told me that the new computerized rules made no sense to her: "Pour moi c'est du chinois.... j'avais tellement peur de toucher à quelque chose qui effacerait tout". She became afraid of using the computer and especially of losing data. She told me that during the first year of computerization, she woke up in the middle of the night trying to recall if she had done all the right computer operations.

To help her out, Nancy prepared a fifteen-page document, where all the steps of various tasks were thoroughly explained. After one year of using the computer, Claire became more autonomous and confident. Computerization had occurred three years prior to my study, and Claire felt she had regained her autonomy during that time period. She did not consult her procedure book anymore, and felt that she knew how the computer worked. In fact, during observation she taught me how to use the computer very effectively. She felt her tasks have been simplified with the computer. She humbly said that after half a day of training somebody else could do her job.

The chief of financial services wanted to expand the tasks of Claire in the near future. Nancy wanted to ask Claire to do more book-keeping verification between statements sent by suppliers, and the balance of the supplier's account in the hospital books. In the long term, Nancy considered that the clerk could take care of accounts payable and receivable, with the help of the computer. Nancy referred to her own experience to illustrate the possibility. She used to be a senior accounting clerk in a hospital of a 150 beds, where she was responsible for accounts payable and receivable. At the time, however, Nancy wanted to spare Claire from other changes because computerization had been very difficult for her.

7.3.2.3 Preparation of financial statements.

The production of financial statements required the recording of many accounting transactions.

Prior to computerization, each department kept a written record of its transactions. These transactions had to be reported as credit and debit in the hospital's accounting system. A regular accounting system contains five types of accounts: assets, liabilities, equities, expenses, and revenues. Every transaction had to be written in two of the five accounts of the hospital: one account in which the amount of the transaction was debited and one account in which the amount of the transaction was credited. For example, if the hospital received a bill, the transactions necessary to note the reception of the bills were to: credit the accounts payable in the liabilities, and debit the expense account corresponding to the department which ordered the desired goods.

When the bill was paid with a cheque, the notations accompanying the transaction were to: credit the bank account in the assets, and debit the accounts payable in the liabilities. Decisions as to what account should be debited or credited were taken by the chief of accounting services. The chief of financial services referred to accounting rules to make such decisions.

Before 1990, the accounting staff themselves prepared the credit and debit notations for the general ledger on computerized forms, which were processed by an outside computer firm. Apart from the accounting department, purchasing and remuneration had to forward summaries of their transactions to the chief of financial operations in order to convert them into debit and credit terms. When Nancy was too busy to prepare all the general ledger entries she asked Claire to assist her.

Once the transactions had been written in the general ledger, the debit and credit notations were reorganized by account. The transactions were divided in the five families of accounts described earlier. For example, all the debits and credits for the assets were placed together by families of account, and so on, for all the other accounts of the hospital. The general ledger notations were written on special forms and sent to be processed by a computer firm. The computer firm entered the data and produced the financial statements.

With the arrival of computers in 1990, financial statements were produced at the hospital. The daily transactions from purchasing and accounting were translated automatically by the computer as debit and credit notations in the general ledger. To produce the report of debit and credit per account, the expense and revenue statements, as well as the balance sheet, the operator of the computer had to follow a series of steps prescribed by the computer. Again, the computer organized the data and presented it under a different form. The operations performed by the computer were invisible to the operator,

who saw only the output. As Nancy put it: "The system does the same thing, but I don't see it".

Nancy remembered the days when all the statements were prepared manually. The tasks required the workers to be meticulous because notations were transcribed in various books and transcription mistakes could take days to find. Rules had to be followed so the notation tasks did not require much attention. They quickly became routine, so prone to computation or transcription mistakes.

The employees in the purchasing department did not realize that the data they entered was also transcribed as debit and credit notations in the general ledger. These operations were invisible to them. During the observation, I asked them how their work was reported in the general ledger, but they were unable to explain the process to me. For Claire, the situation was different because she was aware of accounting rules, and she transcribed her own transactions in debit and credit terms prior to computerization.

According to Nancy, computerization facilitated the accomplishment of tasks, but she still believed that to perform well in financial services, training in accounting was essential. She believed computers provided only a mechanical knowledge of accounting. Some of the operations were described thoroughly but some remained invisible; thus making it difficult for the operator to fully understand the complexity of the accounting system. Nancy thought that if workers did not know the accounting logic apart from what was presented by the computer they could perform the operations but they would not be able to identify and resolve problems within the accounting system. Therefore, she preferred hiring an employee with a background in accounting and no knowledge of computers, rather than an employee who was a computer expert but possessed no training

in accounting. According to her, the technology did not render the accounting logic explicit enough.

7.4 Conclusion

This case study described the computerization experience of a group of workers performing accounting and purchasing tasks in the financial service of a long term care hospital. The software package discussed in this case was a standard package with 5 financial units. We examined the implementation of the purchasing and accounting units.

Purchasing was computerized in October of 1991. The implementation of the technology in the purchasing department changed practices relating to the management of inventory and the preparation of purchasing orders. The management of inventoried goods was followed more closely with the computer technology. More transactions were registered in the computer system, and the potential to create a variety of lists using different criteria made it possible to undertake new form of actions, such as budget decentralization. Furthermore, the data entered when purchase orders were prepared, or when inventory transactions occurred, was processed and replicated in various computer files. This created new transformations and made available new data such as the average price. Finally, the technology also facilitated the preparation of purchase orders, by processing data and creating lists of inventoried goods that needed to be ordered. This computer function contributed to a shift of purchasing responsibilities from the supervisor of the department to the storekeeper. Computerization modified departmental practices and tasks previously performed by the purchasing staff. Some tasks disappeared while new ones were created.

The computerization of accounts payable was done in October of 1990. The computer software simplified the accounting ledger entry operations and the preparation of cheques by automating the sequence of operations to be performed. Once performed by workers, the data processing was partly integrated into the technology. Again, computer data was transformed and replicated in numerous computer files with the activation of one single computer command. These computer functions facilitated the duties of the accounting clerk.

Unlike the graphic design case study, the computerization of the financial tasks did not drastically change the division of labor among employees, but modified the inventory management and accounting practices employed at the hospital. Both types of change will be integrated in our explanatory framework, which will be presented in the next chapter.

Chapter 8: Conceptualization of the constative/performative distinction.

In previous chapters, we emphasized the need to study the forms in which data was integrated in the computerized text, in order to better understand the potential to renegotiate tasks among organizational members after implementation. The input of computer technology was evaluated by comparing task requirements before and after computerization. To fully capture the potential offered by the computer technology, we decided to do a comparative analysis of the technology's input in three newly-computerized organizations. From the data obtained in these research sites, two computer logics emerged to explain the type of informational exchange between the computer and its user, which could potentially contribute to the mobility of tasks: the constatives and the performatives. In this chapter, these two categories will be presented.

The constative/performative categorization was inspired by the work of John Austin. Austin is well known for his locution/illocution/perlocution trichotomy. In a series of lectures presented in 1955, prior to the formulation of his famous trichotomy, Austin (1962) attempted to differentiate speech acts by opposing constative to performative. This categorization was abandoned about halfway through the lectures to develop the locution/illocution/perlocution distinction for which he is now better renowned.

Recently, a few scholars (Coyle 1993; Cooren 1994; Taylor & Cooren 1994) have reexamined the constative and performative distinction, in order to reinstate it.

Although they did not deal with computer issues, the work of Austin (1962), Cooren (1994) and Taylor & Cooren (1994) provide a framework to understand the forms of knowledge integrated in computer technology. In the previous chapters, we have already used the textual and conversational metaphors to describe both the content of the

software package and the interactions generated by its use. It seems only natural, at this point, to adopt a categorization issued from language studies to qualify the potential of technology.

We do not propose to do a grammatical or lexical analysis of computer commands. Our interest does not lie in the linguistic organization of information emerging from the computer, but rather in the potential created by the informational exchange between human and computer that led to the accomplishment of new tasks. The original definitions of constative and performative provided by Austin will be modified to better fit the computerization context.

Section 8.1 will open with Austin's description of the performative and constative concepts. In section 8.2, Austin's definitions will be compared to revised definitions of his concepts, which have recently been developed by other researchers. In section 8.3, the comparative analysis of definitions given to the performative/constative concepts will be followed by a discussion of the pertinence of the application of these concepts in computerization studies.

8.1 The development of the constative/performative categorization by Austin.

For our study, we will concentrate our analysis on Austin's early work. The focus of our discussion will be the lectures presented by Austin in 1955 at Harvard University, and printed in 1962 under the title "How to do things with words". In the first lectures, Austin introduced the performative/constative concepts, which he later abandoned. In this section, we will describe the concepts as Austin had initially defined them.

Through his Harvard lectures, Austin wanted to explore the various forms and effects of utterances exchanged in human interactions. According to Austin, a lot of attention had been given to factual statements, but utterances such as commands, questions, and orders, which did not fit the statement definition[1], were often overlooked in the analysis of human interaction. Austin used the examples of betting, christening and performing a wedding to demonstrate that the way we use utterances extended beyond fact description.

To differentiate factual statements, which he called constatives, from sentences by which actions were performed, Austin developed a new category of utterances. These he named performatives:

> The name is derived, of course, from 'perform', the usual verb with the noun 'action': it indicates that the issuing of the utterance is the performing of an action - it is not normally thought of as just saying something. (Austin, 1962, 6-7).

The performatives differ from the constatives, because through them the speaker accomplishes an action. For example, an utterance such as "I name this ship the Queen Elizabeth"[2], was considered a performative because by pronouncing these words, the interlocutor performed the action of naming the ship. On the other hand, Austin considered an utterance such as "John is running" to be a constative because it described a state of affairs.

Austin tried to further differentiate constatives and performatives by comparing the ways in which the two categories of utterances were validated. The criteria determining the truth of a constative, although never really explained by Austin, seemed to be whether the

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1 Statements were defined by Austin as: "to 'describe' some state of affairs, or to 'state some fact', which it must do either truly or falsely' (1962, p.1)

2 The examples used to illustrate Austin's concepts are taken from his own work.

fact observed corresponded to the fact stated. For example, the truth of "John is running" depended on whether John was running or not. Just as constatives were judged to be either true or false, the performatives could be judged to be either happy or unhappy[3]. In the case of performatives, the conditions of happiness depended on the respect of conventional procedures regarding the utterance of certain words, the setting, the role and involvement of participants. For example, the happiness of "I name this ship the Queen Elizabeth" depended on the respect of the conventional procedure by the correct person having the authority to perform the action. Unlike a constative that could be either true or false, a performative may be judged to vary in degrees of happiness. For example, the right person might attempt to name the ship by using unconventional procedures which were not recognized by the other participants, or the wrong person might correctly perform the conventional procedure. In both cases, the event was not happy, because all the right conditions had not been met. However, the event was not totally unhappy because in both circumstances, some of the conditions of happiness were met.

The frontier between constative and performative became fluid in certain cases. For example:

> ... the utterance 'I warn you that the bull is about to charge' is open to criticism - but not in any of the ways we have hitherto characterized as varieties of unhappiness. We should not in this case say the warning was void - i.e. that he did not warn but only went through a form of warning - nor that it was insincere: we feel much more inclined to say the warning was false or (better) mistaken, as with a statement. So that considerations of the happiness and unhappiness type may infect statements (or some statements) and considerations of the type of truth and falsity infect performatives (or some performatives). (Ibid., p. 55)

Austin tried to differentiate constatives and performatives by using grammatical and lexicographic criteria. Unfortunately, his quest failed. Austin abandoned his attempt to differentiate utterances using constatives and performatives, and developed a new

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3 Austin qualified performatives as being happy or unhappy, in order to designate whether they had been successful or unsuccessful.

conceptual scheme towards the end of his Harvard lectures. In that new scheme, Austin defined speech units as simultaneously being locution, illocution and perlocution. Locution referred to the content of the speech unit. The illocution of utterances was the intent the speakers gave to the speech unit through its utterance. Finally, the perlocution was associated with the subsequent behavior of the person who heard the message. Austin used the following example to render more concrete, the distinction between locution, illocution and perlocution:

> Locution: He said to me, 'You can't do that'.
> Illocution: He protested against my doing it.
> Perlocution: He stopped me, he brought me to my senses,
> (Austin, 1962, 102)

Austin integrated the constatives and performatives concepts in his new scheme by associating locution to constative and illocution to performative. Austin abandoned the constative/performative conceptual framework in favor of the locution/illocution/perlocution categorization.

Although Austin got his academic recognition for his locution/illocution/perlocution trichotomy, some attention is now directed at the reinstatement of his original definitions of constatives and performatives.

8.2 The reinstatement of the constative/performative distinction.

The integration of the constative/performative categories in the locution/illocution/perlocution scheme diluted the strength of the concepts originally developed by Austin. Recently, some attention has been directed to the original definitions, in order to reinstate the two categories outside the locution/illocution/perlocution scheme. In this section, we will present alternatives which simultaneously alleviate some of the

problems encountered by Austin and capture the richness of the original distinction between constatives and performatives.

Austin could not hold on to the action criteria as originally defined, because he realized that within that context, constatives were actions just like performatives were. Although he originally stated that constatives were objective statements which were either true or false, he realized that the speaker formulating the constative was performing an action. The speaker, through the factual description, took a position and negotiated it with the other interlocutor[4]. He took the example of the shape of France to illustrate his point (Austin, 1962, 142). While France can be described as a hexagonal figure, it is not really a fact until both parties accept that definition.

Since stating a fact became an action which initiated an exchange by which the content of the statement was validated, the action criteria, defined in that sociological context, could not be used to differentiate constatives and performatives.

Austin's original distinction between constatives and performatives was recently reexamined by Cooren (1994). Cooren recognized that in both constatives and performatives, the interlocutor was performing an action. He replaced Austin's action criteria by a recognition criteria. He differentiated the constative from the performative by showing that in both cases the object of recognition differed. According to Cooren, the purpose of constatives is to have the hearer recognize the act's propositional statement, while the purpose of performatives is to make the hearer recognize that the speaker is in the process of executing an act.

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4 Naturally, the extent of the negotiation varies depending on the proposition made by the speaker. For example, a statement such as "a chair has four legs" will normally not be subjected to an extensive negotiation but a statement such as "September is the warmest month of the year in Canada" will probably be subjected to some kind of negotiation.

For example, the utterance "the table is green"[5] is recognized by Cooren to be a constative. If we look at Austin's original definition, that utterance would also be categorized as a constative, because it is a fact statement that could be either true or false. Still, the reasons prompting Cooren to categorize this utterance as a constative differed from Austin:

> In all constatives, there are thus illocutionary purposes which exceed the idea of engaging the responsibility of the hearer with regard to the existence of some state of affairs. But there is also the purpose of making the hearers recognize that the speaker wants them to recognize the act's propositional statement. Following from which is the principle that one always expresses something as a function of a precise purpose. (Cooren, 1994, p. 8)

The problem encountered by Austin with the presence of action in both constatives and performatives disappeared. The recognition criteria made it possible to differentiate both categories using an approach, which kept alive the original character of the definitions.

The reinstatement of the constative/performative categories, using the recognition criteria made it possible to overcome the problems associated with the action criteria but it also made it possible to examine the constatives and performatives in a larger context than the one suggested in the locution/illocution/perlocution trichotomy. During his first conceptualization of constatives and performatives, Austin suggested numerous conditions to ensure the happiness of a performative utterance. The conditions included the execution of conventional procedures, the appropriateness of context, and the behavior of participants. In the definition of illocution as performative, Austin dropped the conventional procedure, the context and the behavior of the audience, in order to concentrate on what the speaker does with the utterance (Taylor & Cooren 1994). For

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5 This utterance is taken as an example of constative all through Cooren's analysis.

Cooren, speech acts go beyond the enunciation of utterances; speech acts are acts of recognition which involve both the speaker and the audience. With the reinstatement of the constative and performative, Cooren also reintegrated notions of context and audience, which seem to have been dropped when Austin associated performatives with illocutions.

Substituting action by recognition made it possible to reinstate the constative/performative distinction. In the next section, we will discuss the relevance of using this categorization to explain the forms of knowledge integrated in the technology.

8.3 The use of the constative/performative logic with computerization.

The reinstatement of Austin's constative/performative distinction suggested by Cooren can be used to analyze computer texts. To understand the contribution of technology to the way tasks are renegotiated after the implementation of technology, I believe we need to recognize the coexistence of two forms of computerized data integration, which I will call constative and performative. In this section, we will show the relevance of applying the constative/performative categorization to our study.

Up until now many researchers focusing on technology to explain the shift in tasks following from computerization examined the transformative capacity of the computer to draw their conclusions. The transformative logic focused on the complexity of the operations performed within the technology. As we have discussed in Chapter 2, the explanation based on the transformational power cannot fully explain the results obtained in the various case studies.

We are proposing to look at the informational exchange between computer and user to explain the renegotiation of tasks following from computerization.

At first, we were tempted to use Austin's constative/performative categories to explain the interactions between computer and user and the conditions under which it led to action. In his original conceptualization of constatives and performatives, utterances exchanged during interaction were either issuing a statement of fact, or issuing the performance of an action. Could the performance of an action with the computer be explained by the use of performatives? Again, the problem of determining what is an action arose. If a computer command is triggered to request a statement of fact, is the utterance a constative or a performative? The differentiation between constatives and performatives became difficult to identify. So, the initial differentiation between constatives and performatives, as formulated by Austin (1962), could not be used to explain the sources of new action made possible through the technology.

We believe the replacement of the action criteria by a recognition criteria made it possible to use the constative/performative concepts in the computerized context. Instead of discussing spoken or written utterances, as Austin (1962), Cooren (1994) and Taylor & Cooren (1994) did, we will be discussing computer "utterances". In the rest of this study computer "utterances" will be defined as information emerging from the computerized text. As we define it, a computer "utterance" may be encompassed in one information field, one computer command, one computer screen, one computer printout or a whole set of data represented on a series of computer screens. Since computer "utterances" can be associated with various units of information, in the upcoming sections we will attempt to circumscribe the information we wish to designate when we discuss various statements. Naturally, computer "utterances" come into two categories: constatives and performatives. The object of recognition which is presented to the operator via the computer medium differs,

depending on whether or not we are discussing performatives or constatives. In the case of constatives, the operator recognizes a state of affair presented through the informational content available either on the computer screen or printout. A computerized constative could take the form of data describing the content of the warehouse on the computer screen. That is, the computer user is required to recognize the informational content of the utterance. In the case of a performative, the operator recognizes that the computer is about to execute an action and manifests the recognition through a conversational[6] exchange with the technology. A computerized performative could take the form of a blank form presented on the computer screen which needs to be filled. By filling the form, the computer user converses with the computer text and produces a purchase order, for example. Beyond producing a form, the computer user participated in a transaction engaging him/her in an action jointly performed with the computer.

The application of the recognition criteria not only rendered the two categories applicable to computerized "utterances", but the constative/performative concept permitted us to categorize the form of knowledge presented to the computer operator rendering the accomplishment of new tasks possible.

In Chapter Nine, using data from our field studies, we will illustrate both the presence of performatives in the computerized text and the potential they created to render tasks more or less mobile. In Chapter Ten, we will proceed with the same type of analysis using the constative concept. Finally, in Chapter Eleven we will look at the relationship between performatives and constatives in the computerized text.

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6 Conversational is used here to design the informational exchange between the computerized text and the worker.

Chapter 9: Performatives within the computerized text.

The definition of performative utterances we adopted was based on a recognition criteria: the operator recognizes that the computer is about to execute an action, and manifests the recognition through a conversational exchange with the technology. In computer terms, it means that the computer, through an "utterance", solicits the participation of the user to accomplish an action[1]. The computer "utterance", which we call performative, may take various forms: the computer may present on a screen a question which needs to be answered in order to take action; it may present a form which needs to be filled to take action or it may submit on the screen a series of possible choices among which the user has to choose the desired path of action. The variety of possibilities is endless, but all performatives need to have the user recognize and take part in the action. Recognition and participation in the action become manifest when the user provides information and activates the computer command which insures the accomplishment of that action.

Tasks performed jointly by the computer and the user may or may not replace tasks which were executed prior to computerization.

The use of performatives engaging workers in tasks which were performed prior to computerization, and performatives engaging workers in tasks which were not performed prior to computerization, will be discussed in the first two sections of our analysis. In the third section, we will go beyond the performance of single computer operations, and examine the impact of performatives on sequences of tasks. The fourth section of our analysis will be devoted to the explanation of a new phenomenon linked to performatives,

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[1] Computer "utterances" such as performatives or constatives do not appear on their own. "Utterances" are prompted by the user. In this study, we will not concentrate on the prompting process. Rather, we will focus on the variety of information made available to the user through the different forms of utterances.

which we have called invisible operations. Finally, a summary of our results, and a theoretical discussion of the performative concept and its application, will conclude this chapter on performatives.

9.1 Performatives engaging workers in tasks which were performed prior to computerization.

The tools and the input of workers performing tasks have changed with the advent of computerization. In this section we will look at the impact of computerization on tasks performed prior to the arrival of the computer technology in the three research sites we visited.

At the agency, the graphic designer's manipulation of pens, knives and drawing instruments necessary to prepare a visual had been replaced by a dialogue between the computer and the operator. Drawing, cutting, copying, pasting, erasing and cropping were performed by activating keys on the computer keyboard, or by using the computer mouse. On the computer screen, dialog boxes offering various drawing or pasting operations were presented to the worker. For example, the drawing of regular polygons, circular shapes or lines was greatly facilitated. Instead of having to draw them using pencils, rules and stencils, the graphic artist selected the desired shape with computer keys from a dialog box on the screen. The result instantly appeared from outside the dialog box on the computer layout.

The use of the keyboard and the mouse have changed the worker's input in the process. Prior to computerization, a certain level of dexterity was needed to draw a perfect shape or a continuous line with no smudges. Long continuous movements with the pen or knife were difficult to obtain from the human hand. These tasks were made easier by the

activation of computer commands. This human dexterity is no longer required to perform these tasks[2].

If the drawing of regular polygons and lines have been facilitated, drawing irregular shapes which used to be done with a pen or pencil was complicated by the use of the mouse. The mouse replaced the pen as a drawing instrument. Graphic designers found it difficult to control the movement of the mouse in order to execute the desired drawing. To overcome this problem, graphic artists regularly scanned their drawing into the computer.

The computer commands used to perform the action varied, depending on the graphic design package used, but the drawing tools and paste commands we have discussed up until now were basic functions made available on all of the software packages we have studied for this research.

Many more tasks performed by the graphic designers were integrated in the computer technology. For example, the transformation of a continuous tone visual to a halftone visual, previously done with a camera, was performed through computer commands. Prior to computerization, the visual was reproduced with the use of a halftone filter in front of the camera lens. Using the Freedraw program to obtain the same result, the attributes menu was selected and among the various commands the halftone screen command was chosen. The operator selected the appropriate halftone filter among the series of filters proposed by the computer, and confirmed the operation by activating the appropriate computer keys.

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2 The change from a paper to a computer environment had also changed the texture of work. Texture of work is defined here as the way we use our senses to pick up the information from our work environment. Zuboff (1988) observed the same phenomenon during her study. The feel of drawing pens or knives moving on the artboard has been replaced by activation of computer keys.

The reduction and enlargement of visuals was also facilitated by the use of the computer. Prior to computerization, the reduction and enlargement of visual elements was performed by calculating the size change in percentage. The percentage figures were subsequently fed into the camera. The camera reproduced the visual to the size corresponding to the numbers which had been entered in it. With the computer, these calculations were not necessary. The operator chose the correct computer command and, using the information on the screen, indicated the desired size, confirmed the operation and the change occurred instantly. With the help of the computer, the operator changed at will the sizes of the various elements composing the visual, without using calculations or the camera.

The manipulation of pens, knives and other tools which required some degree of dexterity, along with the use of the camera which required decisions about contrast, exposure time, halftone filters and calculations to enlarge or reduce visuals, have been replaced by the activation of computer commands. The computerized tasks required less input from the graphic designer. According to the graphic designers, the switch to a computer environment has facilitated the performance of those tasks which were executed with less effort in a shorter time period. The biggest challenge for them was learning to draw with a computer mouse, but the difficulties inherent to this task was neutralized by the use of a scanner to digitize hand drawings in the computer.

Some of the tasks performed in the hospital and at the council have had the same type of metamorphosis. For example, at the hospital, the selection of inventoried products which needed to be ordered was computerized. Prior to computerization, Paul used to decide what to order by walking through the warehouse and looking at the quantity of products on the shelves. With the computer, a list of products which needed to be ordered

was printed upon request. For each product kept in the inventory, data regarding minimal stock, maximal stock and point of purchase were fed into the computer and from there the necessary calculations were performed to prepare the list of products to order. The parameters of the decision were integrated in the computer technology, rendering possible the computerized decision-making process. It is interesting to note here that in other firms simpler technologies have been used to indicate the point of purchase for inventoried products. For example, visual marks on the shelves indicated the point of purchase. In any case, at the hospital, computers were the instruments used to facilitate the decision-making process.

At the council, the preparation of a request for bid by purchasing agents had gone through the same type of change. Previously hand-written on a sheet of paper, the document was now prepared and produced with the computer. Computers reduced the input of the workers, by performing all the calculations necessary to prepare the supplier's bid.

Up until now we have emphasized the result of the action, but in order to have an on-going action, the worker has to recognize the proposition formulated by the computer. We believe recognition may take different forms. It may range from the conscious recognition of the action proposed by the computer, to the automatic unconscious acceptance of the performance of the action activated by the computer command. We believe the acceptance to participate in the action, manifested by the activation of computer keys, is a form of recognition. This recognition is often taken for granted, but examples of situations where workers refused to recognize the action made us appreciate the importance of recognition. For example, Paul used the computer to produce a computerized list of products to order, but refused to use the computer to automatically print the purchase order corresponding to the proposed list of products. He openly told me he did not trust the

machine. He did not recognize the machine's capacity to produce purchase orders which were as good as his own purchase order. He said that one day he may trust the machine to do that job, but not now. In the same way, Claire, from the hospital accounting department did not use the computer command to check if the information provided by statements sent by suppliers corresponded to what she had in her files. She did not recognize the computer's capacity to do the job well, and refused to use computer commands to perform that task. Instead, she did it manually. This lack of recognition prevented the computer and operator from engaging in an action performed together.

The exchange between computer and its user could be compared to a conversation where the operator and the computer participate by mutually recognizing what the other party is contributing to the action. In order to have a performative, you need to have the operator recognize the computer capacity's to perform the proposed action. From the moment the operator approves or participates in the execution of the action, both the operator and the computer get involved in the action. In the same way, the computer recognizes the operator's participation, either by taking action on the data, or by signaling to the operator that something is wrong.

In summary, the end result of the task performed before and after computerization remained about the same, but the use of performatives modified the contribution of workers in the execution of the task. The dexterity of hand movement, calculations, use of the camera, and the knowledge of the purchase point of inventoried products were inputs previously provided by the worker. Now they were integrated in the computer technology. In the studied organizations, the change in the worker's input created only slight changes in the task allocation, but we believe it had the potential for greater change in the allocation of tasks.

The greatest change noticed by workers having have had their tasks computerized, was the reduction of the time needed to perform the given tasks. In the case of graphic artists, the time to produce a picture using a halftone screen has shifted from ten minutes to two seconds, and the time to enlarge or reduce a visual has also moved from fifteen minutes to five seconds. The time required to perform calculations has also been greatly reduced. The time saved by computerization was used to perform other tasks, which we will describe later. Still, there were a few exceptions to the general feeling of time reduction. John, the director of the purchasing department at the hospital, commented during an interview that more data entry is required when computer files were opened for new suppliers.

9.2 Performatives engaging workers in tasks which were not performed prior to computerization.

In the previous section, we have discussed the way in which computers replicated old tasks through the use of performatives. Now, we will examine how the potential to execute new tasks has been made available to workers through the use of performatives. Two types of new tasks will be discussed: specialized tasks previously performed outside the organization; and newly-created tasks.

9.2.1 Performatives engaging workers in specialized tasks previously performed outside the organization.

The most spectacular integration of new computerized tasks in our study was observed in the graphic design department of the advertising agency. The software

packages used by graphic artists integrated tasks which were previously executed by outside firms such as typesetting and printing shops.

Prior to computerization, typesetting tasks in the graphic design industry were executed by specialized workers in an outside firm[3]. Before the arrival of computer technology, the agency's graphic artists had to give information regarding type face and point size of letters, composing the text to the typesetters, and from there the specialized workers produced the desired text according to these specifications. Standard settings were selected for spacing, leading and alignment[4] by the typesetters, and if the graphic artist wanted to alter them, more information had to be given to the typesetters.

With computerization, commands to transform text in more than 200 fonts of various sizes were integrated in all three graphic design software packages used within the advertising agency. With the help of computers, the graphic artist executed the typesetting tasks once performed in specialized firms.

For a given text, the operator selected from the choices offered by the computer: the font, the style, the size of the letters, and values pertaining to leading, spacing and alignment. Once the selection was made and the command activated, the transformation took place instantly. If the result did not correspond to operator's wishes, another font could be selected and the result of the transformation appeared instantly on the screen[5].

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3 Graphic artists working within printing firms had direct access to typesetters, but aside from them, most graphic artists dealt with typesetting firms.

4 Spacing, leading and alignment refer to the space dividing letters, lines and spatial organization of the text.

5 Unlike the other software packages, with Phototouch the modification of typesetting variables could not be reselected easily.

It seemed the integration of the typesetting tasks was facilitated by the graphic designer's knowledge of the elements involved in the decision which led to the transformation of text. Prior to computerization, the graphic designers were already involved in the choice of type face and point size of letters. Their training required them to learn the look of basic fonts and the calculation of letter size. They also acquired the necessary language to communicate fonts, sizes, and spacing specifications to typesetters. Books illustrating typesetting also existed to assist graphic artists in their choices.

It is interesting to note, that complex technologies to produce typesetting had been replaced by computer software packages made available to graphic artists. The contribution of the graphic designer in terms of typesetting expertise and knowledge had remained the same before and after computerization. Without having to acquire new knowledge, the typesetting tasks were made accessible to graphic artists via the computer. The contribution of the typesetter and the computer technology differ. As suggested by Samuel in the case study, the typesetting conventions which partly constituted the typesetter's expertise were not integrated in the computer software packages. For example, the individual using the computerized typesetting functions had no way of knowing that two blank spaces are traditionally left after a period.

The three graphic designers integrated the typesetting tasks in their routine. Prior to computerization, the graphic artist would individually order his or her own typesetting, or prepare it on his or her own.

The integration of typesetting tasks by graphic designers was probably facilitated by the knowledge of the variables involved in the transformation, the visibility of the result, and the capacity of most software packages to modify the outlook, by reactivating the computer commands at another time.

Apart from integrating typesetting tasks, graphic design computer software packages offered to the operator the potential to accomplish tasks once performed by specialized workers in the printing shop. Prior to computerization, the tools and capacities of graphic designer were limited. Mechanicals were partly prepared by the graphic designers at the agency, but much of the work was done by specialized workers from print shops. The graphic designer's work was sent to the print shop to be completed with a series of specifications. The specifications, in that case, did not describe the steps which had to be taken by the worker of the print shop. Instead, the graphic designers explained what kind of end product was desired, and from there the printers executed the necessary tasks. Those tasks included: the reduction or enlargement of color visuals, the transformation to obtain special effects on black and white or color visuals, the superimposition or modification of visuals, etc. Once the mechanical was completed, specialized workers produced the necessary films to create the printing plates used to reproduce the visual[6]. The printing processes are numerous and can be very complex, so we will not discuss them here. It is important to note that the both the preparation of the mechanical and the production of films were tasks executed by specialized workers prior to computerization.

With the arrival of computer technology, the graphic designers had the potential to reduce and enlarge both color and black and white visuals, to create special effects, to superimpose and touch up visuals and to prepare the films used later in the printing

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6 In this case study we assume that films were produced at the print shop, since the graphic designers dealt with printers who took care of producing the films. We are aware that in many cases the production of the films and the printing process were undertaken by two different firms. It is important to note that whether films were produced at the printers or not, prior to computerization, graphic designers did not have access to the knowledge and machinery to produce films.

process. We will look at each one of these new processes made available with the computer technology and the impact they had on the workers at the agency.

Prior to computerization, the graphic designers could only reduce or enlarge black and white visuals with the use of a camera. Since color visuals could not be reproduced with the graphic artist's camera, the color originals were always sent to the print or photolithography shop, and from there, according to the size specifications, the specialized workers created the films. Once the films had been prepared, the size of the visual on the film could not be changed. If a change in size was required, a new set of films had to be prepared.

Computer commands integrated in all the graphic design software packages used by the agency's workers could change the size of both black and white and color visuals. Through a computer dialog, the size of visuals was altered and the result of the size modification made visible on the computer screen. For every change in size, the computerized data from which the film would be prepared was readjusted automatically. From the information in the software, sizes of elements composing the visual could be modified at will before the films were printed. Once all the changes in size or other transformations were finished, the computer disk was sent to the print shop. The disk was inserted in a computer at the print shop and from the information stored on the disk, films were printed on celluloid material.

Prior to computerization, the creation of special effects and the superimposition of visuals were done while the films were prepared by specialized workers. Special techniques were required to perform those operations. The graphic designers were not familiar with the operations performed by these specialized workers. The graphic

designers asked for these operations by describing the desired outlook of the visual to the specialized workers.

Through computer technology, the creation of special effects previously performed by print shop workers was made available to graphic designers. For example, with the use of the Phototouch software package, eight different filters modifying the texture of the visual were accessible to graphic designers. With the technology, colors, brightness and contrast could be modified on either a section or the totality of the visual. Visuals could be inverted, equalized or posterized. Furthermore, the computer software packages could memorize and recreate the transformation of one section of the visual on another section of the visual. For example, if you were coloring grapes and giving them texture with the help of Freedraw, the operations necessary to obtain the end result could be reactivated on another grape with one simple command.

The graphic designer's capacity to superimpose visuals had also significantly increased since the computerization of their work. With the Phototouch software package, the graphic artist could cut visuals and create collage where visuals blended in each other in varying degrees. Parts of a visual could be masked, modified or displaced. Furthermore, the Freedraw software package offered the potential to move visual elements from the background to the foreground and vice versa. Those operations rendered accessible through the use of technology were previously done by specialized staff at the printing shop.

Prior to computerization, special effects were produced while films were prepared. Decisions taken while the films were produced by specialized workers were irreversible. With graphic design software packages, most of the decisions were reversible since the films were printed only once the visual outlook satisfied the computer operator. During the

study, the graphic designers used a decision making process based on trial and errors for most of the transformations. They based their decisions on the visual representation of the operations made available to them on the computer screen. They had the opportunity to see the end product before the films were produced.

Unlike typesetting and size modifications which were operations they were quite familiar with, the visual transformation and preparation of films required some practice in order to master the process. In the case of transformations such as the use of filters or the touch up of a visual graphic designers were guided by the choices made available to them in dialog boxes, by the outlook of the visual on the screen and by trial and error experiences. For example, when Brenda produced the corporate Christmas card, she tried one by one, the eight filters proposed to her in the dialog box to see the effect and to decide which one she would use. Subsequently, she modified numerous times, in varying degrees, the contrast and brightness of the visual again to see the impact and decide which combination she would select. Degrees of contrast and brightness were modified through selections made available to the computer user on the screen.

In the case of typesetting, the graphic artists were familiar with the necessary input to obtain the desired output. Prior to computerization, the guidelines accompanying the layout sent to the print shop only explained the desired outlook of the visual, and not the process to obtain the final result. The graphic designers did not really know the details pertaining to procedures they requested. When the opportunity to integrate these operations was offered to them via the computer, they had to experiment with the procedure and experiment with the various variables in order to understand the input needed to obtain the various outputs. Actually, during observation, graphic designers still could not explain the processes by which visuals were transformed. They could describe the required input needed to obtain a set output but when I asked them questions regarding the steps

necessary to obtain the end result, the only answer they could provide was the description of the end product on the screen. To complement the little information they provided on the process, I had to read books on graphic design software packages as well as publications on graphic art reproduction.

Certain problems in integrating the printing shop expertise manifested themselves in different ways. First, only Brenda took the time to experiment and become familiar enough to use the computer commands to transform visuals and create films. Second, when she did use those commands, Brenda called the print shop before sending them her diskette to make sure that she had prepared the job correctly. During those phone calls, she would thoroughly describe, to a specialized worker of the print shop, all the commands she used to make sure that she would obtain the desired end result. Still, during my stay more than half of the jobs sent to the print shop came back with unexpected problems.

The sources of the problems seemed to be the lack of knowledge acquired through experience and the lack of visibility of the end product. The visual seen on the screen does not necessarily correspond to what will be printed from the information in the computer. For example, the colors shown on the screen do not correspond to the printed colors, so every time films were sent to the print shop a series of computer commands had to be executed to alter the colors so the printed version resembled the screen version. We will come back to the visibility issue when we deal with constatives.

In summary: Through the use of graphic design software packages, performatives leading to the accomplishment of new tasks were made available to the graphic artist. To execute new tasks, the workers had to identify the set variables relevant to the operations, select and enter the appropriate input for each one of the variables prio: to the activation of the command initiating the action. In the case of typesetting the integration of the task was

facilitated by graphic designers' knowledge of the variables and the necessary input for each one of them. In the case of tasks previously performed in printing shops, the variables were made visible through dialog boxes which facilitated their identification but the impact of various values attributed to the variables was often unknown and learned through experimentation. Learning by trial and error was possible in many cases because the result of the operation was visible on the screen. When the output following the activation of a command was not made visible, it raised the insecurity of the graphic artist who often had to check with the employees of the print shop whether the sequence of operations would lead to the desired output. Furthermore, frustration took over when a desired output could not be produced because the operator could not find the combination of variables needed to attain the end result.

From the observation of the graphic artists, the factors contributing to the mobility of tasks seem to be: identification of the variables involved in the operation, knowledge of the value which could be given to each one of the variables and visibility of the output.

9.2.2 Performatives engaging workers in newly created tasks.

The potential to create new tasks at the hospital and the council took a different form than the one we have observed at the agency. The modification of the graphic designers tasks was partly due to the technology's capacity to break down the actions of specialized workers in a conversation where operators had to provide the correct input in order to jointly perform new tasks with the computer. In the case of the hospital and the council, no examples were found to illustrate the integration of specialized tasks through performatives. The tasks made available to clerical workers were not previously performed by specialized

workers outside the organizations or by workers within the firm. The computer's capacity to process data made it pertinent to take new forms of actions.

The computer technology's capacity to process data made a whole new set of tasks possible. At the hospital, the products retrieved from inventory were not registered prior to computerization because the number of transactions made it impossible to process and compile them given the number of workers employed in the purchasing service. With the advent of computerization, it became pertinent to register, compile and organize data regarding the quantities of outgoing products. During observation, the data pertaining to outgoing products by various services was entered in the computer. Through a computer command activated by the worker, the data was compiled and computed. From the data entered, quantities of consumed goods were obtained by service, by period, by product groups, etc.

In the case of the graphic designers, the input needed by the worker to respond to the performatives did not represent a problem for typesetting tasks but became problematic in tasks previously performed in the printing shop. In the case of clerical workers, the input necessary to respond to the performatives came from hand-written request forms filled by employees of various departments in the hospital. The request forms and the computer screens were identical. This facilitated the identification of values pertaining to each variable.

While the graphic design software integrated specialized tasks, the inventory software package integrated routine tasks. Like the graphic designers, the clerical workers could describe the output of the computer operations. Unlike the graphic designers, the clerical workers could also explain the process which lead to the computerized output.

The input necessary to respond to the performative presented by the computer did not require special skills or special knowledge from the workers. The transformation of the output was not made visible to the computer user but the process could be checked by consulting the computer files affected by the transformation. Naturally, in order to check the computer files, the computer user had to be aware of the operations performed once the data was entered.

The new clerical tasks performed jointly by the computer and its user seem to be more mobile then the computerized graphic design tasks, since the input was made readily available to the computer user. The criteria to select workers performing these tasks was minimal. For example, John, the director of the purchasing department at the hospital, chose Paul to process and compile the outgoing inventoried goods. John explained that he compared Felicia and Paul's time constraints to determine which of them would be selected to do the new task. John did not perceive prior knowledge of the inventory system or special skills to be necessary.

New operations performed jointly by the computer and its user to process, compile and organize data in various forms were also made available at the council. For example, the clerks entered the information from partial orders, which was compiled by the computer to indicate to the technicians the portion of the budget already spent for every blanket order.

As in the case of outgoing inventoried goods, the input necessary to respond to the performatives presented on the computer screen was readily accessible on paper forms filled by the requesting department. The organization of data on the written form and on the computer screen was similar. This facilitated the identification of the pertinent data.

Can the entrance of new data be recognized as a performative? If we use Austin's original distinction and qualify performatives as actions, data entry can hardly be described as an action in the same way as producing films to print a visual. On the other hand, if we use the recognition criteria suggested by Cooren (1994), data is entered in the computer in response to a situation presented on the screen. Beyond validation of the data entered by the operator, the computer and the user participate in a conversation that produces a transaction. At the hospital, to indicate the product retrieved in the inventory, the computer user activated the file maintenance command and registration of merchandise coming out of inventory command. Once both commands were activated, the operator indicated the department and the product identifications, the requested and retrieved quantities. From there the computer tabulated the average price of the product and the value of the retrieval. The quantity of product retrieved from the inventory was transferred in the product file and the quantity of products in hand was adjusted. Both the quantity of product retrieved from the inventory and its value were also carried over to the departmental file to adjust the consumption of the service. On the computer screen no signs of transformation appeared once the computer commands had been activated, but the conversational exchange between the computer and its user engaged them in action.

We noticed in the observed work settings that the workers tended to use the pronoun "I" in sentences designating tasks performed jointly with the computer. There seemed to be some confusion in the delimitation of the user and the computer's contribution in the accomplishment of tasks. This appropriation of the responsibility of the task by the operator is a phenomenon observed in previous studies (Groleau 1991b). Although we cannot generalize from these few observations, we believe it would be interesting to conduct more studies on the representation workers create of themselves in relationship to the tasks jointly performed with the computer.

The need to enter more data in order for the computer to compile and organize it raised the question again of task organization. Since no special knowledge was necessary to perform the new tasks, the tasks could be considered more mobile than the graphic design tasks which required experience with the impact of a set of variables on the output.

Researchers who believe that managers strive to gain control over workers by reducing their access to complex tasks automatically assume that data entry tasks are given to non-specialized workers. Our case studies demonstrated that even specialized workers end up doing data entry tasks and gain some knowledge from it. At the council, the purchasing agents, not the clerks, were required to enter the product description appearing on purchase requests in the computer. One of the agents observed during the study actually liked to enter the data because it gave her the occasion to familiarize herself with the purchasing request. Once more the knowledge was gained through the manipulation of data surfaces. The computerization of work diminished the data manipulation handled by clerks. This caused them to lose track of the process while the agents increased their familiarity with the purchasing files by entering the data in the computer. The purchasing agent stated that the advantage she found in entering the data was overlooked by other agents who felt diminished by the keyboard functions they had to perform.

The type of tasks observed in our study limited us in our assessment of technology's potential to render new tasks accessible to its users. Still, the comparison between computerization of clerical and specialized design tasks clarified a few points:

The comparison demonstrated that, in various ways, performatives support the integration of new tasks.

In the case of graphic design tasks, the computer rendered visible on its screen, both the variables involved in the performance of the task and the output of the task. The worker had to determine the value given to each one of the variables. In most cases, the graphic designers learned to determine the values associated with each one of the variables through experimentation. The graphic designers did not possess the necessary technical skills to understand the computerized transformation so they relied exclusively on the input/output relationship to evaluate their performance.

In the case of clerical work, the computer rendered visible the variables involved in the performance of the task. The determination of the values for each variable and the assessment of performance were up to the worker. The values for each of the variables was readily available from paper forms. Unlike the graphic designers, the clerical workers possessed the necessary skills to understand the computerized transformation. They did not have to rely on the visibility of the output to assess their performance.

9.3 Performatives modifying the sequence of operations.

Up until now we have only discussed single operations, but computers have also changed the sequence in which these single operations are executed by the computer user.

Computerization affected the sequence of operations in two different ways. First, some software packages rendered possible the execution of a set of integrated tasks but forced the computer user to follow the sequence of operations inscribed in the software package. Second, some software packages rendered possible the execution of a set of integrated tasks but let the computer user free to decide the sequence in which these tasks would be performed.

The ways in which computerization has affected the sequence of operations executed by workers will be illustrated with data from our field study.

The accounting software used in the hospital is a good example of a technology imposing a sequence in the performance of tasks integrated in the software package.

Prior to computerization, the accounting rules already structured the activities of accounting clerks. The rules dictated the way information needed to be organized in the accounting documents and the major steps involved in the transformation of that information. The sequence of the operations and the details pertaining to the execution of individual tasks were negotiated between the clerks and their manager.

As observed previously, the computer technology structured the execution of individual tasks through a series of performatives prompting the user for specific information at different stages of the execution. The computer also structured the execution of a sequence of tasks, again through performatives. Previously negotiated between workers and managers, the sequence in which the tasks were executed during observation was imposed by the computer software. To produce a cheque the operator had to follow a sequence of eight uninterrupted tasks. The tasks entailed the preparation of a list of eligible cheques, the registration of the transactions in the general ledger and the issuance of the printed cheques. In order to execute step 3, steps 1 and 2 had to be completed. If the user skipped a step, the computer would not respond to the commands activated.

The existence of a sequence of operations imposed by the technology reduced the workers and managers' potential to intervene in the organization of the process. The computer presented on the screen the numbered sequence of tasks which needed to be

performed. The visibility of the sequence on the screen rendered obsolete the need to learn the order in which the operations had to be executed.

Furthermore, the imposition of a sequence by the technology modified the way in which tasks were organized among the workers. In the case of the account payable tasks, the sequence of operations imposed by the technology covered the tasks usually performed by two different employees. The imposition of the sequence incited the manager to modify the previous allocation of tasks. The set of tasks previously shared between two workers are now executed by the same worker.

The imposition of a sequence in the execution of the computerized tasks was also observed in one of the graphic designer software package. Phototouch required the computer user to go through a hierarchical decision-making process. The graphic designer using Phototouch had to take a series of decisions when the document was originally created. These decisions limited the potential of future operations. The constraints following from the initial choices created a hierarchy which automatically imposed a sequence in the decision-making process.

For example, in order to transfer a visual in the computer through the use of a scanner, the operator had to select a resolution. Resolution is the fineness of detail of an image measured in pixels per inch (Pocket Pal: A Graphic Arts Production Handbook, p.233). To decide on the resolution of a visual, the operator took into consideration the halftone screen and the printer or image setter which would be used. A resolution was selected when the document was transferred in the computer and could not be altered afterwards.

The size of visual elements composing a layout were subjected to the same rule. Once it had been chosen, the size could not be altered through Phototouch commands. To change the size, the layout had to be redone from the start.

The way in which the sequence was imposed in the Phototouch software packages differed from the way it was imposed in the accounting software package. With the accounting software, the steps of the sequence were made visible to the user via the computer screen. The user did not have to learn the order in which the tasks had to be performed with the computer because the sequence was made visible through a performative utterance. With Phototouch, the sequence was not made visible. The user had to learn the sequence in which tasks and choices had to be performed. There was no computer utterance to clarify the sequence in which the tasks had to be done. According to one of my informants, graphic artists have had problems working with Phototouch because of the need to follow a sequence which is not visible to the computer user.

The graphic design software packages studied for this research did not all follow the logic we have just described. In the cases of the illustration and the editing software packages, the computerization of tasks contributed to dismantle the sequence in which the operations were performed. Prior to computerization, the traditional sequence of operations was made up of three major steps: design, typesetting and pasting. Irreversible decisions affecting the rest of the process were taken at each step. Decisions were irreversible because the worker did not control all the transformations involved in the production of an artwork. Decisions had to be taken once and for all. For example, once a font had been chosen, it was timely and expensive to produce another version of the text in another font because it had to be sent to a typesetting firm. With the help of the computer, the graphic artist was in control of all the transformative tasks, so instead of deciding once

and for all the arrangement and the characteristics of the elements composing the visual, incremental decisions were taken as the artwork evolved.

In the case of the illustration and edition software packages the previously-adopted sequence was dismantled with the implementation of the technology. The illustration and editing software packages treated decisions pertaining to the construction of a layout in a very different manner than the Phototouch software package. With the illustration and editing software packages, no precise sequence had to be followed and decisions were reversible. For example, the decision pertaining to the size of the visual elements composing the layout had to be taken once and for all in the case of Phototouch but could be modified at will with the use of the illustration or editing software. The difference between the two can be explained because the software packages had different ways to define the visual image. With Phototouch the visual image was defined as a series of dots. Once the size or the resolution of an image has been selected, the computer cannot enlarge or reduce the dots composing the image, so the decision was irreversible. With the illustration and editing software, the visual image was defined as a series of vectors. The vectors, or lines, make up the letters, delimit the areas of layout and can be changed as frequently as desired. The difference in the two computer logics may be interpreted as being two different ways to define one single entity but it would be more appropriate to say that the two logics deal with different realities. The dot logic is used mainly for visuals transferred from a scanner to a computer while the line logic is used mainly for typesetting or for drawing lines and regular shapes.

This section on the sequence of operations has demonstrated that the use of performatives can contribute to clarify the sequence of operations imposed by the technology. In the case of the accounting software package, the performatives rendered the sequence of operations visible to the computer user, thus clarifying the link between the

various tasks. In the case of Phototouch, a sequence was imposed but the connection between the tasks was not made visible to the user. The user had to learn through experimentation the hierarchy imposed by the technology. The learning process was complicated by the fact that the tasks integrated in the software package were previously performed by specialized workers and not well mastered by the graphic designers who did not possess the necessary skills to fully understand its potential.

The presence of a hierarchy in the execution of tasks through a computerized sequence modified the input provided by the worker in the execution of tasks. In some cases, the knowledge previously required to establish the order in which operations should be performed was integrated in the technology reducing the worker's input. The comparison of the accounting software to Phototouch also indicated that the visibility of the sequence may vary. Again, the invisibility of sequence altered the worker's input. While visible sequences reduced the worker's input and contributed to render tasks more mobile, invisible sequences required the worker to know the sequence integrated in the technology and act accordingly. In the case of Phototouch, the need to discover the invisible sequence required the worker to acquire knowledge on the computerized sequence.

Finally, we noted that computerization of tasks can also contribute to dismantling the sequence in which the operations were previously performed. In that case, the input necessary to determine the sequence of operations was no longer required from the worker.

9.4 Performatives generating invisible operations.

During our study, a phenomenon not previously discussed in the computerization of task literature, was observed. The phenomenon was first noticed at the financial services

of the hospital: The operator of the accounting software program was invited to participate in the execution of certain tasks, but while the worker was executing these tasks, other tasks which we will call invisible operations were being performed solely by the computer without the participation of the operator. This phenomenon was observed numerous times and investigated.

The action performed jointly by the operator and the computer initiated a series of operations executed by the computer alone. Performatives were the trigger for these invisible operations which is why we will discuss the impact of invisible operations within the performative section of our analysis. Two examples of invisible operations will be provided. The first one deals with the integration of invisible operations replacing tasks previously performed by workers; the second deals with the integration of invisible operations creating new tasks.

The computerization of the work executed by the accounts payable clerk at the hospital transformed some of her previous tasks into invisible operations. Prior to computerization, the accounting clerk matched purchase orders written at the hospital with bills sent by the suppliers. She verified the information on both documents to make sure they were similar and then transferred the data pertaining to the transaction to an accounts payable auxiliary ledger and a cheque ledger. With the advent of computerization, the clerk matched the reception slip and the supplier's bill but used the information on the computer to validate the bill's content. She called-up the reception slip on the screen, modified it if needed and activated the billing report command to change the status of the document. The computer changed the status of the document which was the main goal of the computer commands but invisible operations followed from the activation of that command. The information from the transaction statement was registered in accounting ledgers. With the change of status of the reception slip, the computer user had no

indication that these operations took place simultaneously. But, by simultaneously creating the writings in the ledger, the computer relieved the worker of executing these tasks.

In this case, the accomplishment of invisible tasks by the computer relieved the clerk from registering the data from the reception slip and bill into the ledgers. The implications of invisible operations, we believe, could be more complex than the reality we have observed in this organization. In the case where invisible operations replace tasks previously performed by the worker, as in the case we have just observed, the knowledge and presence of the worker may become obsolete. For example, to perform the ledger writing tasks, the clerk had to know how to organize and compute the various types of data in a ledger. More concretely, in the case of the accounts payable auxiliary ledger, the worker had to possess the knowledge necessary to arrange the data in 14 columns. Furthermore, the time previously spent on performing the ledger writing tasks became idle. In the case of the hospital, the idle time created by computerization did not lead to cuts in the resources but permitted some slack which relieved the workers from their stress. Naturally, the idle time does not always lead to more slack, it can also lead to resource rationalization. In that way, invisible operations can have an impact on the allocation of tasks especially if the tasks initiating the invisible operations and the tasks replaced by invisible operations were previously performed by different workers.

In summary, computerization reduced the worker's input in the accomplishment of the ledger writing tasks. Since computerization, it was no longer necessary for the clerks to know how to organize the written documents because the accounting software package already had a frame organizing the data provided by its user. Furthermore, the accomplishment of numerous tasks was replaced by the joint execution of one performative, again reducing the worker's input. The worker's input was reduced in two forms. First, knowledge about data organization and sequence of tasks was reduced.

Second, the number of operations to be performed to obtain the same results was diminished.

As we have just discussed, invisible operations replaced tasks previously executed by workers, but these operations also permit the worker to be associated with new forms of actions. For example, invisible operations rendered possible the tabulation of the average price[7] of inventory products at the hospital. In the case of the hospital, the average price for the items stocked in the inventory was not previously computed because it required too much data compilation and calculation. This could not be done by the limited staff of the purchasing department. With the arrival of the technology, the treatment of data was greatly facilitated. Each time merchandise was received at the hospital, the workers from the purchasing department searched in the computer to locate the purchase order and compared the quantity and price of the ordered and delivered goods. From this data, which was either taken as is or modified, the worker created a reception slip with the computer. The creation of a reception slip triggered a set of invisible operations. The computer added the quantity and value of the received goods with the quantity and value of the stocked good in order to tabulate the average price which would be applied to the totality of the goods. Furthermore, the quantity of goods indicated in the reception computer file was transmitted to the product file and the following information files were automatically adjusted: the quantity of goods in hand, the quantity of goods ordered for the period, the quantity of product waiting to be received, and the date of the last order.

Again, the accomplishment of invisible tasks which were not previously performed by workers of the organizations raised the question of task allocation. In our case studies, workers often perceived the invisible operations as tasks which they performed. This came

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7 The average price is the price given to similar inventoried items stocked in the warehouse which may have been purchased at different prices.

up during observation. Again, workers used the pronoun "I" to describe invisible operations executed by the machine. Choices in regards to the initiation of the operations performed by the computer seem to have become a highly political issue among the workers involved in the work process.

At the hospital, invisible operations, whether they were replacing old tasks or creating new tasks, were clearly understood by the workers initiating them. During observation, they could easily explain the operations undertaken by the computer. Even if the knowledge needed to perform the old tasks became obsolete by invisible operations, the manager of financial services at the hospital insisted on having workers with accounting knowledge. This duplication of knowledge, according to her, helped the workers understand the consequences associated with the activation of computer commands and facilitated the identification and correction of mistakes.

In summary, invisible operations confronted organizational members with a series of choices. The allocation of tasks had to be reconsidered in work settings where previous tasks were integrated in invisible operations. The responsibility of initiating newly- created tasks through invisible operations also needed to be negotiated.

Apart from task allocations, issues regarding knowledge requirements needed to be resolved:

- Was it necessary for the worker to be aware of the operations executed solely by the computer?
- Was it necessary for the worker to understand the process taken on by the computer?
- Was it necessary for the worker to be able to identify the output of the invisible operations?

- Was it necessary for the worker to possess the necessary knowledge to replicate invisible operations?

9.5 The pertinence of using the performative concept to study the computerization of tasks.

Up until now, our analysis has been devoted to the identification of performatives in the computer/operator interaction. In this section of the analysis, we will debate the usefulness of applying the performative concept to the computerization of tasks. First, we will recall the major findings of our analysis. Second, we will compare the performative concept inspired by the works of Austin (1962), Cooren (1994) and Taylor & Cooren (1994), to other concepts described in the computerization of tasks literature.

9.5.1 Summary of results

The performative and constative concepts were borrowed from language studies, in order to better understand the contribution of technology in the performance of tasks in newly computerized work settings.

Performatives were defined as computer "utterances" soliciting its user to recognize and participate in an action. Performative utterances came in varying forms: The user may be faced with a question, a form to fill or a choice of variables. By providing questions, organized data on a form or choices, the computer led the user on a path. That path structured individual and sometimes sequential tasks.

It would be false to state that the structure of tasks integrated in the software packages was always made visible through performative utterances. We have observed

during our field studies, a situation where the structure of sequential actions had to be discovered through experimentation because there were no performatives utterances clarifying the steps to undertake. Furthermore, the existence of invisible operations also contributed to obscure the process in which the computer user was involved.

Apart from these exceptions, performatives often contributed to a clarification of the necessary steps in executing a task. The way in which software packages clarified the process for the user varied. It sometimes rendered visible the variables involved in the transformation. The identification of the values associated with the variables was up to the computer user. The identification was more or less complex depending on the type of task performed. In the case of graphic design software packages, finding the right value was facilitated by the visibility of the output created from the transformation of the selected input.

Performatives could take many forms. This could explain the various ways in which tasks can be integrated in technology. We limited ourselves to only a few types of tasks which reduced our potential to identify a whole variety of performatives.

By framing the tasks, the technology modified the input provided by the worker in the execution of those tasks. As we have seen in our case studies, the joint execution of the tasks sometimes required the computer user to master new skills and knowledge to provide the necessary input while in other circumstances the skills needed prior to computerization became obsolete.

Up until now, we have presented performatives as frames provided to support the execution of tasks but framing the tasks through computerization did not only provide advantages. In the case of clerical tasks, knowledge created by the manipulation of data

was lost. Furthermore, replacing the drawing pen with a computer mouse made drawing more complicated for graphic designers. The changes from a pen and paper to a computerized context modified the experience workers have with their work. That change in the experience of work sometimes led to certain disadvantages, as we have just seen. Zuboff (1988) discussed, at length, the worker's point of view on the change of medium accompanying the computerization of tasks.

The frame of action provided by performatives and the change of input provided by the worker accomplishing the task can be the source of new negotiation among the members of the organization to determine who will do what, now that the work process is computerized. Depending on the contribution of the technology, the workers needed more or less expertise to accomplish tasks previously performed by others.

In the next section, we will compare the performative concept to previous theories examining the characteristics of technology, in order to determine how computerization contributed to modify tasks.

9.5.2 Performative vs. transformative.

Previous researchers examining the organization of tasks following from computerization often mentioned the need to better understand technology's contribution.

The authors focusing on managerial philosophies to explain the reallocation of computerized tasks sometimes noted that technology constrained managers' action but never developed the idea to fully comprehend those limits. For example, Appelbaum & Albin (1989) stated that constraints may limit the choice of implementation strategy available to managers. Zuboff (1988) was more precise in her appreciation of the role of

technology. She believed the technology's capacity to integrate knowledge varied and rendered tasks more or less accessible through computerization. Finally, Clement (1988) noted in his analysis that management's control over the reorganization of tasks was limited by technology's capacity to integrate expertise.

All these authors suggested that computer technology passed on some knowledge to the user but never investigated what is transmitted to the computer user and how it can contribute to the mobility of tasks.

Finally, the researchers focusing on technological factors to explain the organization of newly-computerized tasks came up with explanations we can contrast our findings with.

Rule & Attewell (1991) categorized the various computer technologies accordingly to their capacity to transform data. According to them, the computer's capacity to transform data was proportional to the computer's potential to create new forms of actions.

By focusing exclusively on the technological characteristics, the authors overlooked both the informational exchange between workers and the technology which makes possible the actualization of new actions. We believe, that the interaction between the computer and its user is crucial in understanding the actualization of potential tasks. The user and the computer take part in the performance of new action, so we need to consider the user's capacity to provide the required input for the action to take place[8]. As our findings have shown, performatives framed action, but the input required from users varied in its complexity. Clerical staff had no problem providing the input to jointly perform tasks with the computer because it required skills they already possessed. On the other hand,

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[8] Even in the case of what we have called invisible operations, the user still needs some form of input to trigger the operations.

graphic designers had to learn through experimentation the impact of the values attributed to the variables presented to them in order to effectively perform the desired computerized task.

Unlike Rule & Attewell (1991), St-Pierre (1985) took an historical look at the technology. She believed the technology of the 60's and 70's encouraged managers to employ workers to perform massive data entry tasks. According to her hypothesis, computer mainframe systems, then, did not allow the worker to participate in the action performed by the computer. She noted a big change in the potential offered by technology in the 80's. The arrival of microprocessors made it possible for non-specialized workers to transform data jointly with the computer.

St-Pierre's argument is based on the computer mainframe configuration. The attributes she gave to technology of the 60's and 70's can still be found now. In a research accomplished a few years ago (Groleau 1991a), I tested her hypothesis in a field study which demonstrated that the mainframe configuration did not appear to be a significant factor modifying the configuration of tasks. In the insurance industry, where the study was conducted, changes in the organization of underwriting tasks began in the 70's while technology introduced in the 80's in the actuarial department did not in any way alter the task organization. Again, with the data from our case study we can question the validity of her hypothesis. The accounting computer system of the hospital could correspond in some ways to what St-Pierre described as an old mainframe integrated system, while the graphic design computer system at the agency could correspond in some ways to what St-Pierre described as being microprocessors. Still, in both cases, the input of technology modified tasks and practices within departments.

Instead of focusing on the transformative capacity of the technology or on the configuration of its mainframe, we propose to look at the computer text to better assess the possibilities made available to organizational members. The conversation between user and computer revealed the existence of what we have called performatives. Those performatives frame the tasks and modify the input of the user. It would be interesting to look at other work processes to have a better idea of how performatives take form in various computer texts.

This analysis would be incomplete if we pretended that performatives could solely explain the reorganization of newly computerized tasks. Rule & Attewell (1991) & St-Pierre (1985) focused exclusively on the transformative capacity of the technology but we noted that their hypothesis could not be validated in case studies other then their own. This incited us to look for other forms of data integration to explain the phenomenon observed in past studies. This is why the performative/constative categories became so appealing for our analysis. We believe the constative concept complements the performative concept because it provides an alternative method to understand the informational exchange between the computer and its user. We believe the combination of the two categories can provide a solid framework to understand that new tasks are made potentially accessible to workers using computer technologies.

Chapter 10: Constatives within the computerized text.

In our dissertation, we emphasized the necessity of examining the forms in which data was integrated in the computerized text in order to better understand the potential renegotiation of tasks among organizational members after the implementation of computer technology.

Up until now we have looked at how, through performatives, workers had been engaged in the performance of various tasks by responding to computer utterances. Our empirical studies, as well as research performed by other authors (Groleau 1991a; Groleau 1991b; Alter 1985), have shown that the use of performatives cannot fully explain the potential to modify tasks presented by technology .

We believe the performative/constative categorization permits us to better capture this potential.

The type of recognition necessary for constatives differs from the one required for performatives In the case of performatives, the computer user is asked to recognize that an action is going on and to take part in it; while in the case of constatives, the computer user is asked to recognize only the informational content of the computer utterance. A list presenting the quantities of various products stocked in the warehouse, for example, is considered a constative. The information on the screen does not directly invite the user to take part in an action. It simply offers a vision of reality: the quantities of products stocked in the warehouse. The data from our field study seemed to suggest that through the informational content presented to the computer user, constatives offer visions of reality which can modify the possible lines of action undertaken by workers.

In the following sections, we will try to illustrate how computer constatives have modified computer user's perception of reality, and how they have contributed to the mobility of tasks in the visited firms. In the first section, we will describe the process by which computers transformed existing data into computerized constatives. In the second section, we will discuss newly created computer constatives offering the worker a variety of perspectives on the work process. In both cases, we will examine the impact of constatives on task reallocation in the three corporations visited during our field research. The last section will be devoted to a discussion of the importance of employing constatives in explaining the reallocation of tasks.

10.1 Constatives replicating information that was available prior to computerization.

In this section we will compare the organization and presentation of information made available to workers before and after computerization. In our field study we noticed that even if some information remained the same before and after computerization, the way in which it was made available to the computer user modified the outlook workers had on their work environment.

More specifically, we observed that information previously available had gone through various types of transformation during computerization. Our analysis will look at these transformations. In the first section of our discussion, we will examine the way in which paper documents were reorganized during computerization. In the second section, we will deal with changes in constatives due to the textualization of information that occurred during computerization.

In our analysis, we will attempt to describe the changes in constatives before and after computerization and see the impact these transformations had on the organization of tasks within the visited firms.

10.1.1 Constatives replicating documents available prior to computerization.

In this section, we will compare the written documents existing prior to computerization with the information presented on the computer screens.

Our observations have revealed that, in some cases, computerization resulted in constatives with a higher degree of data integration, while in some others, it led to constatives with a lower degree of data integration. Degrees of data integration are defined as the capacity to visually join data fields together.

In the accounting service of the hospital, constatives with increased degrees of data integration were encountered. To illustrate the integration of data, we will use the example of the reception slips in the accounting department at the hospital.

Prior to computerization, the date chosen to issue a cheque for outstanding bills was decided when the accounting clerk registered the information from the purchase order/bill in the cheque ledger. Information such as the amount due, the supplier, and the selected date to issue the cheque were written in that ledger. To see which cheque should be issued at a given date, the clerk either consulted the cheque ledger or the paper files --where purchase orders stapled to reception slips and bills were organized by due dates. Until the cheque

was stapled to the reception slip and refiled in the paper files, there was no indication on the reception slip/purchase order/bill of the payment date.

With computerization, eleven information fields were entered or verified by the computer user when the reception slip was transformed into an accounting document. Among those information fields was the payment date. The presence of the payment date on the document with the supplier's name, the amount, the description of the goods or services, the discounts, and the date of the bill permitted the clerk to have a quick but complete assessment of the transaction with the supplier. This information was available without searching in other accounting documents to obtain the date of payment.

At the hospital, the integration of the payment date on the computerized reception slip did not alter the way information was shared among the workers. This was because prior to computerization, one clerk accomplished the whole set of tasks, ranging from collecting reception slips for each product, to writing cheques to suppliers. Since workers had already integrated many tasks, the impact of viewing integrated information was reduced; but we believe that the potential to integrate information could lead to new perceptions encouraging organizational members to renegotiate their tasks.

In the upcoming pages, we will discuss cases of data segmentation, as well as cases integrating new information fields made available through computerization. Using these cases we will further explore the relationship between degrees of data integration and the perceptions workers have of their work process.

While at the hospital computers contributed to integrating data previously presented on various paper documents, at the council computers segmented data previously presented on paper documents.

Again, we will compare the data organization of paper documents and of computer documents. In the case of the council, a paper copy was made of almost every computer document.

During observation, it became obvious that workers relied almost totally on paper documents and seldom used the computer screen to retrieve data. More concretely, the purchasing agents were continuously walking over to the filing cabinets to search for information in the paper form instead of searching through computer files.

The agents disliked the computer files for two reasons. First, to obtain data, a sequence of numerous computer commands had to be activated. Second, information presented on one screen limited the outlook they had on the process.

For example, agents were often called by bidders on a purchasing contract to compare the bid the caller had prepared to the ones of the other bidders. To access the price request through the computer, the agent had to first identify the supplier who had made the purchase order. Once the supplier was identified, the agent brought up all the purchase orders which had been given to that supplier on screen. The agent identified the required purchase order number by looking at the order description beside the sequence of numbers, and then brought up the order on screen. From the information provided on the purchase order, the agent would note the number of the purchase request. The agent entered the purchase request number in the computer and then finally had screen access to the price request number. When the price request number was entered, the details pertinent to only one bid at a time appeared on the computer screen. The agents often had to go back and forth from bid to bid in order to answer the numerous questions of the caller.

To access the price request, a number of computer commands had to be activated. The information made available at each stage of the computerized search was segmented and often required more research. The purchasing agent had to consult numerous screens to retrieve all the desired information. In the paper system, all information was gathered together in one file. Information pertaining to the whole purchase process was instantly available by placing the various paper forms contained in the file side by side. The computerized segmentation of information complicated the search process, and also made it difficult to survey information on the complete purchasing process.

Thus in the case of price requests, the paper documents integrated more information than the computer documents. Three bids were presented in paper form, while only one bid was presented on the computer screen at any one moment.

In other situations, computers replicated the effect of putting written documents side by side by integrating information fields relevant to the whole process onto one computer screen. At the hospital, for example, all the information pertinent to the purchase of products and the payment of the bills (which in the past had been dispersed on various written documents) was integrated into one computer screen.

The integration of the information at the hospital had a minimal effect on the workers, as we have already discussed. At the council, however, the segmentation of information had repercussions on the clerks, who previously assisted the agents in creating purchasing documents.

Prior to computerization, the clerks possessed knowledge of all the steps involved in the process by consulting the paper file while they were typing the paper purchase order form. With computerization, the clerks did not need to consult the complete p ..nase file --

they simply worked with the computerized document presented on screen. Since the implementation of the purchasing software package, the clerks were less involved in the production of documents pertaining to the purchase process. Thus the potential to make links between the various steps of the process was considerably reduced because computerized documents offered a limited view of the whole process. Since computerization, the clerks' level of knowledge regarding the current files has dropped, and as a result, they can no longer answer simple telephone inquiries from bidders, as they had in the past.

In the case of the clerks, information pertaining to the progress of a purchase was not compulsory, but that knowledge permitted them to undertake tasks such as answering telephone requests from suppliers and bidders. It also allowed them to familiarize themselves with the activities of the department. For Helen, one of the technicians in the purchasing department, the experience of the purchase process she gained as a clerk prior to computerization became a strong advantage when she was promoted. Since clerks have lost the opportunity to familiarize themselves with the purchase process, the potential to undertake tasks involving knowledge of the purchasing process became limited.

In the case of agents, their work depended solely on their capacity to view patterns, to create links between various types of information, and to evaluate a situation. To avoid the complex manipulation of computer commands, and to be able to view the whole purchase process at once, agents relied almost exclusively on the paper files.

Such information segmentation (which prevented workers from having a more global view of the work process) reminded us of the Tayloristic work organization. While on the research site, we felt compelled to investigate whether or not the segmentation was a result of managerial decisions. When interviewed, the manager in charge of the department

seemed genuinely unaware of the information segmentation. She was extremely disappointed that we believed the work process to be segmented. The director of the purchasing department had noticed that agents relied on paper files, but she believed it was due to a lack of computer power which slowed down the exchange with the computer. She had even taken measures to speed up the response time in order to encourage agents to cease relying on paper files.

The factor that led to information segmentation was investigated. Ultimately, the pilot of the computer project explained that the emphasis during software development had been on accelerating the speed of producing purchase orders, and that no attention had been given to the organization of data by the computer programmers. This particular emphasis on technology supports our assertion that in computer research, as well as in computer programming, the fascination for the transformative power of technology overshadows the computer's potential to create different views of reality through the informational content presented on the screen.

One last example from the graphic design computer software packages could be used to illustrate new constatives made available through the computer technology, and their impact on the accomplishment of tasks. The three graphic design software packages offered the computer user the potential of viewing the artwork from different points of view. This was accomplished by integrating computer commands which could produce the effect of a zoom in. The ability to zoom in allowed the computer user to touch up visuals -- something which was impossible prior to computerization.

In conclusion, the constatives we have described in this section replicated information which was available prior to computerization; however, the way in which data was organized modified the outlook workers have on the work process.

10.1.2 Constatives textualizing information that was available prior to computerization.

In the previous section, we have described the changes in terms of content: the data integration or segmentation of informational content in written and computerized documents. In this section, we will explore the modifications a change of medium brought to the execution of tasks. Emphasis will be put on the form of the constative rather than on its content.

The arrival of the computer medium changed the way in which constatives were presented to workers. The switch from one medium to another required the computer users to name documents in order to identify and retrieve them from the computer system. The attribution of names to computer documents, which we will refer to as textualization, seemed to be easy in the case of clerical workers, but represented quite a challenge for the graphic designers.

Prior to computerization, the graphic designers worked exclusively with paper. Storing information on paper facilitated its retrieval. Logos, and other visuals, were stored in paper files which designers consulted to access visual elements they needed to produce the artwork. All the variations of one logo, for example, were contained in the same paper file.

With the arrival of computers, the visuals were digitized and the information was now stored inside computer files. The problem designers were faced with now was inventing a system of nomenclature which would permit easy access to visuals stored in the computer. The graphic designers had to agree on the labeling protocol used to organize and

store visuals since all three shared the same computer files. They labeled computer files, like they had done previously in the paper system, but in addition to this, every document contained in each computer file had to be given a name as well.

The textualization of individual documents, meant to facilitate the storing and retrieving of information, led to certain complications. Naturally, it was easy to label a logo with the name of the company associated with it; each logo, however, had numerous variations. The system of nomenclature differentiating the different versions of one logo became complex. Most often, the graphic designers gave similar names to each logo variation, and thus were forced to consult numerous computer files in order to find the one visual they were looking for.

The graphic designers were accustomed to identifying the elements they wanted by visually assessing the differences between the visuals available to them. Now when the graphic designers opened their computer, the constative presented to them was a series of alphabetical names, each associated with one visual. During observation, every layout session was preceded by a search period where graphic designers went through various files and asked their colleagues to help them locate the desired visuals.

In comparison, it is interesting to note that the textualization of data did not cause any difficulties with the workers from the hospital and council. The paper files and individual documents were identified with alphabetical or numerical codes prior to computerization. For example, the list of purchase orders at the hospital had described the content of the document. Other documents, such as purchase orders, were differentiated by means of numerical codes.

The fundamental difference between clerical workers and graphic designers was the relationship each had with textualized data. Clerical workers ordered documents numerically or alphabetically, whether or not they were using a computer. Graphic designers, on the other hand, needed to translate visual data into a textual form in order to accommodate computerization.

The technological mediation of graphic design data modified the relationship workers had with the information they employed to accomplish their tasks. Two new operations were created by the textualization of data: the labeling of each visual unit, and the retrieval of documents based on a protocol employing a textual description of the visual.

Again, in this section we discussed the changes in the way existing data was transformed by computerization. The necessity to textualize visual data changed the relationship graphic designers had with their tasks. They tried to agree on protocols to name and search for data, but had difficulties adapting to the new reality. According to them, the task involving the identification of the visual elements of the layout became increasingly difficult to execute with the arrival of computerization.

10.2 Constatives offering new perceptions of reality

In the last section we discussed the transformation of constatives which existed on paper documents prior to the arrival of computer technology. We noticed two important changes. First, the organization of data in paper form was altered by the process of computerization. Second, the change of medium affected the form in which data was made available to the user. In this part, we will continue our analysis of constatives by describing how computer technology made different perceptions of reality visible.

Various factors influenced the way in which computers brought about new visions of reality. To reflect this variety, we have divided the discussion on new constatives into two parts. The first part will examine new computer documents which were compiled and organized in such a way as to make relationships between different variables visible to the computer user. The second part will present constatives making new visions of reality visible in textual form.

10.2.1 Constatives offering new representations of the reality through the use of computer technology.

In this part of our discussion, we will describe and examine newly created constatives made possible through the use of computers.

In some cases, the new constatives were the result of the compilation, integration, and organization of data available prior to computerization; while in other cases, the new constatives were the result of the compilation, integration, and organization of data not available prior to computerization. We will use examples to illustrate and analyze both types of new constatives.

The observations made at the council provided us with two examples illustrating the emergence of new constatives representing data which existed prior to computerization. In both examples, the constatives were lists of data not compiled prior to computerization.

At the council, the software package in the purchasing department produced lists of blanket orders to be renewed by using the contract termination date of the order as a sort variable. The technicians printed the lists on a monthly basis to identify the contracts which needed to be renegotiated.

Prior to computerization, such lists were not available. The need to renew the contract was communicated to the technician either by the requesting department or by the accounting department[1]. A lack of resources prevented the technician from following up and verifying all the renewal dates. The requesting department had the responsibility to signal the end of the period covered by a blanket order. The computer-generated renewal lists contributed to shifting the responsibility of identifying the contract renewals from the requesting department to the technician[2].

Furthermore, at the council, the computer's capacity to compile and sort data pertaining to suppliers modified the agent's practice.

Prior to the arrival of BUY, supplier names were either in the main computer or in the agent's cardex. Having the supplier's name in the main computer was of no help to the agents because the files were not well organized. The confusion was the result of non-standardized data entry practices. Thus the agents preferred using the information from their cardexes to select suppliers. The cardex system, however, limited the number of suppliers available to the agent, because it organized the suppliers along merely one set of criteria: alphabetical order. Most often, purchasing agents either pulled out the previous purchase contract file and invited the same bidders to submit prices, flipped through their cardexes, or relied on memory to determine which companies should be invited to bid.

The purchasing department's new software package allowed the computer user to pull names of companies using industry codes. With the potential to store and sort

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1 The accounting department communicated the need to renew the contract when the requesting department's expenditures were greater than the budget allowed.

2 The computer's capacity to compile and display the expenditure associated with each of the blanket orders also contributed to this shift .

suppliers by industry codes, it became easier to locate the firms invited to bid. The agents did not have to rely on previous order files, their cardexes, or memory, because the computer offered them a new constative. This new constative made it possible to invite more companies to submit a bid for a contract. The potential of inviting more companies, and rotating the companies invited to bid, made it easier for the agents to follow purchasing policy, and gave potential suppliers a fairer chance to obtain a contract. Furthermore, the organization of supplier information under industry codes reduced the importance of an agent's past knowledge and experience in finding the appropriate firms.

In the two examples we have just provided, new constatives were created from already existing data. With the arrival of computer technology, it became possible to compile data using a variety of criteria[3]. The multiplicity of perspectives available on information generated by the computer made new relationships visible to the computer user. This in turn, opened up new lines of action.

Prior to computerization, corporations, such as the council, did not have the necessary resources to produce and store the multiple copies of written documents required to create a variety of viewpoints on transactions. Ordinarily, two or three paper copies of documents were kept and stored.

The limited human, spatial, and temporal resources which prevented corporations from maintaining and storing information compiled along more then two sets of criteria also made it impossible to keep written records of every transaction. As we have seen in the section on performatives, the advent of computerization offered the possibility to easily keep a record of all transactions, and, furthermore, permitted new transactions. Data

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3 The capacity to organize data using a variety of criteria also depended on the standardization of data.

generated by newly created transaction records was also compiled and organized to create new constatives.

Several instances taken from our observation at the hospital will provide more concrete examples of the im[illegible] f new ways of compiling and organizing information.

At the hospital, one of the most important new outlooks created from the inventory operations was the product consumption per service profile.[4] Computerization enabled tracking the consumption of products in the warehouse, and offered the potential to organize information related to consumption along various criteria. Three criteria were available to sort the transaction data: consumption could be presented on a departmental basis, on a product basis, or on a temporal basis. Furthermore, criteria could be combined, offering reports detailing the consumption of one service over a given time period for one or more products. On more concrete level, the computer provided detailed information, such as the number of pill containers used by the fourth floor of the hospital in the course of one month. The information was displayed on computer printouts or on the screen. The hospital's various departments received a computer printout, prepared by the accounting staff, detailing their consumption profile on a monthly basis.

The consumption profile initiated two new lines of action:

First, the director of financial services decentralized the budgeting functions. Since data on the product consumption of every department was available, each department was made aware of its consumption, and was thus held accountable for its expenditures. It is important to note that computerization did not necessarily lead to budget decentralization,

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4 That profile was made possible because the retrieval of inventory products, the new performative described earlier became possible with the technology.

but it offered the potential to compile the necessary data which made decentralization possible. The decision to decentralize was then made by the managers. At the council, for example, the consumption profile of various departments was also made available by computer technology, but did not seem to lead the managers to move toward budget decentralization.

Second, the consumption profile made new data regarding the needs of each department available to the purchasing department staff. By using the consumption profile, and by asking the users to analyze their consumption habits, the purchasing department produced customized purchase requests containing the products most often consumed by every department of the hospital. This action was taken to improve the quality of service offered by the purchasing department. Felicia, the purchasing clerk, printed and sent the standardized request forms to the various departments of the hospital on a weekly basis, and Paul received the completed forms and prepared the deliveries. The customized request forms changed the relationship the purchasing staff had with the various departments. They moved from a role where they responded to requests, to a role where they anticipated and helped formulate the requests forwarded to them. The new way in which they performed their tasks and defined their relationship to other departments was a change facilitated by computer technology.

The written evidence of transactions made many new constatives available. Prior to computerization, the possible lists of the inventory data were: supplier's list, supplier's list for a given product, a list of inventoried products[5], and a list of purchases for inventoried products. After computerization, a whole new set of lists was made available to the worker. These new lists were: lists indicating the quantities of products stocked in the

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5 The list presented the names of inventoried products, but the list did not indicate the quantity of products stored in the warehouse.

warehouse, lists of inventory retrievals per service, per product or per period, lists of purchase orders for non-inventoried products per service, per product and per period, and average price of products stored in the warehouse.

Finally, in some cases, newly created data was integrated into documents which existed prior to computerization. The ability to view newly created transactions and data previously available simultaneously on one screen offered the computer user the potential to assess a situation in different ways. When the list of inventoried products at the hospital was kept on paper cards, the amount of information for each product was limited to information regarding the product's code, description, price, the identification of the various suppliers selling the product, and the quantity of product ordered, received and consumed at the hospital on an annual basis. With the advent of computerization, more data on the product became available. The screen displayed 28 fields of information describing the product. Apart from the information previously registered on the product card, the computer offered data regarding the average price of the product, quantity of product kept in the inventory, minimal and maximal stock, point of purchase, and suggested quantity of goods to order. With that information in hand, Paul determined when and what quantity of a product needed to be ordered. Prior to computerization, it was impossible to determine this using the written documents. Paul had to go in the warehouse and look at the shelves to see what products he had in stock. From there, he consulted the product card to have more data on the product and consulted the manager of the department to decide whether or not to order the product. The richness of the new outlook on the product profile was due to more available data, but also to the ability to view all of it simultaneously.

In conclusion, the discussion pertaining to newly created constatives showed us that the computer's capacity to compile, sort and integrate existing or newly created data

modified the vision workers had on the work process. Concretely, the constatives displayed by the computer technology encouraged organizational members either to undertake new forms of action, or to renegotiate the allocation of tasks among them. In the case of the compilation and organization of data pertaining the consumption of products in inventory, two new forms of actions were taken while in the case of the compilation and organization of data pertaining to blanket orders and the product file, the tasks were renegotiated among the organizational members.

10.2.2 Constatives textualizing information not available prior to computerization.

The transformation which textualized data in order to be integrated by the computer technology was already discussed in section 10.1.2. We described the discomfort felt by graphic designers who had to refer to visuals by name in order to store and retrieve them.

Now we will use the concept of textualization to present a new category of constatives which computer technology made available to graphic designers. Textualization, in the case of new constatives, means that text was produced by the computer to facilitate the identification of visual characteristics.

Prior to computerization, information regarding letter sizes and fonts, as well as colour composition, was accessible by consulting specialized publications illustrating all the various fonts and color combinations. The graphic designers had to flip through these publications either to select or identify characteristics of letters and colours. Computerization simplified the identification of these variables and made a textual description instantly accessible to the graphic designers.

Having visual information translated into textual form helped the graphic designers perform their tasks because industry standards of colours, fonts, and sizes were quickly available from the computer. Prior to computerization, for example, if a particular colour was desired by a graphic designer, she or he had to look it up in the colour catalogues in order to find the corresponding name and number before sending work to the print shop. With computerization, locating the name and number of a certain colour was done by pointing to the colour on the screen with a mouse. The computer's capacity to convert and display visual information in industry terms made it easier to communicate with other workers in the graphic design industry.

10.3 The pertinence of using the constative concept.

The use of constatives helped us go beyond the performative aspect of technology. We discovered the potential computers had of shaping our view of reality by combining various kinds of information on the screen and on printouts. Concretely, we observed that the possibility of producing constatives from already existing or newly created data modified the view workers had of their tasks.

In this section we will debate the usefulness of using the constative concept in research on the computerization of tasks. We will first summarize the results of our analysis. Second, we will compare constatives to other concepts used to describe the visibility of data in past studies.

10.3.1 Summary of results.

In our study of the computerization of work, we borrowed the performative/constative categorization in order to identify the forms of input made available to workers in their dialogue with computers.

Both performatives and constatives required workers to recognize information presented to them through a dialogue with computer technology. The difference between performatives and constatives lies in the type of recognition required from the computer user. As we have previously explained, performative utterances solicited the users to perform an action while constative solicited the user to recognize the informational content of the utterance.

It is important to note here that other forms of constatives existed prior to computerization. Before the arrival of computers, information was exchanged through different media, such as paper documents. Our study did not want to prove the existence of constatives, but, rather, sought to identify the change in perception experienced by workers in a newly computerized work environment composed of new constatives. More specifically, we have tried to answer the following question: How can computerized constatives disseminate information potentially leading to the renegotiation of tasks among organizational members? The sources of input contributing to task mobility seemed to emerge from the various characteristics of constatives: content, organization, and form.

First, computerized constatives offered new sources of task input through their informational content. The computer's capacity to process and compile data in different ways generated a whole new set of visible data to its user. Furthermore, a variety of criteria framed existing and newly created data in ways not previously known to workers.

These new representations of reality made new relationships visible. In this context, the informational content of constatives offered unprecedented potential for workers to perform new tasks or renegotiate old ones. Furthermore, the computer's potential to make the initial and final state of the process evident to its user through computer constatives appeared to be another factor contributing to the mobility of tasks in the work settings we have observed.

Second, data organization and, more specifically, the integration of data within one constative proved to be another factor influencing task mobility. It became important to address the issue of data integration implementing new technology, because during computerization paper documents were reorganized in computer documents with varying degrees of integration. In cases of increased data integration, the capacity to connect data fields provided the workers with the necessary input to undertake new forms of action. In the case of data segmentation, the lack of connectivity made the relationships between various types of information more difficult to evaluate. As we have seen in our case studies, segmentation could prevent workers from performing tasks which they executed prior to computerization.

Third, the form of constatives seemed to have repercussions on the way tasks were performed following the implementation of the technology. Form refers to the way in which the data was made available to workers using the computer technology. For example, the graphic designers moved from a visual to a textualized environment with the advent of computerization. Textualization subsequently changed the input provided by the worker, and the input provided by the tool performing the task. In the case of labeling, the worker increased the input previously required to perform storing and retrieving tasks; whereas the textual description of visuals became a new input offered by the computer, aiding the graphic designer's work. Textualization can be conceptualized as a change in the

worker's informational environment which has repercussions on the worker's contribution in the accomplishment of certain tasks.

Like performatives, constatives contributed to alter the balance previously existing between the input provided by workers and by other sources, such as co-workers or tools.

If we described the function of performatives as utterances framing the accomplishment of tasks, we could describe constatives as utterances framing the informational environment of the work process. The informational content of constatives can become a source of input contributing to task mobility. To understand how shifts in tasks can occur in a computerized work environment, the input of the various sources available to a worker before and after computerization could be compared.

As we discussed in the section on performatives, we believe the computer technology's contribution to the work process essentially depends on the characteristics of the tasks performed by workers. The variety of tasks examined in this research permitted us to identify some of the changes which occurred when computers were implemented. The use of the performative/constative logic could also be extended to other work settings to see how performatives, constatives, and the link between both types of utterances could contribute to a task renegotiation based on knowledge shifts.

10.3.2 Constative and the concept of visibility discussed in previous studies.

It is difficult to compare constatives to one recurring concept identified in the literature on computerization of work. Performatives had the transformative logic to compare itself to, but, in the case of constative it was impossible to identify a definite

concept to measure it against. The only theme that seemed to be comparable to the constative logic was visibility. Visibility was defined in a variety of contexts in the literature. Visibility was mostly referred to as the capacity to render transactions or data observable through the computer medium. In our analysis on the significance of the constative logic, we will examine what was meant when authors discussed visibility, and contrast their findings with ours.

Clement (1988) believed managers were inclined to enforce Tayloristic work organizations and focused his study on the informational flow between computers and managers. He assumed computers increased the level of data available either to execute or monitor tasks performed by workers: "working in an automated office may feel like being in an electronic fishbowl because activities and performance are more exposed" (Clement, p. 232) He compared integrated computer systems and stand alone computers to illustrate the limits managers were faced with in terms of visibility within the computerized world. We believe that to identify the barriers managers face concerning the visibility of data, we have to go beyond computer configuration and look at the informational content emerging from computer documents such as constatives. Computer constatives do not necessarily give all the elements of the work process increasing visibility. All tasks do not produce the same constatives and as our study has demonstrated, computer software packages do not necessarily offer constative which the work process more visible. By neglecting to discuss the content of computer documents and focusing only on computer network configuration, we believe Clement (1988) overlooked important dimensions of visibility in the computerized environment.

Rule & Attewell (1991) did not explicitly use the concept of visibility but referred to the increased visibility of data relating to transactions associated with computerization. In their case studies, they observed that transactions left "electronics records that, when

properly compiled provide management with a broader view of the overall processes" (Rule & Attewell, 1991, 142). Their argument, like Clement's (1988), rested on a belief that computers favor a higher degree of visibility without concretely identifying constraints that could limit that visibility. They seemed to feel that increased visibility depended completely on management's will to control the data flow. Their argument rested on the assumption of an increased information flow between computers and managers without examining the documents created by computers. Furthermore, the authors did not consider the impact that computerized data flow could have had on workers using the technology.

Clement (1988) and Rule & Attewell (1991), like many other researchers conducting studies in newly computerized work settings, share the assumption that informational flow has increased since computerization, but have not really concretely documented that increase. They often neglected to take into consideration the types of tasks performed by workers, and the characteristics of the computerized tools implemented in the organization to support the hypothesis of increased data flow. Many of them focused their concern on identifying the managerial strategies implemented to control that increased information flow. In so doing, they also neglected to observe the informational exchange between workers and their computers which, we feel, contributes to the social renegotiation of tasks.

Finally, Zuboff (1988) also addressed the issue of visibility but from a different angle. She discussed the change in form provided by computerization. She used numerous examples to illustrate the change in texture brought into a variety of work situations by the implementation of computers. Furthermore, Zuboff (1988) recognized the existence of an informational exchange between workers and their computerized tools. She used the text metaphor to describe the information made available to the users of computer technology. Her definition of a text as formalized knowledge integrated in technology was

very close to Taylor's text concept (Taylor 1993; Taylor & Van Every 1993). Some of the findings we have discussed in the constative section have already been presented in her study. She identified the potential computer technology had to textualize data and display variables involved in data processing to the computer user. By doing so, she clarified some aspects of the informational exchange between workers and technology. We feel our study adds to her work by detailing a variety of constatives available to workers, and by focusing on the contribution of the information exchange in the execution of various tasks.

Our studies have demonstrated that many factors can influence the way in which reality is represented to workers through computer technology. The representation of the work process offered by computers can vary in content, degrees of integration and form. This sometimes produces computerized constatives less complete than the ones existing prior to computerization. Furthermore, the transformation of information displayed by the computer, into task input can vary in complexity making some tasks more or less mobile.

We believe it is important to look at the informational exchange between workers and managers, in order to understand the changes resulting from computerization. Understanding the way in which that worker/manager relationship has evolved, however, necessitates assessing the content, form and organization of the computerized text. This would permit us to see how it influences the social relationships within the organization.

Chapter 11: The dynamic relationship uniting constatives and performatives.

Although through our analysis we have alluded to links between performatives and constatives, our study has separated the two categories constituting our framework. That is, we have differentiated them by the type of recognition they solicited from computer users. As we have previously explained, performative utterances solicited the users to perform an action, while constative solicited the user to recognize the informational content of the utterance. In this chapter, we will explore the links uniting performatives and constatives, to clarify how their combined presence can contribute to task mobility. In section 11.1 we will use the data from our field study to explore the relationship uniting constatives and performatives. This first section will conclude with a reexamination of Austin's conceptualization of the performative/constative relationship. Section 11.2 will be devoted to the application of the performative/constative categorization to different organizational settings. Other case studies will be used to identify the pertinence of the framework we have developed.

11.1 The relationship between constatives and performatives.

The relationship between constatives and performatives to be examined in this section has already been suggested in past sections. We have mentioned that newly created data from traces of transactions contributed to create new constatives. The discussion on the relationship between constatives and performatives will be divided into three sections. In section 11.1.1 we will explore the content of constatives and traces of performatives found in constatives. In Section 11.1.2 we will look at the dynamic between the two categories, by asking ourselves if computerized performatives always produce constatives.

In the last section, we will compare our reflection on the dynamics between constatives and performatives to that of Austin (1962).

11.1.1 Constatives emerging from performatives.

In this section of our analysis devoted to constatives, we have noticed that many of the constatives presented on the screen to the computer user were linked with performatives.

The informational content of the constative often represented a vision of reality which had been constructed by the outcome of transactions accomplished by performatives. For example, lists of blanket orders were constatives produced by compiling the outcomes of performatives which were activated when partial orders were prepared. The same phenomenon was observed at the hospital with the production of lists, such as those indicating the quantities of products stocked in the warehouse, lists of inventory retrievals per service, per product or per period, and lists of purchase orders for non-inventoried products per service, per product and per period. These lists were produced by compiling various transactions which had been accomplished through the use of performatives.

Lists are good examples of constatives resulting from performatives, but constatives such as reception slips at the hospital and price requests at the council also represented the results of the activation of a performative. Reception slips were constatives produced to indicate what merchandise had been received, while price requests were constatives showing the transactions that had occurred between the agent and the bidders.

The traces of performatives rendered visible through constatives at the hospital and the council, have opened up new lines of actions, as we have already discussed prior in this section.

The observed link between constatives and performatives at the hospital and the council was also noted at the agency through the use of the three graphic design software packages. Constatives were constantly transformed on the screen when the computer user activated a performative[1]. The visibility of the transformation of data seems to have contributed to a new way of performing graphic design tasks. We will explore this issue in the next few paragraphs.

Prior to computerization, the graphic designers saw the changes they created with their pen and knives, but many transformations were performed in the print shop by specialized workers. The extent to which transformations were visible to the graphic designers was limited, because the work produced at the print shop was only shown to them once all the work was completed.

The graphic design software packages extended the number of transformations made available to the graphic designers. It also produced constatives showing the computer operator the result of these new performatives on the computer screen.

The constitution of constatives described in relationship to performatives had an impact on the ways tasks were attributed, especially at the agency. The potential to have a visual representation on the screen resulting from the activation of a performative changed the way graphic designers executed their tasks. For example, Samuel told me he relied

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[1] There are a few exceptions. Not all performatives led to a visible transformation of the constative.

solely on the visual representation of the layout on the screen to evaluate his work. When he saw the result of the transformation on the screen, he decided whether or not he would modify it again or keep it that way. For the graphic designers, the visual representation on the screen seemed to have become one of the key aspects guiding them through the production of their layouts. During the field study, the two other agency graphic designers told me that the outlook of the computer transformation helped them experiment with and learn the various commands integrated in software packages. For example, one day Phil was exploring the potential of Phototouch and tried out various computer commands. Each time he got an interesting result on the screen, he would invite his colleagues to see the result of his work. Basically, he learned the potential of the software through experimentation with the computer commands.

The combined impact of the computer textualization of the transformation process through the identification of relevant variables, and the capacity to see the impact of the performative on the screen, seemed to have greatly facilitated the integration of new computerized transformations for graphic designers. Furthermore, the ease of using the software packages gained through the performatives and constatives available to the computer user appeared to be one of the factors which made computerized graphic designer's tasks available to workers with computer experience, but with no graphic design skills. For example, Brian and Denis from the advertising agency performed graphic design tasks with the computer, without having ever had training in graphic work.

The examples we have used seem to illustrate that constatives emerge from performatives[2]. We believe the relationship between constative and performative is much

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[2] There is one exception. The logic we have developed to explain the composition of constatives did not apply to textual descriptions of computer files provided by graphic designers to identify them. But, it can be applied to the textual description of colors, fonts and sizes of visual images, since these textual descriptions were detailing the result of computer performatives.

more complex then the simple causal relationship we have suggested up until now. We could formulate the hypothesis that constatives are utterances which precede and succeed performatives. In the case of graphic design, prior to the activation of a performative, the computer user was faced with a constative which was transformed by the activation of a performative. In turn, constatives were both the utterance upon which an operation was performed, and the utterance resulting from that operation. This dynamic became clearly visible by examining the graphic designers using their computer. This relationship suggested by the use of graphic design software packages raised an important question: If constatives can be considered to be the result of the activation of performatives, can each performative be associated with a constative which displays the result of the computer transaction? We will explore this issue in the next section.

11.1.2 Performatives creating constatives.

In the last section, we have observed that constatives contributed to render the result of performative visible to the computer user.

While in the case of graphic work, the relationship between constatives and performatives was clearly visible on the computer screen, we need to question if all performatives really did create a computerized constative with the two other computer software packages observed in our study.

Some examples support the hypothesis that performatives created constatives displaying the result of the transformation in the case of purchasing and accounting software packages. One of them is the performative activated by the accounting clerk, which transformed the purchase/bill information in credit and debit entries in the general

ledger. The computer produced a printout indicating the transformation that had just taken place.

On the other hand, other examples were not so clear in illustrating the production of constative following the execution of a performative. For example, when merchandise was received at the hospital, the computer user performed a transaction which triggered a set of invisible operations. Data fields in various computer files were modified. The result of the performative was not automatically shown to the computer operator, as it was for the graphic design software. Naturally, the computer user could look up the various computer files to see the impact of the performed tasks, but the results from the computer operation were not made visible to the user all at once on a computer screen or printout after the execution of the performative.

As the chief of financial operations at the hospital remarked during observation, the detection of errors became tedious with the use of the accounting computer software package. The outcome of the performative was spread around in various computer files which were not made visible to the operator once the operations were completed. This is why she preferred to hire workers with accounting experience over computer specialists with no accounting experience, even if they were not that familiar with computers.

Since there were no immediate visible signs to indicate that the operations had been performed for many of the performatives in the accounting software package, workers[3] often doubted that the information had really been processed. Claire, the accounting clerk, mentioned during the observation that when she started using the computer system, she was afraid the operations had not been registered in the system, or worse. She feared that

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3 Even with accounting experience.

the operations she performed would erase all the computer files: "Pour moi, c'est du chinois, j'avais tellement peur de toucher à quelque chose qui effacerait tout".

Even if the constative did not always appear automatically after the execution of a performative in the purchasing and accounting software packages, constatives to verify the transformation could be identified by searching through the computer files. For example, once merchandise was received at the hospital, it was possible to obtain constatives of the reality transformed by the performative, by searching in the computer system for the product file.

As we have discussed earlier, there seems to be a link between the integration of new tasks which constitute the object of no increased expertise, and the immediate appearance of the constative following from the execution of a performative. It would be interesting to evaluate to what extent the immediacy and the content of the constative appearing after the execution of a performative eased the learning process of a new set of computerized tasks. Our observation seems to suggest that there is a relationship, but the extent of the present research does not permit us to validate this new hypothesis.

11.1.3 The constative/performative dynamics.

The dynamic relationship observed between constatives and performatives performed in organizational settings during the field studies differed from Austin's view of the two categories. He did not establish any link between the two categories. The observations from our case studies seem to suggest that constatives and performatives are intertwined. It is as if the constatives were in turn both the input and output of the performative.

The recognition of the constative/performative/constative dynamic seems to alleviate some of the problems encountered by Austin in identifying some utterances as either constative or performative. For example, in his book he gave the following examples (p.79):

I thank	I am grateful	I feel grateful
I apologize	I am sorry	I repent
I congratulate	I am glad about	

Austin believed the first column contained the performative; the second column was made up half descriptive and half performative; finally, the third column represented reports. At this point, Austin's definition of performative involved the action criteria. According to the recognition criteria, column two and three could be considered as constatives because they uttered a state of affairs. For the sake of our argument, if we assumed interlocutors sincerely expressed their intentions in their speech acts, in order to thank, one must recognize a state of gratitude[4]. Then, according to our logic, "I am grateful" is not a performative but can be the input of the performative "I thank". In the same way "I am glad about" is not a performative but is the constative input of the performative "I congratulate". The fact that the constatives "I am grateful" and "I am glad about" are the input of the performatives "I thank" and "I congratulate" might have caused Austin's hesitation to categorize the expressions from the second column as utterances which were simultaneously constatives and performatives.

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4 The intentionality of the speaker could be questioned. That is, the speaker might not be sincere or the speaker might not have a clear idea of the intentions motivating the speech act. Intentionality is the object of much debate in speech act theories which we do not wish to address. To simplify our argument we posit that the speaker is sincere.

With the examples provided by Austin, it is difficult to fully demonstrate the application of the constative/performative/constative dynamic, because the utterances are not situated in any form of temporal context. Still, the categories which seemed difficult to identify as constative or performative by Austin become easier to identify if the recognition criteria was used, and if the dynamic relationship between constative and performative was applied.

More work would need to be done to see if this link between constatives and performatives can be applied to a variety of settings.

In the next section, we will attempt to apply the framework we have developed in this dissertation to other organizational settings described in prior researches.

11.2 The relevance of the performative/constative categorization to computer studies.

In the previous chapters, we discussed the relevance of using the performative/constative categories through discussion of case studies, and by a comparison of the categories to other theoretical frameworks used in computerization studies. In this section, we pursue our reflection on the relevance of our framework, by attempting to use the categories we have identified to make sense of other case studies described in computerization literature. Naturally, it will be difficult to use as much detail to defend our argument with other case studies as we did with the case studies performed especially for this research. Data collected by other authors might not provide all the necessary data to fully sustain our argument. Still, we believe the use of other cases studies to discuss the potential use of the constative/performative argument will strengthen our position.

Three case studies will be used to illustrate the relevance of the constative/performative logic. The case studies we will use come from various sources. First, we will look at a study dealing with the computerization in the insurance industry which we conducted (Groleau 1991a) a few years ago. Second, we will use the research findings described by Alter (1985) in his book on the computerization of clerical work. Finally, we will apply the constative/performative logic to the case study of policeman described in Taylor & Van Every (1993). The work of Alter (1985) and Taylor & Van Every (1993) were chosen because the situations they described were difficult to explain with the concepts traditionally developed to explain the computer/task dynamics.

The study conducted in the insurance industry looked at the computerization of underwriting tasks. Underwriting tasks once performed by specialized workers had been delegated to clerks who performed them jointly with computers. Underwriting tasks consist of evaluating and rating the risk associated with the insurance policy requested by customers. In the 1980's, insurance computer systems integrated algorithms mimicking the underwriting process. From that moment on, clerks executing underwriting tasks worked with computerized performatives identifying the relevant variables, to which they had to feed the correct values in order to obtain the price associated with the requested policy. The values which were fed into the computers by clerks were taken from written documents coming from brokerage houses, on which all the details pertaining to the desired policy were gathered. The activation of computer commands to execute the underwriting task was followed by the appearance of a constative on the computer screen indicating the result of the underwriting operations.

The mobility of the underwriting tasks could be explained both by the computer technology's capacity to transform the data , and by the existence of computer utterances

such as performatives, which framed the execution of the task, and constatives, which rendered the result of the operations visible on the computer screen.

The computerization experience of 'underwriting clerks', as they were called in the insurance firms, was similar in some ways to the one we have observed with graphic designers. That is, both categories of workers were asked to perform with the help of the computer technology specialized tasks with which they had little experience prior to computerization. In both work settings, workers were faced with performatives which guided them in determining the relevant variables involved in the accomplishment of the task. Furthermore, both the underwriting clerks and graphic designers were offered computerized constatives showing the transformation which had taken place after computer commands were activated. The difference between the computerization of underwriting and graphic design tasks lay in the input provided by the worker to execute the task. In the case of underwriting clerks, the values corresponding to each variable appearing in the computer performative was taken from paper documents which were provided to them. In the case of graphic designers, the value corresponding to each variable had to be determined by the computer user.

In the case of graphic designers, the necessary input to accomplish the specialized task was more complex than in the case of underwriting clerks[5]. Still, in both cases, the utterances made available to the computer user reduced the necessary input provided by specialized workers in work settings before the implementation of technology.

The explanation provided to clarify the task mobility in insurance firms could be contested by authors using the transformative logic. It could be argued that the

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5 It is important to note here that underwriting clerks only evaluated uncomplicated policy requests. Complex policies were evaluated by professional underwriters.

performative is just a fancy concept to replace the transformative logic. We believe our categorization goes beyond describing technology as a tool possessing transformative powers which increase task mobility. First, the example from the insurance industry illustrated, again, the dynamic relationship between constative and performative. Second, the comparison between graphic design and underwriting tasks permitted us to notice a subtle difference in task mobility between the two sets of computerized tasks. That is, in the case of graphic designers, the determination of variable values rested totally on the expertise of the worker. In the case of underwriting task, the determination of variable value was provided on paper documents.

Our second case describes the computerization experience of clerical workers. Alter's study (1985) observed the implementation of various telecommunication/word processing technologies, and the repercussion it had on the social organization of work.

It became difficult to make sense of the changes in the division of labor he described using the traditional models resting on either the transformative characteristics of the technology or managerial philosophy. Computerization contributed to change the allocation of tasks, but computer technology described in the case had a very low level of transformative power. Furthermore, as observed by Alter, the managerial philosophy of the organizational leaders was difficult to implement because managers had problems controlling the computerized informational flow. Alter's explanation of the results rested solely on the complex social dynamic of the organization.

We believe the constative/performative framework can contribute to explain the particular context in which the social interaction described by the author took place. The implementation of telecommunication/word processing technologies seemed to have changed constatives made available to clerical workers. Documents previously stored in

filing cabinets, out of reach of clerical workers, became visible to them through the computer system. The consultation of computer files changed the clerk's point of view on the working environment, inciting them to undertake new forms of actions. In constative terms, our interpretation of events is not incompatible with Alter's argument, which rested on the social dynamic of the newly computerized organization. We think that discussing the visibility of the information flow emerging from the technology and made available to workers helps us better understand the particularities of the social dynamic described by Alter. Although Alter offered a detailed description of the technology implemented in the organization, he did not consider the technological characteristics which could have influenced the negotiation of task allocation.

In their book on computerization of organizations, Taylor & Van Every (1993) presented a case study which they believed challenged the traditional framework presented in computerization literature. They described the computerization process of a 911 police telephone answering service. The study described the implementation of a computer-assisted dispatching system. The implementation of technology created problems in the work process, which we will attempt to analyze using the constative/performative framework.

Prior to computerization, emergency calls were received by dispatchers who had worked in police patrol cars. Dispatchers had, on average, 21 years of service in the force. As described in the case, they relied on their previous experience in patrol cars to assess the emergency and dispatch the call to their colleagues on patrol.

With the advent of computerization, dispatchers with police experience were replaced by clerks with neither specific expertise nor prior experience in police work. The

computer system provided information to help the clerk act upon the emergency calls which were received. The information they had access to through the computer was:

> Emergency calls are displayed for dispatchers on a computer screen as a telephone number and the address of the caller...The dispatcher, with three screens, at his or her disposal, has available a list of other calls in progress for the district concerned along with the status of patrol cars in the area. The computer further supplies data on demand, such as previous police visits to the indicated address, a history of crimes associated with it (if any), the presence of ambulances and/or fire trucks at the site, and other calls in progress in the same district. This information allows the dispatcher to alert one or more units to respond to the call, taking account of the priority assigned by 9-1-1, the latter being based on factors such as danger to life and property and the likelihood of suspects still remaining on the scene. The computer itself suggests the appropriate action to take, although the final responsibility is the dispatcher's.
> (Taylor & Van Every, 1993, 40)

The clerks experienced many problems with the police patrollers to whom they dispatched calls. The patrollers thought the clerks were not 'police minded'. Many reasons, ranging from the entrance of new members in a tight organizational culture, to the technological characteristics of the computer system, could contribute to an explanation of the problematic situation experienced by workers. Actually, the authors provided a very rich explanation to clarify the case. We do not wish to single out the computer system as **the** source of the problem, but by using the constative/performative concepts, we would like to formulate a series of hypotheses to explain some of the complications described in the case.

As we have said earlier, the police patroller complained that the newly-hired clerks did not understand the police work. One of the examples, they gave to support their complaints was the dispatching clerk's use of an outdated computerized city map which rendered the patroller's drive to the emergency site more complicated and longer. According to the patrollers, this problem did not occur when they dealt with dispatchers with previous police experience because they knew the streets well enough not to rely on a

map. The input provided by old dispatchers based on their own experience was replaced by computerized information presented on the computer screen to the inexperienced clerks.

The clerk's lack of experience, and the limited level of information they got from the computer compared to the knowledge of previous workers, seemed to be at the core of the problem. In other terms, the input previously provided by the experienced dispatcher was not rendered visible to the computer users trying to perform the dispatch task jointly with the computer.

In the analysis of our own case studies, we discussed the dynamic relationship between constative and performative, indicating that the constative can be in turn both the input and output of performatives. In that case constatives were the input of performatives. During computerization, a set of constatives were drawn to guide the computer user in the performance of the dispatching tasks. If the constative did in fact help the clerks to assess the situation, they did not seem to be enough to replace the input previously provided by experienced workers. The hypothesis we have formulated would need to be tested with more information, but some of the comments from the case study seem to corroborate our point of view: The explanation we have come up with using the constative/performative logic, does not exclude the presence of other factors coming into play, but we hope it contributed to clarifying the issue.

Before we conclude, it would be interesting to note that the worker's input in the assessment of the situation probably grew as the clerks gained more experience, diminishing over time the impact of incomplete computer constatives.

In this section, we have attempted to extend the use of the constative/performative framework to other case studies, in order to strengthen our position. In the insurance

industry, we have suggested that constatives played their part in the mobility of tasks, and that more subtle degrees of mobility could be identified with our proposed performative concept we have proposed. The two other case studies illustrated the use of constatives to provide a better source of understanding of complex social interactions coinciding with the implementation of computer technology.

Chapter 12: Conclusion

The concluding remarks of this dissertation will be divided into three sections. Section 12.1 will summarize the research findings. Section 12.2 will discuss the limitations of our research. Finally, section 12.3 will present future research emerging from the framework developed in this dissertation.

12.1 Summary of the results

The goal of this dissertation was to explore the forms of input provided by computer technology to its user, in order to understand how technology could potentially contribute to the mobility of tasks in a variety of settings. We wanted to explore the content of the computerized text, to see what kind of conversations it rendered possible.

This research differs from previous studies focusing on the technological characteristics of computers to explain the mobility of tasks on a few points. First, our argument did not rest on technology as the sole determinant of the allocation of tasks following from the implementation of computers. We conceptualized technology as an instrument setting boundaries to the social interaction of organizational members, through the informational content it made available to them. Second, we refrained from isolating the technological variable to identify its constituents as algorithms or any other form of processes, as it had been done in prior studies. Instead, we focused on the informational exchange between technology and its user, to see how data stored in the technology was made available to its user, and how it potentially provided some form of input in the execution of studied tasks.

In our study, we attempted to address the shortcomings of computerization literature focusing on sociological factors to explain the allocation of tasks following from computerization. For example, the role of worker in the organizational social dynamic was often neglected. Furthermore, the studies focusing on sociological factors seemed to have overlooked the contribution of technology in the newly created social dynamic. Authors such as Strassman (1985) and Zuboff (1988) had expressed the need to take into consideration the pertinence of data stocked in computers to better understand the computerization phenomenon but not much work has been accomplished in that direction. Although our research did not offer an explanation pertaining to the social dynamic of the organization, we feel our study presented a framework rendering clearer the contribution of technology to organizational actors negotiating the allocation of tasks in various organizational settings. By doing so, we think we have alleviated some of the difficulties faced by researchers relying exclusively on either technology or social dynamic to explain the changes experienced by newly computerized organization.

We believe our work filled a gap in the literature. It offered a different point of view on the technology, and it made it possible a consideration of technology as a social force having an impact on the evolution of the organization. Furthermore, we think our work contributed to answer recent questions on the link that could be made between technological and sociological factors.

To answer our research question pertaining to the form of input provided by the technology in the accomplishment of various tasks, we have visited three newly computerized organization. From the data collected in these organizations, an explanatory framework was developed. The framework was inspired by Austin's categorization of utterances (1962). His constative/performative categorization was reworked and used to explain the computerized input made available to workers. Performatives were defined as

computer "utterances" requiring the user to recognize the performance of an action. Constatives were defined as computer "utterances" requiring the user to recognize a state of affairs. Both types of computer utterances provided different types of input from workers, potentially modifying task allocation.

By applying the performative concept to our field data, we discovered a series of concrete computer manifestations which had changed the input required by the worker in the accomplishment of tasks, and contributed to their mobility. The performative framed the action jointly performed by the computer and its user. The observations pertaining to performatives were:

- The activation of a performative may lead to data processing activities requiring varying degrees of input from the worker using the technology. In our case studies, the computer data processing operations replicated specialized data processing techniques previously performed by experts outside the studied organization. The same process was performed, but the input of the worker activating the performative was less than the one previously required by specialized workers using complicated machinery. Furthermore, the rapidity of computerized data processing initiated through performatives also facilitated the performance of routine tasks which used to be extremely demanding in terms of human and temporal resources.

- The content of a performative may render data processing variables visible to the computer user. The visibility of the variables involved in the processing of data rendered obsolete the need to learn them. On the other hand, the need to identify the value associated with each one of the variables may vary in complexity.

- The activation of a computer performative may lead to the execution of a cascade of multiple operations. These multiple operations, which we have called invisible operations, may either reproduce tasks performed prior to computerization or initiate new ones. If previous tasks are reproduced through invisible operations, the need to acquire the necessary knowledge to perform them became obsolete.

- The performative may render visible the sequence in which single operations must be executed. This may relieve the worker from acquiring knowledge about the sequence of operations to be followed. Our case studies revealed a whole series of findings on the computerization of sequences having the potential to impact the mobility of tasks. Apart from rendering visible the sequence of operations, the computer technology may hierarchize operations without rendering the sequence visible to its user. In that case, through computer use, the worker had to acquire knowledge about the sequence. Finally, computer technology may contribute to dismantling a sequence previously existing in the non-computerized environment.

In various ways, performatives may combine the characteristics we have just described to either increase or decrease the mobility of tasks.

Constatives also contributed to the mobility of tasks by rendering the informational environment visible in new ways through the technology.

The observations pertaining to constatives are:

- Constatives may replicate information previously stored in other media in varying degrees of integration. The transformation pertaining to the organization of data from one medium to the other may alter the perception workers have of their work environment. As we have seen in our case studies, this change in perception may contribute to increase or decrease the potential to accomplish existing or new tasks.

- By altering its form, constatives may replicate information previously stored in other media. We refer here to the necessity to textualize information processed by the computer. The textualization of data may be executed by the worker or by the computer. Depending on the case, it might increase or decrease the worker's level of input in the accomplishment of a task.

- Constatives may present newly created information rendering new tasks accessible to the computer user.

Again, in various ways, constatives may combine the characteristics we have just described.

We believe the interest in the constative/performative categories lies in their complementarity. That is, both categories cover a variety of situations. Beyond that, we found links between the two categories which again contributed to clarify the computer technology's potential role in the accomplishment of various tasks. Using our empirical data, we observed that the constative emerges from the performative. That is, constatives may be both the input and output of performatives. This potential to render visible the initial and final stages of a transformation seemed to have an impact on the mobility of tasks among organizational members. Beyond that, the potential to see both the constative and performative in a dynamic relationship permitted us to reflect further on Austin's framework (1962), which opposed the two categories.

The application of the constatives and performatives in the computerization context helped us grasp the forms of input available to workers accomplishing their tasks with the computer medium. In section 12.2 we will discuss the limitations of our studies, and in section 12.3 we will discuss the pertinence of our findings and future research.

12.2 Limits of the research.

The framework we have developed through this research provided some potential to answer questions pertaining to the computerization of tasks, but the restricted number of tasks observed in this research led to some limitations.

The application of the constative/performative framework to other case studies has consolidated our argument, but the forms in which constative and performative can render tasks more or less mobile would need to be further explored.

At the research design stage of this research, a limited number of tasks, with varying degrees of data processing skills, had been chosen in order to perform a thorough analysis of the tasks. The thoroughness of data helped us see emergent patterns in the informational exchange between workers and computers, but the variety of these exchanges was limited due to the number of tasks observed. The findings we have come up with, concerning the form of contribution made available through constatives and performatives, were documented by observations made in more than one case studies. There were exceptions which illustrated the singularities of certain tasks. For example, the particularities of graphic design tasks helped us understand the textualization of data which would have been difficult to fully comprehend with the accounting or purchasing software packages. A more extensive study would have helped us identify the specificity of various tasks and integrate them in the constative/performative framework.

Though the lack of details provided in case studies described by other researchers prevented us from examining the informational exchange between the worker and the computer in other work settings, it did permit us to extend the application of the constative/performative framework.

We believe the dynamic relationship between constative and performative would also need to be examined in a variety of situations, in order to clarify the link between the two categories. We alluded to the link uniting them, but more research would be needed to further explore the complexity of the dynamic and better assess its role in the mobility of tasks.

Other limitations pertaining to the integration of the researcher in the organizational settings, the thoroughness of data, and the internal and external validity, were addressed in the methodology chapter.

12.3 Future research.

Apart from the suggestion formulated in the previous section, to further develop the constative and performative categories, we believe the framework presented in this dissertation can be used as a stepping stone to acquire a better understanding of computerization in a variety of contexts.

From the start, the identification of technology's contribution to the accomplishment of tasks was viewed as a preliminary step in better grasping the social interaction following from computerization. We believe the framework provided in this research helped us appreciate the content of the computerized text which can contribute to the creation of a new organizational reality through various conversations following from it. From our framework, a study could be conducted to compare the conversations created from similar computerized texts implemented in two different organizations.

Our empirical work provides us with two cases studies describing the computerization of graphic design work (Groleau 1991b), which could be used to illustrate the difference created by the implementation of similar texts in different organizational settings. In the case of graphic design software packages: Performatives reduced the input of workers to execute tasks existing prior to computerization; performatives rendered specialized tasks more accessible; and finally, the visibility of constative before and after the activation of a performative contributed to increase the mobility of task. This potential

was used differently in the two studied organizations. At the agency the implementation of computer technology did not greatly alter the allocation of tasks, but at the other research site the same potential was exploited differently. Prior to computerization, graphic work in that organization was performed by three graphic designers, each possessing a specific expertise. One graphic artist designed the work. Another graphic designer performed typographical tasks while the third one did paste up jobs. After computerization, all three workers executed the same tasks, regardless of their previous area of expertise. With the help of the new technology, each integrated the design, typesetting and paste-up tasks. It is interesting to note here the difference between the two conversations ated from one similar computerized text implemented in both organization. We think it would be fruitful to explain the social dynamic in both organizations by comparing how the same computerized text was appropriated and negotiated differently by organizational members. We believe this type of study on the sociological dynamic following from implementation would be more complete than the one previously suggested by Appelbaum & Albin (1989) or Barley (1986). These studies examined the social interaction, and did not consider the way in which technology influenced that process.

Furthermore, the framework could also be used to support the hypothesis that all computer technology does not subject the organizational members to the same type of negotiation, since computerized texts vary. As we have suggested when we compared the input integrated in graphic design software packages and insurance computer system, the systematic categorization of performatives and constatives helped us explain how, in various work processes, the potential to negotiate the reallocation of tasks varies. It would be interesting, for example, to study and compare the computerized text made available to graphic designers, to the one offered to police dispatchers in the case study written by Taylor & Van Every (1993); to identify the possibilities both texts made available to the organizational actors. The recognition of differences in computerized text can help us

appreciate the evolution of the organization's division of labor following from computerization.

Up until now we have proposed applications of the framework which permitted us to retroactively make sense of events occurring in a newly computerized organization. Our research experience also suggests that the framework could be used to guide designers during the computerization phase. Although we are not that familiar with the computer design literature, we have noted that at the council, the constative logic had been overlooked in favor of the performative one. The categorization could be used to make designers sensitive to the importance of both constatives and performatives in the representation of a task within the computerized text.

The framework could even be used to assess training needs. In terms of performatives and constatives, the content of the computer text could be evaluated and contrasted with the knowledge already possessed by the future computer users.

We feel our research also raised other questions which would need further investigation. One of them was the representation workers had of themselves when they performed computerized tasks. Workers in our field study appropriated themselves the responsibility of performing computer operations by frequently using the pronoun "I" in sentences designating tasks jointly performed with the technology. We believe this fuzzy limit between the computer and the worker could affect how workers represent themselves and others in relationship to the tasks to be allocated. We believe that phenomenon was also observed by Turkle (1984) but would need to be examined more in depth.

We believe the application of the constative and performative categories to computer studies, could encourage researchers to recognize the potential of Austin's original

framework, which had been neglected up until now. The relationship observed between constative and performative could also shed some light on the dynamic relationship of speech acts within a text, whether it is computerized or not.

Finally, in concrete terms, we believe that the concepts that led to the proposed categorization permit managers and workers to assess more precisely the potential of the technology and consequently the new possibilities in the division of labor.

Moreover, this categorization allows us to reexamine the common belief that technology increases the availability of data. In our study, we have observed and analyzed different tasks which led us to think that data stored in the computer contributed in a variety of ways to increase the mobility of tasks or to decrease the mobility of tasks. Apart from recognizing the existing various possibilities in the ways tasks can be reallocated, we conceptualized a framework which permitted us to identify technology's contribution in the accomplishement of tasks.

The possibility to conceptualize the contribution of technology in terms of constatives and performatives helped us identify the various forms of human input necessary for the accomplishment of actions jointly performed with computers. These two categories require different forms of participation from the user in order to perform a task.

We believe, first, that recognizing the variety of input required from the worker in the accomplishment of newly computerized tasks and, second, understanding the technology's input as constatives and performatives categories, help to a better understanding of the potential mobility of tasks within newly computerized organizations.

Bibliography

Alter, N. La Bureautique dans l'Entreprise: les Acteurs de l'Innovation. Paris: Les Éditions Ouvrières, 1985.

Appelbaum, E. and Albin, P. "Computer Rationalization and the Transformation of Work: Lessons from the Insurance Industry." The Transformation of Work: Skill Flexibility and the Labour Process. Ed. Stephen Wood. London: Unwin Hyan, 1989. 247-265.

Attewell, P. "The Deskilling Controversy." Work and Occupations 14 (1987): 323-346.

Austin, John. How to do things with words. Cambridge, MA: Harvard University Press, 1962.

Bannon, L.J. Emerging Perspectives on Systems Development and Cooperative Work. Département Sciences Humaines et Sociales CNRS. Social Science Research Technical Systems and Cooperative Work Workshop, Paris. 1993.

Baran, B. "The Technological Transformation of White-Collar Work: A Case Study of the Insurance Industry." Computer Chips and Paper Clips. Vol. 2 Ed. Heidi Hartman. Washington DC: National Academy Press, 1987, 25-62.

Barley, S.R. "Technology as an Occasion for Structuring: Evidence from Observation of CT Scanners and the Social Order of Radiology Departments." Administrative Science Quarterly. 31 (March, 1986): 78-108.

Beirne, M. and Ramsay H. "Computer Redesign and 'Labor Process' Theory: Towards a Critical Appraisal." New Technology and the Labour Process. Ed. D. Knights D and H. Willmott. London: The MacMillan Press Ltd , 1988, 197- 229.

Blauner, R. Alienation and Freedom. Chicago: University of Chicago Press, 1964.

Blomberg, J. "The variable impact of Computer TEchnologies on the Organization of Work Activities." Computer-Supported Cooperative Work: A book of readings. Ed. I. Grieff. San Mateo, CA: Morgan Kaufman Publishers, 1988. 771-781.

Braverman, H. Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century. New York: Monthly Review, 1974.

Bryman, A. Quantity and Quality in Social Research. Greenwich, Conn: JAI Press, 1988.

Burgess, R.G. In The Field. London, England: George Allen & Unwin, 1984.

Carlisle, K.E. Analyzing Jobs and Tasks. Englewood Cliffs, N.J.: Education Technology Publications, 1986.

Carter, N.M. "Computerization as a Predominate Technology: Its Influence on the Structure of Newspaper Organizatio." Academy of Management Journal, 27 (1984): 247-270.

Cavestro, W. "Beyond the Deskilling Controversy." Computer- Integrated Manufacturing Systems. 3 (1990): 38-46.

Clement, A. "Office Automation and the Technical Control of Information Workers" The Political Economy of Information. Ed. V. Mosko and J. Wasco. Madison, WI: University of Wisconsin Press, 1988. 217-246.

Clement, Andrew, and C.C. Gotlieb "Evolution of an Organizational Interface: The New Business Department at a Large Insurance Firm". ACM Transactions on Office Information Systems. 5 (1987): 328-339.

Cooren, François. Towards a Reclassification of Speech Acts: the Problem of Recognition. Paper presented at the International Communication Association, Australia, 1994.

Coyle, K. Reading conversation, re-presenting Austin. Paper presented to the annual conference of the Speech Communication Association, Miami. 1993.

Crozier, M. & Friedberg, E. L'Acteur et le Système. Paris: Seuil, 1977.

Davis, L.E. and Cherns A. The Quality of Working Life: Problems, Prospects and the State of the Art. New York: The Free Press, 1975.

De Blasis, J.P. Les Enjeux-clés de la Bureautique. Paris: Éditions d'Organisation, 1985.

DeTerssac, Gilbert. Autonomie dans le Travail. Paris: Presses Universitaires de France, 1992.

Dunlop C. and Kling, R., eds. Computerization and Controversy: Value Conflicts and Social Choices. San Diego, CA: Academic Press, 1993.

Groleau, C. Le Rôle de la Technologie Informatique sur la Structure du Travail dans l'Industrie de l'Assurance. Montréal: Université Concordia, 1991a.

Groleau, C. Le Rôle de la Technologie Informatique dans la Répartition du Travail: Une Étude Ethnographique. Université de Montréal: Actes du Troisième Colloque en Communication Organisationelle, 1991b, 77-92.

Guimond, S. et G. Bégin. Le Choc de l'Informatique. Ste-Foy: Presses de l'Université du Québec, 1987

Hirschheim, R. A. Office Automation: A Social Organizational Perspective. Chichester,Great Britain: John Wiley & Sons Ltd, 1985.

Hughes J.A. et al. "Faltering from Ethnography to Design." CSCW 92 Proceedings. (1992), 115-122.

Hull, F. et al. "The Effect of Technology on Alienation from Work." Work and Occupations. 9 (1982): 31-57.

International Paper Company. Pocket Pal: A Graphic Arts Production Handbook. Twelfth edition. New York: NY, 1979.

Kelley, M R. "Alternative forms of work organization under programmable automation." The Transformation of Work: Skill Flexibility and the Labour Process. Ed. Stephen Wood. London, UK: Unwin Hyman, 1989. 235-246.

King, J.L. & George, J.F. "Examining Computing and Centralization debate." Communications of the ACM. 34 (1991): 64-72.

Kling, R. "Computerization and Social Transformations". Science, Technology and Human Values. 16 (1991)

Kling, R. "Social Analysis of Computing: Theoretical Perspectives in Recent Empirical Research". Computing Surveys. 12 (1980): 61-110.

Kuuti, L. Work Activity as the Bridge between Social and Technical. Département Sciences Humaines et Sociales CNRS.(Paris). Social Science Research Technical Systems and Cooperative Work Workshop, 1993.

Lefebvre, L.A. et al. L'introduction et l'utilisation de l'informatique dans les Petites entreprises: Etude des perceptios et des attentes de leur dirigeants. Laval: Centre Canadien de Recherche en Informatisation du Travail (CCRIT), 1987.

Long, R. New Office Information Technology: Human and Managerial Implications. New York: Croom Helm, 1987.

McClelland, D. and C. Danuloff. Mastering Aldus Freehand. New York, N.Y. Richard D. Irwin Inc., 1991.

Mintzberg, H. The Structuring of Organizations. Englewood Cliffs, N.J.: Prentice-Hall, 1979.

Nora, S. et Minc, A. L'Informatisation de la Société. Paris: La Documentation Française, 1978.

Orlikowski, W.J. "Integrated Information Environment or Matrix of Control? The Contradictory Implications of Information Technology." Accounting Management and Information Technologies. 1 (1991): 9-42.

Perrow, C. Complex Organizations: A Critical Essay. New York: Random House, 1986.

Putnam, L."The Interpretive Perspective: An Alternative to Functionalism." Communication and Organizations: An Interpretive Approach. Ed. L. Putnam and M.E. Pacanowsky. Beverly Hills: Sage, 1983.

QuarkXPress reference manual. Quark Inc., 1993.

Rogers, Y. Juxtaposing the Social, the Technical and the Cognitive: The Need for Multiple Perspective of Computer Mediated Activities. Département Sciences Humaines et Sociales CNRS.(Paris).Social Science Research Technical Systems and Cooperative Work Workshop, 1993.

Rule, J. & Attewell, P. "What Do Computers Do?" . (Eds) Computerization and Controversy: Value Conflicts and Social Choices. Ed. C. Dunlop and R. Kling. New York: Academic Press Inc., 1991. 131-149.

Shaiken, H. Work Transformed. New York: Holt, Rinehart and Winston, 1984.

Sheppard, J. Automation and Alienation: A Study of Office and Factory Workers. Boston: Colonial Press, 1971.

Smith, S. "How Much Change at the Store? The Impact of New Technologies and Labour Processes on Managers and Staffs in Retail Distribution." New Technology and the Labour Process. Ed. D. Knights and H. Willmott. London: The MacMillan Press Ltd., 1988. 143-161.

St-Pierre, C. "Enjeux et Défis du Virage Technologique en Milieux de Travail.", Informatisation et Bureautique 3 (1985): 9-23.

Strassman, P.A. Information Payoff: The Transformation of Work in the Electronic Age. New York: The Free Press, 1985.

Suchman, L. Plans and situated actions: the problem of human- machine communication. Cambridgeshire, N.Y.: Cambridge University Press, 1987.

Taylor, F.W. The Principles of Scientific Management. New York: Harper, 1911.

Taylor, James. The Vulnerable Fortress: An Essay on Bureaucracy in the Information Age. Montréal: Université de Montréal, 1991.

Taylor, James and François Cooren. Reinstating the Performative/Constative distinction: An application to the Discourse Analysis of Organization. Paper presented to the Speech Communication Association, USA, 1994.

Taylor, J.R. Rethinking the theory of organizational communication: How to read an organization. Norwood, NJ: Ablex, 1993.

Taylor, J.R. and Giroux, N. "The Rhetoric of Management: Conversation and Text." EGOS Conference. Paris, July 1993.

Taylor, J.R. and Van Every, E.J. The vulnerable fortress: Bureaucratic organization and management in the information age. Toronto, Ont.: University of Toronto Press, 1993.

Turkle, Sherry. The second self : computers and the human spirit. New York : Simon and Schuster, 1984.

Weinmann, E. and P. Lourekas. Photoshop for Windows. Berkeley, CA: Peachpit Press Inc., 1994.

Wilson, F. "Computer Numerical Control and Constraint in Computer-Based Manufacturing." New Technology and the Labour Process. Ed. D. Knights and H. Willmott. London: The MacMillan Press Ltd., 1988. 66-89.

Wood, S "The Transformation of Work" The Transformation of Work: Skill Flexibility and the Labour Process. Ed. Stephen Woods. London, UK: Unwin Hyan, 1989. 1-43.

Zuboff, S. In the Age of the Smart Machine. New York : Basic Books Inc, 1988.

APPENDIX I: DESCRIPTION OF THE COMPUTER SOFTWARE PACKAGES USED BY THE WORKERS OBSERVED IN THE THREE RESEARCH SITES.

EDITALL SOFTWARE PACKAGE.

The Editall software package will be described through the content of its tool box and menus (QuarkXPress reference manual, 1993).

The tool box: Th. ol box contains 13 tools executing 6 editing tasks.

1. The item tool : it is used to move, group, ungroup, cut, copy and paste items.

2. The content tool: it is used to import, edit, cut copy, paste, and modify box contents.

3. The rotation tool: it is used to rotate items manually.

4. The zoom tool: it is used to reduce or enlarge the view of the document.

5. The text box tool: it is used to create text boxes.

6. The rectangle picture boxtool: it is used to create rectangular picture boxes.

7. The rounded-corner rectangle picture box tool: it is used to create rectangular picture boxes with rounded corners.

8. The oval picture box tool: it is used to create oval picture boxes.

9. The polygon picture box tool: it is used to create polygon picture boxes.

10. The orthogonal line tool curve tool: it is used to create vertical and horizontal lines.

11. The line tool: it is used to create lines of any angle.

12. The linking tool: it is used to create text chains to flow text form text box to text box.

13. The unlinking box: it is used to break links between text boxes.

Each tool is represented by an icon in a toolbox which appears on the screen.

The menus

Editall offers 6 menus, each offering a set of related functions.

1. File menu:

The File menu includes commands that relate to entire documents, templates, and libraries - in other words, files. File is the standard industry term for an electronic document (QuarkXPress reference manual, 1993. p. f1). The commands are:

new
open

close
save
save as
revert to saved

get text
save text
save page as EPS
collect for output

document setup
page setup
print

quit

2. Edit menu:

The edit menu includes commands for editing text, pictures and items, for changing Editall default specification, and for controlling text formatting features (QuarkXPress reference manual, 1993, p.E1). The commands are:

can't undo

cut
copy
paste
clear
select all

subscribe to
subscriber options

show clipboard

find/change
preferences
style sheets
colors
H&J's

3. Style menu:

The entires in the style menu vary according to the item that is active: a text box, a picture box, or a line. The Style menu for text includes the command for specifying character attributes and paragraph formats (QuarkXPress reference manual, 1993, p.S1)

The commands of the style menu for texts are:

fonts
size
type style

alignment
leading
formats

shade
horizontal/vertical scale
kern
baseline shift
character
flip vertical

rules
tabs
style sheet

flip horizontal

The commands of the style menu for pictures are:

color
shade
negative

normal contrast
high contrast
posterized
other contrast

normal screen
60-line line screen/0°
30-line line screen/45°
20-line dot screen/45°
other screens

flip horizontal
flip vertical

The commands of the style menu for lines are:

line style
endcaps
width
color
shade

4. Item menu:

The Item menu includes commands for working with text boxes, picture boxes, lines and groups - in other words, items (QuarkXPress reference manual, 1993, p. 11) The commands are:

modify
frame
runaround

duplicate
step and repeat
delete

group
ungroup
constrain
lock

send to back
bring to front
space/align

box shape
reshape polygon

5. Page menu:

The page menu includes commands for arranging pages in a document and for navigating through a document (QuarkXPress reference manual, 1993, p. P1). The commands are:

insert	previous
delete	next
move	first
last	
master guides	go to
section	display

6. View Menu:

The view menu includes commands for controlling what you see on-screen and how items and pages are displayed (QuarkXPress reference manual, 1993, p.V1) The commands are:

fit in window	hide tools
50%	hide measurements
75%	show document layout
actual size	show colors
200%	show trap information
thumbnails	
windows	
hide guides	
show baseline grid	
snap to guides	
hide rulers	
show invisibles	

FREEDRAW SOFTWARE PACKAGE.

The Freedraw software package will be described through the content of its tool box, menus and palettes (McClelland & Danuloff, 1991).

The tool box:

The tool box contains 19 tools performing 6 picture editing tasks.

1. The arrow tool : it is used to move, select and duplicate existing objects in an illustration.

2. The type tool: it is used to create new type as well as to work with the existing fonts.

3. The rectangle tool: it is used to create a rectangle.

4. The rounded-rectangle tool: it is used to create a rounded rectangle.

5. The oval tool: it is used to create an oval.

6. The line tool: it is used to create a straight line.

7. The freehand tool: it is used to create free form paths.

8. The pen tool: it is used to draw a series of individual points.

9. The knife tool: it is used to cut segments of exiting paths.

10. The curve tool: the curve tool is a specialized point-creation tool. It is used to draw of path made up of individual points.

11. The corner tool: the corner tool is a specialized point-creation tool. It is used to create corner points only.

12. The connector tool: the connector tool is a specialized point-creation tool. It is used to create connected points only.

13. The rotate tool: it is used to rotate one or many elements of the visual around a point called the rotation origin.

14. The reflect tool: it is used to flip one or many elements of the visual across a reflexion axis.

15. The scale tool: it is used to reduce or enlarge one or many elements of the visual.

16. The skew tool: it is used to slant one or many elements of the visual.

17. The trace tool: it is used to convert bitmaps into smooth object oriented graphics.

18. The zoom tool: it is used to contract or expand the view size of the illustration.

19. The hand tool: it is used to scroll the illustration.

Each tool is represented by an icon in a toolbox which appears on the screen.

The menus

Freehand offers 6 menus each offering a set of related functions.

1. File menu:

The Aldus Freedraw File menu controls broad document-level activities, including the opening, closing, printing, and saving of illustrations. Additionally, the File menu controls the importation of graphic images and the exportation of encapsulated PostScript files. (McClelland & Danuloff, 1991, p 30)

The commands are:

new
open

save
save as
revert
quit
document setup
preferences

page setup
print

place
export

2. Edit menu:

The menu contains most of Freedraw's duplication commands. Two edit commands - cut contents and paste inside - are unique to FreeHand, although they conform to the Edit menu tradition of working with the Clipboard. (McClelland & Danuloff, 1991, p.33)

The commands are:

undo all
redo
clone
cut
copy
paste
clear

cut contents
paste inside

select all
duplicate

move
transform again

3. View menu:

The commands in the View menu determine how your illustration appears on screen. The first command affects the display of the information bar, the toolbox and other palettes. The next two commands are used to alter the view size and the display mode. Other commands control the display and effect of rules, grids and guides. (McClelland & Danuloff, 1991, p.35)

The commands are:

windows
snap to guides
magnification

rulers
grid
guides
lock guides

snap to point

snap to grid

4. Element menu:

Commands in the Element menu affect relationships between selected objects (McClelland & Danuloff, 1991, p.36).

The commands are:

bring to front
bring forward
send backward
send to back
join element
element info
points

lock
unlock
group
ungroup

alignment
blend
constrain

split element

5. Type menu:

The type menu commands used to edit and alter type in FreeHand, particularly when the Text dialog box is displayed. The Convert to paths (command) converts a block of text into editable paths (McClelland & Danuloff, 1991, p. 39).

The commands are:

font	spacing
size	horizontal scaling
leading	baseline shift
type style	
effect	convert to paths
type specifications	alignment

6. Attributes Menu:

Commands in the Attributes menu are used to specify the strokes and fills of objects in your illustration. These commands also allow you to define and name new fills, strokes, and colors, and to edit existing ones (McClelland & Danuloff, 1991, p. 42).

The commands are:

fill and line	hairline
halftone screens.	5 pt
set note	1 pt
	1.5 pt
remove fill	2 pt
remove line	4 pt
	6 pt
colors	8 pt
styles	12 pt

The palettes.

Freedraw offers three palettes: the colors, layers and styles palettes. The palettes are accessible through the View menu by choosing the window command.

The palettes offer the following potential:

1. The colors palette:

> ... the colors palette allows you to define and access the colors used in the current illustration. Directly below the palette title bar is a pop-up menu that offers three options - "Fill," "Line," and "Both" - each of which is used respectively to view or alter the fill, the stroke, or both the fill and the stroke of a selection (McClelland & Danuloff, 1991, p.44).

2. The layers palette:

> ... the layers palette allows you to define and access a series of invisible planes, called layers, on which objects may be organized in the current illustration. By default, Freedraw offers three layer names in the scrolling list: "Foreground," which contains the printing objects that make up your final illustration, "Guides," which contains the non-printing ruler guides used to align type and graphic objects, and "Background," which contains non-printing tracing templates and other images used in the creation of an illustration, but which will not appear in the finished artwork (McClelland & Danuloff, 1991, p.46)

3. The styles palette:

> ... the style palette allows you to define and access attribute styles used in the current illustration. Attribute styles affect the fill and the stroke of an object, as well as its halftone screen. By default, Freedraw offers one attribute style, "Normal" which may be modified (McClelland & Danuloff, 1991, p.47)

PHOTOTOUCH SOFTWARE PACKAGE.

The phototouch software package will be described through the content of its tool box, menus and palettes (Weinmann & Lourekas 1994).

The tool box:

The tool box contains 20 tools performing 6 picture editing tasks.

1. Selecting:

    rectangular marquee
    lasso
    elliptical marquee
    magic wand

2. Editing:

    cropping
    eraser
    blur/sharpen
    smudge
    dodge/burn

3. Filling:

    paint bucket
    gradient

4. Painting:

    line
    airbrush
    rubber stamp
    pencil
    paintbrush

5. Typing:

    type

6. Zooming:

    zoom

Each tool is represented by an icon in a toolbox which appears on the screen.

The menus

Phototouch offers 8 menus each offering a set of related functions.

1. File menu:

The file menu commands are used to create, open, place, close, save, scan, export or print a picture as well as set defaults and exit Phototouch (Weinmann & Lourekas, 1994, p.9)

The commands are:

new
open
open as
place
print
close
save
save as
revert

acquire
export

page setup

preferences

exit

2. Edit menu:

Edit menu commands include Undo, which undoes the last modification made, the Clipboard commands Cut and Copy, and the Paste options. The Fill and stoke commands, and Composite Controls, which affect how an image is pasted, are also executed via the Edit menu (Weinmann & Lourekas,1994, p. 9)

The commands are:

undo all
take snapshot
cut
copy
paste
paste into
paste behind
clear
fill
stroke
crop

define pattern

composite controls

3. Mode menu:

A picture can be converted to any of eight black and white or color modes using the Mode menu (Weinmann & Lourekas,1994, p.10)

The commands are:

bitmap
grayscale
duotone
indexed color
RGB color
CMYK color
lab color
multichannel

color table

4. Image menu:

Commands under the command menu are used to modify a picture's brightness, contrast, orientation, size dimensions and resolution. The Canvas Size dialog box is used to add a border to a picture (Weinmann & Lourekas,1994, p.10).

The commands are:

map	image size
adjust	canvas size
calculate	histogram

fliptrap
rotate
effects

5. Filter menu:

Filters are organized in submenu groups. Some filters are applied in one step by choosing the filter name. Other filters are applied via a dialog box (Weinmann & Lourekas,1994, p.11).

The commands are:

radial Blur

andromeda
blur
distort
noise
sharpen
stylize
video
other

6. Select Menu:

The "All" Select menu command selects an entire picture. The None command deselects all selections. Other Select menu commands enlarge, load and save selections and modify selection edges (Weinmann & Lourekas,1994, p.11)

The commands are:

all	border
none	feather
inverse	defringe
float	hide edges
grow	load selection
similar	save selection

7. Window menu:

Window menu commands control new window creation, display sizes and the display of rules, palettes, and the Status Bar. Open pictures are listed and can be activated using the Window menu (Weinmann & Lourekas,1994, p.12)

The commands are:

new window
cascade
tile
arrange icons
show info
close all
show status bar
zoom in
zoom out
show rulers
show brushes
show channels
show colors
show paths

8. Help menu:

The Help menu commands provide access to on-screen support. Choose Using Help to learn about the Help commands. Plug-ins information is also accessed from this menu (Weinmann & Lourekas,1994, p.11).

The commands are:

index
keyboard
commands
procedures
tools & palettes
screen elements
glossary
using help
about Adobe Phototouch
about plug-in

The palettes.

Phototouch offers five palettes: the colors, the brushes, the channels, the info and the path palettes. The palettes are accessible through the View menu by choosing the window command.

The palettes offer the following potential:

1. The colors palette:

The colors palette is used for mixing and selecting colors to be applied with the painting, editing, and fill tools. Color models, chosen form the Control menu, affect which colors are available. Colors can also be appended, loaded and saved using the color palette (Weinmann & Lourekas,1994, p.15).

The commands appearing on the colors palette are:

grayscale	load colors
RGB color	append colors
HSB color	save colors
CMYK color	
lab color	close

2. The brushes palette:

The brushes palette is used for defining painting and editing tool attributes tip size, edge, opacity, pressure, and mode. Each tool retains its own settings. You can choose commands to further customize, add, delete, save and load brushes form the control menu (Weinmann & Lourekas,1994, p.16). The commands appearing on the brushes palette are:

new brush
delete brush
brush options
define brush

load brushes
append brushes
save brushes

close

3. The channels palette:

The channels palette is used to display one or more of the channels that make up a picture and any specially created alpha channels, which are used for saving selections. A channel is a color "overlay" which contains the pixel information for that color. A grayscale picture has one channel, an RGB picture has three channels and a CMYK has four channels (Weinmann & Lourekas,1994, p. 227-8)

The commands appearing on the channels palette are:

new channel	split channels
delete channel	merge channels
channel options	close

4. The info palette:

The info palette displays a color breakdown of the pixel under the pointer. The info palette also shows the position of the pointer on the picture and may show dimensions and angle of rotation, depending on which tool is selected. To make these options available choose, options from the palette control menu, and check the show mouse coordinates box. You can choose a unit of measure from the same dialog box (Weinmann & Lourekas,1994, p.17).

The commands appearing on the info palette box are:

options
close

5. The path palette:

The pen tool creates curved and straight line segments connected by anchor points. Together they form a path. The pen tool and its variations for modifying a path are selected form the paths palette. A path can be saved and used as a selection, and can be stroked or filled (Weinmann & Lourekas,1994, p.18).

The commands appearing on the path palette box are:

save path	clipping path
delete path	reverse subpath
make path	close
make selection	
fill path	
stroke path	

BUY SOFTWARE PACKAGE.

The BUY software package will be described through the enumeration of its commands. The commands are organized under six master commands which are:

1. Entering the purchase requests
2. Updating the price requests
3. Managing purchase orders
4. Reporting on the purchase process
5. Managing the purchasing process
6. Treating special data

1. Entering the purchase requests.

The commands under this master command are used to register purchase requests and partial order requests. The operator can also use the commands under this master command to enquire about past requests. The commands are:

registering a purchase request
registering a request for partial order
interrogating purchase order requests using numbers
interrogating partial order requests
transforming a purchase request in a partial order
listing the uncompleted partial orders

2. Updating price requests

The commands and sub-commands under this master command are either related to the production and management of a price request or to the preparation of partial orders. The commands are:

updating and printing partial orders
    updating the status and prices of a partial order
    interrogating a request for partial order
selecting the products and suppliers for the price request updating the prices on a price request
interrogating a price request
printing a price request
printing an individual price request
changing the suppliers selected for a price request

3. Managing purchasing orders.

The commands and sub-commands under this master command are either related to the production and management of purchase orders or to the preparation of discrepancy notes.

The commands are:

modifying an already created purchase order
printing a purchase order
confirming a purchase order
interrogating a purchase order
confirming or interrogating a purchase order
managing the particularities of a blanket order
listing the blanket orders
closing a purchase
discrepancy notes
    updating a discrepancy
    printing a discrepancy
    listing a discrepancy

4. Reporting on the purchase process.

The commands and sub-commands under this master command help the operators prepare lists regarding purchase requests and purchase orders.

The commands are:

reporting on the purchase request
- listing the non completed purchase requests
- listing the purchase requests per agent
- listing the purchase requests by services

printing a form for bid openings
reporting on the purchase order
- listing purchase orders per supplier
- listing purchase orders per agent
- listing purchase orders per number
- listing purchase orders per activity center

listing partial orders per blanket orders.

5. Managing the purchasing process

The commands and sub-commands under this master command help the operators to manage the supplier's file as well as the system tables.

The commands are:

updating supplier information
- updating the characteristics of suppliers
- updating the industry codes given to suppliers
- interrogating suppliers
- printing the supplier's list in alphabetical order
- printing the supplier's list per activity sector

updating the system tables
- interrogating the list of purchasing agents
- updating the purchase methods
- interrogating the list of services
- updating the list of industry sectors
- grouping the industry sectors
- updating the format

6. Treating special data

The commands and sub-commands under this master command help the operators to prepare end of period lists and reports.

The commands are:

listing the purchase order for the period
- listing the purchasing orders per supplier
- listing the purchasing orders per agent
- listing the purchasing orders per number
- listing the purchasing orders per date

preparing the end of period reports
- listing the blanket orders to be renewed
- listing the non finished purchase orders
- listing non treated purchase requests
- purging purchase orders closed for more than 3 years
- cancelling a purchase order.

HOSPITAL FINANCIAL SOFTWARE PACKAGE.

The three following satellites will be described:

1. inventory
2. purchasing
3. accounts payable

Inventory satellite

1. basic operations
    - 1.1 file maintenance
        1. parameters
        2. catalogues
        3. pharmaceutical good trolley
        4. product/supplier
        5. inventory consultation
    - 1.2 lists
    - 1.3 physical count of inventory
        1. product list
        2. transaction entrance
        3. production of final report
    - 1.4 registration of merchandise reception
    - 1.5 registration of merchandise coming out of inventory
    - 1.6 historic consultation

per product
current year
1. interrogating
2. printing

past year
1. interrogating
2. printing

per department
current year
1. interrogating
2. printing

past year
1. interrogating
2. printing

2. interface with pharmacy (not operational)

3. daily operations.

All the operations from inventory menus are listed. Besides each command a set of keys which activating the command is given.

4. furniture (not operational)

Purchasing

1. basic operations
    1.1 management of the purchasing process
        1. file maintenance
        2. interrogation
        3. product/supplier file maintenance
        4. text integration
        5. purchase contract maintenance
        6. update of the contract
    1.2 lists
        1. list of suppliers
        2. supplier's catalogue
        3. product/supplier catalogue
        4. list of texts
        5. detailed list of commitments
        6. control ledger by product
        7. list of contracts per product
        8. list of maintenance and service contracts
        9. list of purchases per procedure
    1.3 negotiation of purchases
        1. purchase projection
        2. status and projections
        3. product presentation
        4. product to negotiate
        5. product to order

    1.4 preparation and status of purchase order.
        Preparation of purchase orders:
        1. registration of a purchase order
        2. print of individual purchase order
        3. print of the purchase order journal
        4. report of unprocessed purchase orders
        5. print of purchase order by batch
            - by number
            - by supplier

        Status or purchase orders:
        6. interrogation of purchase order
        7. print of the requested information
        8. delivery projections
        9. selection of the recall
            1. non received or partially received orders
            2. returned products
            3. non received products
            4. products added to a purchase order

    1.5 order reception
        1. registration
            1. order reception
            2. product return
            3. correction
            4. interrogation
            5 cancellation

2. order reception report
3. exception's report
4. order reception report with general ledger interface
5. outcome per service

1.6 billing (not operational)
1. bill entrance
2. correction of transactions non transferred to account payable

1.7 analysis report
1. price analysis report for a given product
2. supplier reliability

1.8 purge

1.9 special procedure

2. purchase negotiation

automatic negotiation
1. product to negotiate report
2. list of product to order
3. product to order report
4. automatic production of purchase order

Accounts payable

1. file maintenance
2. list of files
3. transactions
    - manually prepared purchase orders:
        1. transaction entrance
        2. transaction report
        3. general ledger interface
        4. elimination of transactions
    - computer prepared purchase orders:
        1. transaction entrance
        2. billing report
        3. billing report with general ledger interface
        4. list of commitments with general ledger interface
4. payment
    1. list of eligible checks
    2. selecting of transactions
    3. deselecting transactions
    4. preliminary list of checks to be printed
    5. printing checks
    6. registering checks
    7. registration of data in the general ledger
    8. transfer to the historic of paid transactions
5. check cancellation
6. historic profile of accounts payable and issuance of checks
7. statement of bank transactions
8. year end treatment
9. special procedures