

The impact of new manufacturing requirements on production line productivity and quality at a focused factory

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Abstract

This research studies how changes in manufacturing requirements affect production line performance in a focused factory. Specifically, we examine whether production line labor productivity and conformance quality decline as the range of models produced and the heterogeneity of production volume increase in a factory designed for high volume production of a narrow range of models. We use the organizational nature of production lines to argue that the performance of focused production lines will decline when the lines adopt new manufacturing tasks that are outside the scope of the absorptive capacity developed through the execution of their prior focused manufacturing task, but not otherwise. The study examines four years of data from 16 production lines of a compressor manufacturing factory of the Copeland Corporation. Our statistical analysis identifies limits to change, suggests paths to successfully changing the manufacturing requirements of a focused factory, and places the operations strategy discussion of focused factories in a dynamic environment. © 2000 Elsevier Science B.V. All rights reserved.

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1. Introduction

In the Operations Management literature, the argument that focused factories should typically outperform more general-purpose production facilities started with the seminal work of Skinner (1974) and continues to date (Schmenner and Swink, 1998). Although most of the writing on manufacturing focus emphasizes stable manufacturing environments

(Stobaugh and Telesio, 1983; Hayes and Wheelwright, 1984, p. 90, p. 108; Hayes and Clark, 1985; Hill, 1994, p. 152), most factories inevitably face changes in their manufacturing requirements. Owing to difficulties in adaptation, it is possible that the performance of focused factories will decline when their activities change. This paper examines the relationship between manufacturing focus and factory performance in a dynamic environment. Specifically, we examine how the performance of a focused factory's production lines changes after the factory changes its manufacturing requirements. We define focus in terms of manufacturing requirements and

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measure changes in focus through variables that affect production line activities.

Our explanations of relationships between change in manufacturing requirements and production line performance draw from a conceptual model of manufacturing activities that includes two dimensions: manufacturing routines and absorptive capacity for adaptation of routines. We base the model on the organizational nature of production line activities. A production line is an organizational unit, which one can view as a collection of self-sustaining routines (Nelson and Winter, 1982). Organizations and their sub-units such as production lines often find it difficult to depart from prevailing routines. We draw most directly on the concept of absorptive capacity, which is the ability to recognize, evaluate, assimilate, and utilize new knowledge (Cohen and Levinthal, 1990). We argue that manufacturing focus sometimes creates conditions under which production lines lack the absorptive capacity to adapt effectively to requirements unrelated to their existing focused task. We conceptualize manufacturing tasks as activities that the manufacturing function needs to accomplish. We hypothesize that the performance of focused production lines will decline when the lines adopt new manufacturing requirements that are outside the scope of the absorptive capacity developed through the execution of their prior focused manufacturing requirement.

We test the hypotheses at 16 production lines of a well-known focused factory of the Copeland Corporation of Sidney, Ohio, using primary output and performance data over a four-year period during which the company changed the manufacturing requirements of the production lines. The factory is located at Hartselle, AL. Consistent with the requirements of a theory testing case study, the conceptual variables of the hypotheses are general constructs, while the operational variables are specific to the site. Our statistical analysis both illustrates the limits of change in operations strategy and identifies paths through which factories may undertake successful change.

2. Background literature

Studies seeking empirical evidence on the benefits and costs of factory focus include case studies and

statistical studies. Several broad, multi-industry, multi-plant case studies (Skinner, 1974, Ferdows, 1997) as well as narrower-scope site-specific studies (Hayes and Wheelwright, 1984, p. 34, Ruwe and Skinner, 1987) suggest that focused factories lead to better manufacturing performance and competitive success. In the practitioner literature, studies by consulting firms such as McKinsey (Rommel et al., 1995), and Andersen Consulting (Harmon, 1992) report substantial improvement of operating performance of factories through implementation of focus at over 2000 factories worldwide. However, while case studies examining specific focusing efforts often suggest superior factory performance, the conclusions often come from broad observations rather than scientific examinations.

In addition, a few statistical studies have studied how product variety, which is one surrogate of focus, affects manufacturing performance, producing ambiguous results. Some researchers have observed positive relationships between manufacturing performance and measures of limited product variety, both cross-sectionally (Banker et al., 1990; Brush and Karnani, 1996; McDuffie et al., 1996) and longitudinally (Anderson, 1995). Other researchers have found little effect of product variety on manufacturing performance (Hayes and Clark, 1985; Foster and Gupta, 1990; Kekre and Srinivasan, 1990). Thus, it is difficult to arrive at a generalizable empirical conclusion about the relationship between product variety and performance from prior studies. More importantly for our purpose, however, most of these examinations do not address whether the manufacturing plants they studied engaged in the managerial exercise of focusing, which involves determining limited manufacturing requirements and tailoring the manufacturing systems to these requirements. Moreover, the studies differ in the variables they have used as measures of performance and product variety. Studies that use relatively simple measures of product variety find little correlation between variety and cost (e.g., Hayes and Clark, 1985; Foster and Gupta, 1990; Kekre and Srinivasan, 1990), while studies using more sophisticated measures of product variety often find a positive relationship between limited variety and superior performance (e.g., Banker et al., 1990; Anderson, 1995; McDuffie et al., 1996). This speaks to the need for careful consideration of the

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