Factors Influencing Successful Implementation of Computer Based Technologies in Knowledge-Intensive Activities

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The mission of the paper is to make a contribution to increasing the understanding of implementation process of Computer Based Technologies (CBTs) in “knowledge-intensive activities”, i.e. the activities that are mainly based on high technical and professional skills. A model of the organizational aspects influencing the implementation process, developed on the basis of the literature and the authors’ research, is presented. On the basis of this model, the authors studied the implementation process of CBTs in software production activities of eight Italian firms, representative of industrial and service sectors. From the discussion of results of the study, implications both for the theory and for the management of the implementation process are derived.

In recent years Computer Based Technologies (CBTs) have become commonplace in every organization, bringing significant modifications, especially in “knowledge-intensive activities”, i.e. the activities that are mainly based on high technical and professional skills. These activities often occur in such fields such as management consulting, software production, research centers, engineering companies, etc. In such firms individual knowledge has more importance than other inputs; for this reason they are labeled with the term “knowledge-intensive firms (KIF)”. Exceptional and valuable expertise dominates ordinary knowledge within the KIFs and the widely shared knowledge is exceeded by personal and idiosyncratic knowledge (Starbuck, 1992). CAD (Computer Aided Design) systems are the most relevant example of information technologies in engineering activities, because of their widespread use and the considerable investment of many companies in them, especially for the development of new products (Robertson and Allen, 1993; Adler, 1989). The greatest use of these technologies is in supporting mechanical design and engineering, but in the last few years they have also been applied in new fields. CASE (Computer-Aided Software Engineering) is an example of applications of information based technologies in the software development process. Generally, all these technologies promise to offer companies large improvements in flexibility, innovation, efficiency and responsiveness to customer needs.

Generally, the implementation of CBTs in knowledge-intensive activities promises to offer companies large improvements in flexibility, innovation, efficiency and responsiveness to customer needs. Nevertheless, the achievement of such results is not easy: in several cases these technologies have not delivered the benefits the managers expected (Majchrzack and Salzman, 1989; Robertson and Allen, 1993).

The most recent evidence shows that the successful implementation of Computer Based Technologies is as much an organizational as a technical change. However, the mechanisms through which these technologies are successfully implemented are not identified (Orlikowski, 1989; Geisler, 1991), because the implementation of information technologies in knowledge intensive activities involves particular...
problems concerning the autonomy of professionals. Professionals appreciate the importance of their autonomy whenever the firm demands their services to absorb unpredictable variations of the current environment. New technology plays an ambiguous role in this autonomy (Weick, 1990), because it can be considered either as a threat to the professional’s position or as an opportunity for the professional to update his competence. In the first case the new technology reduces the perceived autonomy, while in the second case the new technology amplifies the perceived autonomy.

Both at the theoretical and at the operational level, it is unclear how these technologies can integrate or partially substitute the individual expertise and how managers can reduce the resistance of professionals to the new technology, by enhancing the possibility of rebuilding a new autonomy.

For all these reasons, the study of organizational change around Computer Based Technologies is becoming increasingly important, at both the theoretical and the managerial level. At the theoretical level, models are needed which, taking social and organizational factors into account, can explain the use and impact of CBTs (Majchrzack and Salzman, 1989). At the managerial level it is important to identify and manage the factors that influence the implementation process (Orlikowski, 1989) and, in particular, to understand the relationship between the use of CBTs systems and the company’s performance (Robertson and Allen, 1993).

This paper shows the results of a study on implementation of CBTs in eight Italian firms which are representative of industrial and service sectors. The methodological approach is based on a dynamic model, developed by the authors. The model points out the cyclical character of the implementation process and allows the misalignments between the opportunities offered by these technologies and the results achieved to be identified.

From the results of the study, implications both for the theory and for the management of the implementation process are derived.

**Implementation of CBTs in Knowledge Intensive Activities: Managerial Issues**

Several studies (Adler, 1989; Badham, 1989; Brooks and Wells, 1989; Friesen and Orlikowski, 1989; Lee, 1989; Robertson and Allen, 1992, 1993) have pointed out that the effective implementation of information technologies in knowledge intensive activities requires significant changes in the organization. As a consequence, managers have to understand the social and organizational dimensions of the implementation process and to plan adequately the changes in organizational dimensions (culture, structure, processes, etc.) (Majchrzack and Salzman, 1989).

For these reasons, as Geisler states (1991), the following questions become increasingly significant: “... how should these technologies be linked or networked with existing technologies and processes? how should we evaluate the performance of these technologies? what are the problems associated with the application, adoption, adaptation and usage of these technologies and how can we resolve them?...” (p. 291).

The recent literature on managerial facets of computer based technologies has pointed out several issues that influence the effectiveness of the implementation of these technologies:

- the perceptions of the management about the technologies and their capabilities: different perceptions of CBTs will lead to different use of the systems (Majchrzack and Salzman, 1989; Weick, 1990; Robertson and Allen, 1992, 1993);
- the expectations managers have for the CBTs. When managers view these technologies primarily as a machine to enhance productivity they tend to adopt a minimalist approach to organizational change. When managers view CBTs as a means to increase the individual’s efficiency, these technologies “became a catalyst for needed organizational change” (Majchrzack and Salzman, 1989 p.177);
- the “technological frames” (Orlikowski and Gash, 1991), that is “the set of assumptions, meanings, knowledge and expectations that people use to understand the nature and role of technology in organizations” (p. 4).
- the user’s interpretation of the technologies and the social interests and motivations in using them (Goodman et al., 1990; Orlikowski and Gash, 1991; Tyre and Orlikowski, 1992; Lewis and Seibold, 1993);
- the relationships between technologies and the user’s environment (Leonard-Barton, 1988; Meyer and Goes, 1988; Majchrzack and Salzman, 1989);
- the modifications in social relationships within project teams (Orlikowski, 1989; Brooks and Wells, 1989);
- the number and variety of interventions on organizational aspects (such as skills, training, changes in procedures, structure, organizational culture, etc.). In several cases, as Majchrzack and Salzman (1989) state, the perspective of managers is that implementation of information technologies “requires only little organizational change” and that “these organizational change will naturally follow the technological change” (p. 174). Nevertheless CBTs are more likely to achieve their intended benefits when managers take organizational and social aspects of implementation process into account (Brooks and Wells, 1989);
- the linking of organizational changes with the technical changes, without which the benefits of the new technologies will not be achieved (Adler, 1989);
- the explicit strategy of implementation followed by the firm, i.e., as Friesen and Orlikowski (1989) state, the way in which “the manner, timing, and phases of diffusing” of the new technologies are introduced and clearness in “delineating the role to be played by the automated aids, the system