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An empirical analysis of just-in-time production in Japanese manufacturing companies

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Abstract

This paper focuses on the requirements for just-in-time (JIT) production systems and the roles and consequences of JIT production for manufacturing companies. The paper reports nine reliable and valid measurement scales concerning JIT production practices for 46 Japanese manufacturing plants. Based on these measurement scales and a summarized super-scale, it is proved that JIT production systems contribute to improving competitive performance, and that efficient equipment layout has a strong impact on the competitive position of the manufacturing plant. More importantly, JIT production interacts with other operations management areas. Fourteen scales are closely correlated with JIT production. They jointly characterize a committed and coordinated organization, high problem-solving competence of human resources, a solid base for total quality management, stable or predictable information systems, inter-functional technology development, and the business/manufacturing strategy encouraging functional integration.

Keywords: Just-in-time production; Inventory management; Manufacturing; Empirical research

1. Introduction

Just-in-time (JIT) production has been one of the hottest research areas in operations management since 1980s. It describes the idea of producing the necessary items in the necessary quantities at the necessary time, and eliminating all sources of waste in operations. If such an idea would be realized throughout an organization or a supply chain, the level and the cost of inventory could be reduced drastically, and inventory turnover could increase sharply. JIT production has been approached by various methodologies such as conceptual modeling, case studies, mathematical models and simulation methods. The pull system was devised to realize the JIT concept, where the flow of materials along the supply chain is seen oppositely from downstream toward upstream. One example of the pull system is the kanban system invented by Toyota Motor Corporation. To make JIT production work, many other things should be done; leveled master schedule, small lot size, setup time reduction, multi-functional workers, JIT layout and equipment, perfect quality, autonomation, supplier relations, etc. MRP systems and accounting practices should be adapted to JIT production systems.

Centered on the JIT production, some researchers have proposed more integrative production system concepts. Schonberger (1986) advocated the concept of world class manufacturing, which combined JIT production, total quality management (TQM), total preventive maintenance (TPM), and human

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resources management. Harrison (1992) and Flynn et al. (1995) emphasized the integration of JIT production and TQM. Monden (1998) described the Toyota production systems as a mixture of JIT production on the shop floor, human resources management, TQM, and information systems. The conceptualization of lean production by Womack et al. (1990) can be interpreted as a mechanism to harmonize designing products, purchasing parts and components, manufacturing, and marketing.

From a perspective of competitive strategy, a deliberate production system is often seen as a source of core competence, that is, a mighty weapon for improving delivery performance and reducing its manufacturing cost. Hamel and Prahalad (1994) listed many examples where an integrated technology or skill builds up core competence. One way to attain competitive advantage in manufacturing industries is to exploit excellent production and inventory control systems and secure the position of cost leadership. The linkages between JIT production and other operations management areas are critical and sometimes hidden weapons for this line of strategy. Some excellent manufacturing plants in Japan have been involved in the implementation and improvement of their own JIT production systems for a long time.

The main objective of this paper is to empirically discuss what requirements should be satisfied for the development of JIT production systems, and whether the implementation of JIT production systems can lead to improved decisions or practices in other operations management areas and higher competitive performance. This is based on the measurement scales concerning JIT production and the data collected from world class manufacturing plants and randomly sampled plants in Japan through extensive questionnaires.

2. Analytical framework and hypotheses

Fig. 1 shows an analytical framework with four major building blocks to assess the real value of JIT production for Japanese manufacturing companies: (1) organization and human resource management; (2) quality management, production information systems, and JIT production systems; (3) technology development and manufacturing strategy; (4) competitive performance. Organization together with human resource management provides an infrastructure on which elaborate manufacturing systems are established and manufacturing strategy is formulated. The second block consists of core manufacturing operations systems concerning quality, inventory, production planning and information. The third block includes technology development and manufacturing strategy, which are closely related each other and interact with core manufacturing operations systems. These three blocks are put together to determine the competitive performance of manufacturing plants.

This paper focuses on JIT production systems within the framework. In addition it explores their relationships with organization, human resource management, quality management, production information systems, technology development, manufacturing strategy, and competitive performance. It is assumed that JIT linkage is a key factor determining competitive performance not merely directly but also indirectly through the impact upon other manufacturing practices and strategy. The following hypotheses are to be tested:

Hypothesis 1. Excellent JIT production interrelates with organization, human resource management, quality management, information systems, technology development, and manufacturing strategy.

Hypothesis 2. JIT production contributes to competitive performance of the plant.

3. Research variables

In order to operationalize the analytical framework and the hypotheses in the preceding section, some research variables below are introduced. They are divided into four categories.

3.1. JIT production measurement scales

The first set of variables is concerned with the role of JIT production systems for manufacturing companies. To measure various practices on JIT production the following nine scales are introduced:

1) *Daily schedule adherence* (DSA) assesses whether there is time for meeting each day's schedule including catching up after stoppages for quality considerations or machine breakdown.
2) *Equipment layout* (EL) measures use of manufacturing cells, elimination of forklifts and long conveyers, and use of smaller equipment designed for flexible floor layout, which are all associated with JIT manufacturing.