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Factors impacting AMT implementation: an integrative and controlled study

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Abstract

Advanced manufacturing technology (AMT) poses tremendous advantages and challenges for organizations. To integrate previous studies of AMT implementation, we investigate how varied operations strategies, organizational cultures, and implementation practices impact performance. Our research design controlled for the type of AMT and examined the timing effects of implementation, enabling a survey of 110 plants that had implemented computerized die/mold machinery over the past 3 years. Results indicate that high-performing plants employ: a strategy that emphasizes quality, delivery, and flexibility over costs; a balanced culture that stresses flexibility and control; and systematic practices that facilitate change (training, pilot projects, long-term AMT objectives). Moreover, we find that implementation timing may act as a confounding variable, as plants that had recently implemented AMT outperformed those with older implementations. © 2002 Elsevier Science B.V. All rights reserved.

Keywords: Advanced manufacturing technology; Implementation; Operations strategy; Organizational culture; Survey research/design

1. Introduction

Advanced manufacturing technology (AMT) encompasses a range of programmable machinery that execute, monitor, and connect the production process, including computer-aided manufacturing, flexible manufacturing systems, and computer numerically controlled machines. Since its inception in the 1970s, AMT has been praised for enabling greater process control and flexibility indicative of “high-performance manufacturing” (Boyer et al.,

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1997). High-performing plants use AMT to dramatically improve production precision and speed, developing operations as a competitive advantage (Hayes et al., 1988).

AMT implementation, however, has proven a considerable challenge, with results typically falling well below expectations. High-performing plants are the exception rather than the rule. Reports suggest that 50–75% of implementations are dubbed failures in terms of quality, flexibility, and reliability (Chung, 1996). Yet researchers in the areas of operations management and organization studies claim that AMT machinery is not the problem. Rather failures stem from inadequate attention to implementation factors, such as whether a plant's strategic priorities, culture, and employee training support new AMT (Lewis, 1998; McDermott and Stock, 1999; Parthasarthy and Sethi, 1992; Zammuto and O'Connor, 1992; Zhao and Co, 1997).

Existing studies offer insightful, but limited understandings of these implementation factors, for AMT researchers face sizeable challenges as well. In particular, it is very difficult to ascertain on an a priori basis (1) which technologies a plant employs and (2) when a new AMT is introduced. Gathering this information requires extensive pre-survey work to locate potential respondents or longitudinal efforts to collect data over several years. Pagell et al. (2000), for example, used pre-screening to identify plants that had introduced specific FMS or CNC machinery. This led to a more controlled study, but required a time-consuming, labor-intensive process to achieve a relatively small sample size ($n = 30$). Consequently, most researchers make compromises, conducting either a rich, detailed case study of a single AMT implementation or a cross-organizational survey that assesses the impact of one or two implementation factors on a wide variety of AMTs (Boyer, 1999; Dean and Snell, 1996). The result is an expansive, but fragmented literature. Noticeably scarce are larger survey studies that examine the impact of multiple implementation factors across organizations (Lin and Chen, 2000).

In response, we sought to contribute a more integrative and controlled study. To integrate existing research, we investigate the effects of several implementation factors: varied operations strategies (i.e. quality, flexibility, delivery, cost), organizational cultures (i.e. flexibility- and control-orientation), and implementation practices (i.e. employee training, pilot projects, long-term AMT objectives, an AMT champion). Working closely with a major AMT manufacturer enabled us to control for the type of AMT implemented and examine potential timing effects. Through access to their extensive and diverse customer network, we contacted 271 plants that had implemented a particular AMT (computerized die/mold machinery) over the last 3 years, for a final sample of 110 plants.

This article begins with a review of the literature to propose a series of implementation-related hypotheses. We then discuss our research design, analyses, and results noting potential implications for AMT researchers and decision makers. Our findings suggest that high-performing plants develop a supportive fit between the capabilities of the new AMT and their strategic priorities, organizational culture, and employees' skills and knowledge.

2. AMT implementation literature and research hypotheses

Not surprisingly, as organizations continue to struggle with AMT, the fields of operations management and organization studies have witnessed a boom in related research.

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