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The Impact of Information Technologies on Managers' Work: From the Productivity Paradox to the Icarus Paradox ?

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Most Fortune 1000 firms claim to have downsized since 1980 (Willis, 1987); over half of large corporations have been involved in major business process reengineering projects since 1990 (Champy, 1992; Gantz, 1993); many organizations are reshaping their structures through strategic alliances and networking, and many claim this will be a way of life in the future (Charan, 1991). These organization-level changes imply a fundamental redefinition of the work of managers in general, and of middle managers in particular (Brandt, 1994; Drucker, 1988, 1993). American firms of the service sector alone spend over 100 billion dollars annually to acquire hardware (Roach, 1991) and almost forty percent of United States capital spending is being used to acquire IT (Davis, 1991), much of it to modify office work and improve its productivity. Yet many claim that the results have been disappointing at best, that is, IT spendings have failed to yield significant productivity gains, hence the productivity paradox (Davis, 1991; Davis, 1993; Loveman, 1988; Osterman, 1986; Panko, 1991; Roach, 1985, 1991; Strassman, 1990). There are alternative explanations before condemning IT for lack of impacts. Many argue that empirical evidence suffers from serious measurement problems and suggest that rather than trying to assess output and productivity, more attention should be given to how IT affects the process of managing itself (Davis, 1991; Kelley, 1994; Panko, 1991; Strassman, 1990). The present study follows this line of thought and aims at determining whether and how usage of IT by middle managers transforms their work.

Propositions

There are three propositions we wanted to test in this exploratory study. First, it has been widely argued in the literature that because of its comparative advantage, IT would absorb most information-related activities (gathering, storing, diffusing). *We expected that It would be associated with spending less time on the informational activities (Proposition 1)*. Second, we expected that the slack resources thus created would be reinvested into different activities, and that this reallocation of time would depend on the organizational context. Based on Freeman and Cameron (1993), we expected that IT impacts on the work of middle managers would be more pronounced in organizations living a strategic reorientation period (characterized by abrupt shifts in strategy, power distribution, structure, and control systems and by the desire to do different things or the same things differently) than in the ones in a convergent period (incremental and adaptive change, where the focus is on improving consistency and efficiency). *We expected that IT impacts would be more pronounced in reorientation periods than in convergent ones (Proposition 2)*. Third, *we expected that the nature of IT impacts would depend on the nature of the strategic reorientation taking place in the organization (Proposition 3)*. For example, IT might lead managers to spend more time supervising employees in some organizations while it might increase attention given to customers in others.

Research Method

This study focuses on changes in management processes resulting from managers' usage of IT rather than trying to determine productivity impacts of computerization, in terms of increased output. It evolves around two main variables: middle managers roles and usage of IT.

Middle Managers roles. Middle managers are defined as line managers just below departmental heads (ex. marketing, production, finance) and above first-line supervisors who are responsible for carrying out actual

work. Managers' work has been conceptualized and measured using Mintzberg's role typology (interpersonal: figurehead, liaison, leader; decisional: entrepreneur, disturbance handler, resource allocator, negotiator; informational: monitor disseminator spokesman).

Usage of IT. IT is conceptualized in this study as being the computer and its related telecommunications devices that permit managers to directly access, manipulate, and store information. We measured the *intensity of usage* in terms of number of minutes during which managers directly and actively uses IT in a given task.

To study the relationship between the two variables, we compared the time allocation patterns to the ten roles of 59 middle managers with similar jobs (same levels, responsibilities, authorities, etc.) in three organizations. Data were collected through two complementary methods in three large organizations: a utility company (in a convergent and stable strategic period), a telecommunication company (in a pre-reorientation period), and a bank (in a strategic reorientation period). First, all managers were asked to keep a log of daily activities for one typical work day. Managers who used IT were also asked to identify the main software packages they used and a specific form for each program was used to record *all* direct and active IT usage (what packages were used, for what purpose, for how long, etc.) for the typical work day. Directions as to filling out the forms were given over the telephone as well as written with the said forms. The subject was to return the form to the interviewer upon completion and before the interview.

Second, interviews were conducted by a member of the research team the day after the respondents had filled out and sent their two logs. Interviews contained questions about IT use and about how much time they usually devoted to various management roles. The purpose of the interviews was twofold. First, they permitted to validate the data on the log sheets with the respondents and to clarify any unclear matters. Second, the interviews were used to analyze the users' perception of how IT has changed their jobs, if at all, and to better understand what was the essence of their work, how IT fit in their job, and how IT was implemented.

Results

To test the propositions, we used the path analysis approach. *The data do not support our first proposition.* IT was found to increase the time devoted by managers to the informational roles in the Telecommunications company (1.037, $p=.026$) and in the Bank (0.884, $p=.003$), and to decrease the time devoted to the decisional and interpersonal roles, overall, in both companies (total effect of IT = -0.171 on negotiator; -0.520 on leader; -0.522 on liaison in the Telecommunications company; -0.159 on negotiator; 0.466 on leader; -0.643 on liaison; -0.340 on entrepreneur; -0.103 on disturbance handler in the Bank). IT did not affect the informational and the decisional roles in the Utility company, and had a limited positive impact on interpersonal roles in the Utility company (0.648 on liaison). Therefore, overall, IT increased the time spent on the informational roles and decreased the time spent on the decisional and interpersonal roles.

The data provide preliminary support to our second proposition. IT impacts were more pronounced in the two organizations living a reorientation period (Telecommunications and Bank) than in the organization living a convergent period (Utility). IT significantly affected four roles in the Telecommunications company (informational, negotiator, leader, liaison) and 6 roles in the Bank (informational, negotiator, leader, liaison, entrepreneur, disturbance handler), whereas it affected only one role in the Utility company (liaison). Also, IT had both direct and indirect effects on different roles in the Telecommunications company and in the Bank, indicating that there was a reallocation of slack resources among the roles whereas it had only a direct effect on one role in the Utility company, indicating a local and limited impact.

The data also provide preliminary support to the third proposition. The *Telecommunications company* was in a "pre-reorientation" phase in which top management recognized the fact that the environment was changing quite rapidly and drastically, but had not yet defined its new strategic thrust. The main issue was understanding the changing environment. IT impacts seemed to reflect this state of organizational evolution. IT increased significantly the time devoted to the informational roles by middle managers

(1.037, $p=.026$) and decreased the negotiator (total effect = -0.171), leader (-0.683), and the liaison roles (-0.522). The increased time devoted to the informational roles lead to decreases in the time spent to the leader (total effect = -0.501) and liaison roles (-0.503). The substitution was done from the decisional and interpersonal roles to the informational ones. Having access to IT (electronic mail, external databases, etc.), middle managers started spending more time trying to find relevant information in their respective domains.

The Bank was already well in its strategic change. Its new customer orientation stressing tighter relationships with clients and closer monitoring of accounts, and its accompanying structural and operational changes, had just been implemented. Branch managers, our respondents, had to become much more involved in the development of new markets, the consolidation of existing clientele, and the monitoring of the different accounts. IT impacts reflected here again the strategic thrust of the organization. IT had a strong positive impact on the informational roles (total effect = 0.884, $p = .003$) and negative impacts on negotiator (total effect = -0.159), liaison (-0.643), entrepreneur (-0.340), and disturbance handler (-0.103). The increased time devoted to the informational roles resulted in less time spent on negotiator (total effect = -0.385), liaison (-0.727), entrepreneur (-0.385), and disturbance handler (-0.548) as well. Quite interestingly, however, IT significantly increased the time spent on the leader role (total effect = 0.466) and, similarly, greater time devoted to the informational roles was associated with more time spent on the leader role (0.527). This seemed to indicate that IT was used to directly reinforce the critical roles of gathering more information on the market and on monitoring closely customer accounts (informational roles), and of using this new information to segment clientele, develop new markets and reinforce current relationships with customers (leader role). The substitution of time in this organization was done from the negotiator and liaison roles in favor of the informational and leader roles.

The *Utility company* was in a very stable, long-lasting convergent period in which attention was given to improving efficiency of existing procedures and operations and improving consistency across units. In this company, IT impact was isolated and limited as slack resources were reallocated in existing roles with existing time allocation patterns. IT did not affect the informational and decisional roles, but increased the time spent on the liaison role (total effect = 0.648), which had no subsequent effects. There was no substitution of time among roles as IT essentially reinforced existing roles.

From the Productivity Paradox to Icarus Paradox ?

This study also indicates that notwithstanding the nature of the impacts of IT in the two organizations where it was significant, IT was associated with an important concentration of time on the informational roles, which seems counter-intuitive. It appears that slack resources were over-allocated to the informational roles, that is, that the substitution went further than the strategic necessity. For example, given the "pre-strategic reorientation" situation of the Telecommunications company, it might have been more appropriate to also spend more time on the liaison and on the leader roles. Similarly, in the Bank, reinvesting slack resources solely in the informational and leader roles might have been of a too limited span. The entrepreneur and disturbance handler roles seemed also critical to the strategic orientation of the firm. Although we do not have empirical support in this study to explain what appears to be an "over-concentration" on the informational roles associated with IT usage, we offer a preliminary explanation based on the Icarus Paradox:

The fabled Icarus of Greek mythology is said to have flown so high, so close to the sun, that his artificial wings melted and he plunged to his death in the Aegean sea. The power of Icarus' wings gave rise to the abandon that so doomed him. The paradox, of course, is that his greatest asset lead to his demise. And that same paradox applies to many outstanding companies today: their victories and their strengths often seduce them into the excesses that cause their downfall. (Miller, 1990, p.3)

Miller (1990) posits that organizations achieve outstanding performances by focusing on a few distinctive competencies and winning strategies. They react to their success, by putting still more emphasis on the same competencies, and by using the same strategies, that is, by embarking on a *trajectory* that will

ultimately lead them to their own loss. Similarly, managers tend to exploit more intensively the one or two activities at which they are best; and it induces them to neglect the other activities.

The present study suggests that IT tended to focus middle managers' attention and time on those roles they performed best, the informational roles, or that were seen as critical to the organization, to the detriment of other roles. This concentration may seem beneficial at first, managers focusing on one or two areas crucial to the firm's operations and strategy. But it also seems to contain the seeds for an over-specialization that goes beyond strategic necessity, in which manager's decision-making and flexibility are greatly impaired, and so is organization's chances of success. The mechanism resembles in all point to the dynamics of the Icarus paradox: as successful organizations do, middle managers may well be launching themselves into a specialization trajectory, focusing more and more on very precise activities and roles that IT permit them to do best, mostly the informational roles, and limiting their implication in the other dimensions of their work perceived as marginal. Miller (1990) argues that in such a situation, managers develop the specialized knowledge and organizations reinforce this pattern by hiring specialized workers and failing to recruit and retain people with different talents and skills. The work of managers might thus become ever more specialized and eventually fall into a specialization spiral just as organizations do.

References available upon request from Alain Pinsonneault.