Organizational and strategic predictors of manufacturing technology implementation success: an exploratory study

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Abstract

In this study, we empirically investigate how organizational and strategic variables are related to success in technology implementation. Organizational culture, operations strategy, and the outcomes associated with manufacturing technology implementation are assessed from data collected from a sample of manufacturing plants across a wide range of industries. We then analyze the relationships between these variables using multiple regression analysis. Our findings indicate that both culture and strategy variables are significantly related to technology implementation, but the relationships are dissimilar for different types of implementation outcomes. © 2001 Elsevier Science Ltd. All rights reserved.

1. Introduction

The traditional paradigm of operations management and manufacturing strategy holds that efficiency is possible only through the production of large volumes of standard products, while customization is necessarily penalized with higher costs. Advanced manufacturing technology (AMT) directly contradicts traditional thinking by promising the capability of providing both efficiency and flexibility. In particular, we define AMT as a group of computer-based technologies, including computer-aided design (CAD), robotics, group technology, flexible manufacturing systems, automated materials handling systems, computer numerically controlled machine tools, and bar-coding or other automated identification techniques (Sambasivarao and Deshmukh, 1995; Zairi, 1992; Zammuto and O'Connor, 1992).

Clearly, the most distinguishing feature of AMT is its capability to provide a combination of flexibility *and* efficiency. While these *operational* benefits are extremely important, they may generally be seen as a means to the ultimate end of financial benefits, namely improved profitability, market share, and sales growth. This paper therefore explores relationships associated with these *competitive* outcomes as well.

Successful implementation of AMT often requires different types of organizations and/or management practices than are found in more traditional environments. This is because these technologies often directly challenge established norms and strategic options considered in a pre-AMT facility. Because these technologies are quite different from the equipment they may be replacing, the culture of the adopting organization itself may ultimately affect the level of success managers have with the technology. A firm whose organizational culture is characterized by flexibility-orientated values may be more likely to be effective in implementing AMT than one that is not (Zammuto and O'Connor, 1992). Prior research has recognized a link between organizational culture and operations strategy (Bates et al., 1996), so it stands to reason that a firm's operations strategy may also be a factor in implementation success. A firm whose strategy emphasizes operational flexibility might be expected to be more effective in implementing manufacturing technology than a firm emphasizing other competitive priorities.

Our paper focuses on how organizational culture and

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operations strategy relate to operational and competitive outcomes in AMT implementation. The remainder of the paper is organized as follows. The second section examines the literature relating to AMT implementation, organizational culture, operations strategy, and operational and competitive benefits. The next section discusses our methodological approach and sample. We then present our findings and end with a discussion of the contribution of this research to our understanding of AMT implementation and how it may be relevant to practicing managers.

2. Conceptual framework

While it often represents a radical change from their predecessors on the shop floor, advanced manufacturing technology is widely used in many companies. Its rise in popularity has been accompanied by questions regarding its effective implementation. In this section, we outline the conceptual basis for our study. Based on an examination of the literature on organizational culture and operations strategy, we consider how these constructs might be expected to affect AMT implementation outcomes. We then present a set of hypotheses that follow from this discussion.

2.1. Organizational culture

Culture as a factor in technology implementation has received little attention in the literature. In fact, with few exceptions (Bates et al., 1996), organizational culture and its relationship to any area of operations management has been the topic of very little research. In this paper, we explicitly examine the relationship between organizational culture and AMT implementation.

In general, culture is the "programming of the mind which distinguishes the members of one human group from another" (Hofstede, 1980). To be more specific, organizational culture is

> a pattern of basic assumptions—invented, discovered, or developed by a given group as it learns to cope with its problems of external adaptation and internal integration—that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems (Schein, 1985).

The organization's culture is built on its shared values and ideas, but this is only one element that defines organizational culture. An organization's culture is the set of shared ideas and values that serve as a means to *accomplish* something (e.g. in the definition quoted above, to solve problems).

Organizational culture affects the operation of a firm in many different ways. As such, it is becoming increasingly clear that it can and does play an important role in many areas of managing an organization (Denison and Mishra, 1995). Research on the topic provides useful insight into the dimensions and variations of culture within the firm. The conceptual model of organizational culture used in this paper is the competing values framework (Quinn, 1988; Quinn and Rohrbaugh 1981, 1983; Zammuto and O'Connor, 1992). The competing values model is characterized by a two-dimensional space that reflects different value orientations (Denison and Spreitzer, 1991). The first dimension in this model, *the flexibility–control* axis, shows the degree to which the organization emphasizes change or stability. A flexibility orientation reflects flexibility and spontaneity, while a control orientation reflects stability, control, and order. The second dimension in this framework, the *internal–external* axis, addresses the organization's choice between focusing on activities occurring within the organization (internal) and those occurring outside, in the external environment. An internal orientation reflects an emphasis on the maintenance and improvement of the existing organization, while an external reflects an emphasis on competition, adaptation, and interaction with the external environment.

This two-dimensional typology yields four ideal cultural orientations that correspond to four major models in organizational theory. *Group* culture emphasizes flexibility and change and is further characterized by strong human relations, affiliation, and a focus on the internal organization. *Developmental* culture also emphasizes flexibility but is externally oriented. The focus is primarily on growth, resource acquisition, creativity, and adaptation to the external environment. Continuing with this model, *rational* culture is also externally focused, but is control oriented. Such firms emphasize productivity and achievement, with objectives typically well-defined and external competition a primary motivating factor. *Hierarchical* culture, like rational culture, emphasizes stability. However, the focus is on the internal organization. This orientation is characterized by uniformity, coordination, internal efficiency, and a close adherence to rules and regulations. Fig. 1, which was adapted from prior work by Quinn and Spreitzer (1991), provides an illustration how these ideal types fit within the two-dimensional competing values framework.

There are two important assumptions underlying this framework. First, each quadrant is an *ideal* type. It is likely that an organization will exhibit a combination of different culture orientations, although one type may be more dominant than the others. An organization's culture would therefore be characterized by a *profile* in the two-dimensional space, rather than a single point (Denison and Spreitzer, 1991). Therefore, a high rating on one