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On the complementarity between internal and external just-in-time bundles to build and sustain high performance manufacturing

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ABSTRACT

The focus on the sequential nature of the improvement initiatives has neglected the synergistic effects among practices and literature lacks research on complementarity between internal and external bundles of practices. The aim of this paper is to test the existence of complementarity among internal and external just-in-time bundles. We run statistical analysis using the third round of High Performance Manufacturing international research project data set and we find that upstream and downstream JIT are complements. This finding suggests the importance of managing the interdependencies both in designing and implementing upstream and downstream JIT in order to maximize operational performance.

1. Introduction

Research and practice have clearly shown how internal and external integrations lead to overall improvements in operational performances, customer service, relationships among supply network members, levels of inventory and lead times (Cooper et al., 1997; Harland et al., 1999; Simchi-Levi et al., 2003).

However, achieving integration is not an easy task and it cannot occur overnight. Each company involved in integration initiatives should first enhance internal integration and then, gradually, embrace inter-organizational integration within the supply network (Cooper and Ellram, 1993). Several studies have indeed emphasized that the rationalization and improvement of internal processes must precede practices of integration along the supply chain (Scott and Westbrook, 1991; Olsen and Ellram, 1997).

These recognitions notwithstanding, Operations Management (OM) literature has not delved into the tangled relationships between internal integration practices, external integration practices and operational performances. In particular, in line with recent contributions (Siggelkow, 2001; Cassiman and Veugelers, 2006), we maintain that OM literature has not adequately searched for complementarity between internal and external integration practices, i.e. to what extent internal integration practices increase the marginal returns of external integration practices, and vice-versa. This is a nontrivial issue since the existence of complementarity has in fact relevant implications both in designing and implementing integration initiatives (Milgrom and Roberts, 1995; Siggelkow, 2001; Siggelkow, 2002a, 2002b; Cassiman and Veugelers, 2006).

In this paper we focus on the implementation programs of just-in-time (JIT) practices along the supply chain. These programs are aiming at integrating the logistic flows both within the focal firm and between the focal firm and upstream suppliers and downstream customers (Ballou, 1992; Hahn et al., 1983; Dong et al., 2001). Indeed, JIT includes those practices related to stream production flow, such as lot size reduction, cycle time reduction, quick changeover techniques and production process reengineering (Shah and Ward, 2003).

JIT is one of the main facet of lean manufacturing, i.e. a managerial philosophy and a set of integrated socio-technical practices aimed at eliminating waste along the whole value chain within and across companies (Womack et al., 1990; Holweg, 2007). On a managerial level this approach turns into a collection of sets of practices and techniques that both implement and support lean philosophy. JIT is one of these sets of practices (Dal Pont et al., 2008).

The aim of this paper is to study the complementarity among internal JIT, upstream (towards suppliers) JIT and downstream (towards customers) JIT. We also test the complementarity between downstream JIT and upstream JIT. According to previous literature (Shah and Ward, 2003; Slack et al., 2007), we consider the classic operational performance areas: quality, dependability, flexibility and cost.

The paper is organized as follows. The second section reviews the relevant literature on just-in-time as one of the most relevant

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lean manufacturing bundle. We highlight the interdependencies between internal and external JIT practices and rely on the theory of complementarity to advance a set of testable hypothesis. The third section provides the methodological background and research design. The fourth section presents statistical results and analyses while the fifth section discusses theoretical and managerial implications. The final section highlights the limitations of our study and outlines avenues for future research.

2. Literature review

2.1. The importance of internal and external integration: JIT as an integrated system

One of the challenges that firms have to cope with nowadays is the search for high levels of operational performance through the adoption of an integrated and coherent system of innovative practices (Womack et al., 1990; Schroeder and Flynn, 2001).

Several studies have shown how integration often leads to competitive advantage or improvement in the operational performances (Ettlie and Stoll, 1990; Safizadeh et al., 1996; Pagell et al., 2000).

Organizational literature has mainly focused on the integration between dyads of internal functions. Hill (1994) and Verma et al. (2001) show how a close collaboration between purchasing and marketing leads to enhanced level of profitability of the firm. Narasimhan and Das (2001) demonstrate the positive correlation between the integration of the purchasing function and its practices and the operational performances.

Similarly, Operations Management literature highlights the importance of integration among different practices (or bundles of practices) within the firm. Several papers show that integration between different sets of practices leads to the maximization of the operational performance. For example, although Total Quality Management (TQM) and JIT work separately, their combination leads to further performance improvements (Sriparavatsu and Gupta, 1997; Mefford, 1989; Flynn et al., 1999). TQM practices improve JIT performance by reducing manufacturing process variance that leads to safety stock inventory reduction and yields shorter cycle times. On the other hand, JIT practices affect quality by reducing potential scrap and reworking resulting from process failure.

OM Scholars have also considered the need for external integration (Watts et al., 1992). Several scholars argue that companies no longer compete as solely players but as members of an integrated supply chain. Achieving integration along the whole supply chain becomes a key success factor to compete in today's ever complex and competitive markets (Frohlich and Westbrook, 2001). Tan et al. (1998) demonstrate that when companies "integrate and act as a single entity, performance is enhanced throughout the supply chain" while Lee and Billington (1992) argue that integrating suppliers and customers could spark new opportunities for improvement at the supply chain level. In their seminal work, Frohlich and Westbrook (2001) present how that firms extensively integrating both upwards (i.e. towards suppliers) and downwards (i.e. towards customers) reap higher performances than firms adopting other integration strategies.

Within this last stream of research scholars have focused primary on supply chain logistics integration, in particular showing that integration between internal and external just-in-time practices leads to the maximization of operational performance. Just-in-time initiatives, aimed at streamlining the supply chain, improve the coordination between the supply chain partners and enhance supply chain performance (Lamming, 1993). Helper (1991) shows how extending JIT practices to suppliers is crucial to improve the long-term competitiveness of the firm. Buyers can reap benefits on quality, cost and deliveries by engaging suppliers in adopting JIT practices in the manufacturing and distribution activities. Simchi-Levi et al. (2003) maintain that "strategic partnership between suppliers and manufacturers may have a significant impact on supply chain performance". Kulp et al. (2004) find a strong link between an effective customer–supplier logistics coordination and operational performance. Stank et al. (2001) and Gimenez and Ventura (2005) demonstrate that a higher level of external logistics integration leads to higher performance.

2.2. Internal and external just-in-time practices: implementation process and complementarity

The implementation of internal and external just-in-time practices is not an easy process to carry out. Even though it is not enough to determine the success of an integration process, many scholars maintain that the process itself should follow a time sequence that starts with the internal integration and ends with the external one.

Stevens (1989) claims that the integration process should follow four stages: no integration, internal integration, company integration and finally external integration. Cooper and Ellram (1993) share this point of view. They maintain that firms should improve their internal integration before getting involved in external integration with the other members of the supply chain. Along this vein, Scott and Westbrook (1991) point out that the rationalization and the improvement of the internal activities should precede the integration practices with suppliers and customers. Bowersox (1989) focuses on internal logistical process and suggests that supply chain integration process should start from the internal integration of the operational and logistical processes and then involve customers and suppliers. Cagliano et al. (2006) underline the fact that the lack of internal integration is one of the reasons why projects of external integration fail.

Since the adoption of internal integration influences external integration, managers should adopt a holistic approach to the integration initiatives. An example is the use of Kanban as a method of just-in-time to implement a pull control along the supply network. First a firm should adopt Kanban to trigger the movement of materials within its production process to get improvement in terms of fall-off in overproduction and work in progress. When internal JIT is successfully in place and thoroughly operational, the firm should start implementing JIT towards customers and suppliers using vendor-Kanban for raw materials and outsourced components.

The implementation process is not only a matter of a sequence of predetermined stages. It is argued that internal and external integration practices are in fact interwoven and support each other over time. Some scholars maintain that the implementation of just-in-time practices, both internally and externally oriented, improve the performances of the firm because lean practices, of which just-in-time is their epitome, though separated, are highly interrelated (Womack and Jones, 1996; Flynn et al., 1999; Shah and Ward, 2007).

Das et al. (2006) highlight how internal logistics integration acts as a "catalyst" in the development and implementation of the external integration practices because it creates a strategic linkage between these practices and the competitive aims of the firm. Rosenzweig et al. (2003) claim that internal integration is a first step towards the whole supply chain integration, but, at the same time, integrating with suppliers and customers can spur opportunities for internal integration.

Stank et al. (2001) find that to improve its performance the firm has to reach high external integration through an increase of