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Effects of simplicity and discipline on operational flexibility: An empirical reexamination of the rigid flexibility model

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Abstract

This study empirically tests the rigid flexibility model proposed by Collins and Schmenner [Collins, R.S., Schmenner, R.W., 1993. Achieving rigid flexibility: factory focus for the 1990s. European Management Journal 11 (4), 443–447]. It investigates relationships between flexibility performance and adoption of simplicity and discipline programs in manufacturing. The research replicates the study by Collins et al. [Collins, R.S., Cordon, C., Julien, D., 1998. An empirical test of the rigid flexibility model. Journal of Operations Management 16 (2–3), 133–146] with some modifications, including the use of a broader international database, the assessment of both technology and organizational programs, and the testing of the moderating role of dedicated line layout on the relationships between simplicity, discipline and flexibility. Analysis of data from 285 manufacturers of fabricated metal products, machinery, and equipment from 14 countries indicates that simplicity and discipline related positively to performance in product customization, volume flexibility, mix flexibility, and time to market, and that some of these relationships were more positive in high volume processes than in low volume processes. The results provide empirical validation to the rigid flexibility model in an international manufacturing context.

Keywords: Flexibility; Operations improvement; Regression analysis; Empirical research

1. Introduction

Building flexibility to respond quickly to changing market needs has been regarded as one of the major challenges in operations management over recent years (Bordoloi et al., 1999; Barnes-Schuster et al., 2002). Industrial markets have been increasingly subject to frequent changes regarding product variety and demand volumes (Bayus and Putsis, 1999; Jack and Raturi, 2002). In most cases, however, customers do not accept paying higher prices or waiting longer for products fitting to new demands. For many operations, the challenge is how to build flexibility at no expense to cost, quality, or delivery performance (Boynton et al., 1993; Suarez et al., 1996).

Over the last decade, a great deal of research has aimed at tackling such flexibility challenge (De Toni and Tonchia, 1998). Most authors focused on either exploring the relationship between flexibility and performance, or building conceptual typologies or taxonomies (Narasimhan and Das, 1999). However, few studies focused on the links between flexibility and operations improvements. Among those, Collins and Schmenner's (1993) rigid flexibility model appears to provide one of the most consistent answers to producers squeezed by market volatility.

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The rigid flexibility model suggested that flexibility competence could be developed by building simplicity and discipline in manufacturing. Simplicity was about streamlining information and materials flow processes. Discipline was about carrying out procedures in dedicated and consistent fashion. Both simplicity and discipline would result from improvements in several areas including information and process technology, labor development, product design, and process configuration. The model's premise was somewhat paradoxical, as flexibility would result not from building capacity or inventory buffers [as suggested by several studies in operations and supply chain management, e.g. Fisher, 1997; Huang et al., 2002; Jack and Raturi, 2002] or from allowing improvisation in manufacturing. Instead, flexibility would result from rigid processes that consistently and diligently pursued strategic tasks: "... if the requirement is flexibility, then an atmosphere of permissiveness cannot be tolerated" (Collins and Schmenner, 1993, p. 444). Simplicity, rather than reducing the number of options available to the firm, should provide a streamlined process that was easier to reconfigure and adapt to changing requirements. Discipline, rather than stiffening procedures and skills, should promote the best practices and work methods that enabled the firm to respond to market changes.

Despite the model's appeal and influence in the operations strategy field [providing foundations for studies on trade-offs and the world-class paradigm, e.g. Noble, 1995; Flynn and Flynn, 1999; Beach et al., 2000], there has been surprisingly limited research to validate its propositions. So far, only Collins et al. (1998) appear to have developed an empirical test. They provided evidence to relationships between simplicity/discipline and flexibility in manufacturers from the five western European countries of Britain, Germany, Switzerland, the Netherlands, and Finland. No study appears to have tested the model by using a broader geographical base, cross-examining different process types, or assessing the role of the manufacturing and information technologies that today appear critical to flexibility performance. Thus, while Collins et al. (1998) provided a valuable contribution in validating the model in a specific context, more research is needed to assess its applicability in a broader framework.

This study addresses that research requirement. It searches for evidence to the rigid flexibility model through using a broad international database, building scales for simplicity and discipline that incorporate both technology and organizational approaches, and exploring relationships in high and low volume processes. Furthermore, the analysis focuses on core flexibility dimensions including product customization, volume flexibility, mix flexibility, and time to market. The study uses data on the flexibility performance and improvement programs of 285 manufacturers of fabricated metal products, machinery, and equipment from 14 countries. The research aims to replicate the study by Collins et al. (1998), while incorporating some modifications to provide further knowledge about the model's applicability in different contexts.

2. Background

2.1. Manufacturing flexibility

Flexibility of a system has been defined as its ability to adapt to environmental change (Sethi and Sethi, 1990; Gupta and Goyal, 1989). It entails modifying processes and product configurations with little penalty in time or cost to deal with changing circumstances (Slack, 1987; Upton, 1994; Van Dijk, 1995).

According to Bordoloi et al. (1999) and Barnes-Schuster et al. (2002), flexibility has grown in priority due to pressures to respond to changing market needs and shortening product life cycles. Several studies provided evidence to increasing volatility in customer demand. For example, a majority of respondents to Åhlström and Westbrook's (1999) survey of British operations managers indicated that customers were requiring increasing levels of customization and non-standard products. Mendelson and Pillai (1999) found a steady decrease (average 9.4% per year) in the duration of product life cycles in several industry segments over the period from 1988 to 1995. Similar trends appear to affect requirements in product mix (Kekre and Srinivasan, 1990; Karuppan and Ganster, 2004), and demand volume (Suarez et al., 1996; Jack and Raturi, 2002).

Research on flexibility is extensive and appears to have peaked in the 1990s. Sethi and Sethi (1990) and De Toni and Tonchia (1998) provided broad literature reviews. The major interest in research appears to be the classification of flexibility. Several authors have used organizational, hierarchical, temporal, or objective criteria to build flexibility taxonomies (De Toni and Tonchia, 1998). The most common taxonomies use objective criteria to define flexibility types corresponding to different elements of a production system. One may classify these in two groups. The first group involves taxonomies by authors such as Browne et al. (1984), Sethi and Sethi (1990), and Gerwin (1993). They provided comprehensive classifications involving types such as machine, materials, production, volume, and routing flexibility. Each flexibility type can be