COMPLEMENTARITIES IN SUPPLY FLEXIBILITY ON FIRM PERFORMANCE

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ABSTRACT

As today’s firms face a number of trends such as outsourcing and mass customization, firms are forced to find flexible ways to respond to uncertainty and meet customer demand effectively and efficiently. Firms recognize the necessity of attaining flexibility by means of looking beyond the borders of their own firm to their suppliers. Building upon the theory of complementarity, this study is to investigate complementary effects of supplier flexibility and supply network flexibility on a firm’s performance. According to the results, complementarity between supply network flexibility and supplier flexibility exists and leads to improved performance in terms of reliability, cost and time-based performance.

Keywords: Supply network flexibility, supplier flexibility, complementarity, firm performance

1 INTRODUCTION

Today’s firms face volatile business environment. Mergers, acquisitions, market shifts, economic upheavals, and other events can quickly knock a firm's supply chain off balance. Firms can’t solely rely on adjusting functional processes and systems but are forced to find flexible ways in response to uncertainty and meet customer demand effectively and efficiently. Recent researches have recognized the necessity of attaining flexibility by means of looking beyond the borders of their own firm to their supply chain (Liao et al., 2010; Tachizawa & Gimenez, 2009; Chan et al., 2009). Some studies focus on resources and abilities vested within suppliers that can be deployed, coordinated and bundled to form buyer’s capabilities. Flexible suppliers are capable of taking greater risks; therefore they enable firms to adapt to new knowledge, new technologies, market changes, or other developments by building and applying resources residing in the supply base (Rogers et al., 2011; Tachizawa & Gimenez, 2009; Chan et al., 2009; Chu et al., 2011). Another line of work in the academic literature about supply flexibility addresses dynamics in supply network emerging from the focal interactions with supply chain participants to adaptable structure of the network (Oh et al., 2013; Lummus et al., 2003; Khan & Pillania, 2008) It reflects the network abilities enable firms to cope with changes from suppliers, market, and technology.

Although different lines of research have provided important insights on how to establish and maintain a responsive supply base, examination on supply flexibility from an integrative perspective has been by-and-large ignored. Studies focusing solely on supplier flexibility or supply network flexibility fail to recognize that greater synergy can be created by pursuing
both flexibility capabilities in upstream supply chain. On the other hand, although there is an increasing amount of research being conducted on supply flexibility, most studies have examined its conceptual nature (Lummus et al., 2003; Soon & Udin, 2010) and its antecedents (Gosain et al., 2004; Wang & Wei, 2007; Chu et al., 2011). Building upon the theory of complementarity, this study is to investigate complementary effects of supplier flexibility and supply network flexibility on a firm’s performance.

LITERATURE REVIEW

As concept of flexibility was extended to supply chain, firm-specific capabilities reside in each supply chain entity. Lummus et al. (2003) defined that flexibility in supply chain is a result of interrelationships among supply chain partners. Coupled with the ability to restructure the supply base, companies must bring suppliers who can be more flexible and willingness to take greater risks in responding to changes into the supply network. (Kumar et al., 2006; Mahapatra & Melnyk, 2002; Zhang et al., 2002; Pujawan, 2004). Liao et al. (2010) conducts an empirical study to demonstrate that supply flexibility is a multidimensional concept, of which supplier flexibility and supply network flexibility are two distinct but interdependent dimensions.

Since customer tastes change quickly, companies need to respond quickly and supply the new products/services. Meeting these needs in the supply chain requires the ability to switch supply sources effectively and rapidly. Therefore, supply chain should be designed with change in mind. This study builds on the pioneering works of Lummus et al. (2003), Pujawan (2004), and Duclos et al. (2003) in regard to the importance of taking a flexible perspective in designing supply network. Supply network flexibility is defined as the ability of a firm to efficiently and effectively reconfigure the supply base with respect to environmental changes (Duclos et al., 2003; Singh & Sushil, 2004; Pujawan, 2004; Lummus et al., 2003; Gosain et al., 2005).

Supplier flexibility refers to the suppliers’ willingness and ability of responding to the changes requested by buyers. From strategic sourcing perspective, flexibility in the sourcing side of the supply chain plays a direct role in the performance in the downstream supply chain. Often, it is the ability and willingness to accommodate that limits the ability of a manufacturer to respond effectively and rapidly to customer demands (Gunasekaran, 1999). In particular, in certain industries characterized by innovative products or short product life cycle (i.e., electronics, computer), firms are most successful if they can work with suppliers who have the ability of satisfying changes in buyers requests (Pujawan, 2004).

Firm performance measures effectiveness and efficiency by how well end-customer demand and operational efficiency are met (Hausman, 2005). This study takes three aspects into consideration. Reliability defines the extent to which a supply chain is performing promised activities and services dependably and accurately, cost performance refers to the effectiveness in managing costs associated with operating the supply chain. Time-based performance indicates the extent to which a supply chain is improving in speed and responsiveness.
HYPOTHESES DEVELOPMENT

The theory of complementarity states that when resources have complementarities, their potential to create value is particularly enhanced (Milgrom & Roberts, 1995). Complementarity exists when a research produces greater returns in the presence of another resource than by itself. In this study, we propose that similar complementarity exists among two dimensions of supply flexibility. While supplier flexibility and supply network flexibility are distinct, they are also interdependent. Suppliers with a higher degree of flexibility contributed to delivering products/services with greater responsiveness (Malhotra & Mackelprang, 2012; Liao et al., 2010). The ability to change supply networks over time and in response to competitors’ changes allows the network participants to take advantage of opportunities to improve their individual positions and performance (Madhavan et al., 1998; Garavelli, 2003). The higher the adaptability of the resources on the supply side, the better the resource chain may be reconfigured and redeployed. Capable firms, such as Cisco and Gap, have developed both aspects of supply flexibility to maximize the value created from their supply bases. They tailor different supply chains to the nature of markets for products. And these complementary supply chains can serve as backups in case of an emergency (Lee 2004). Hence we propose hypotheses as

- **H1**: Complementarity of supplier flexibility and supply network flexibility has a positive effect on reliability performance.
- **H2**: Complementarity of supplier flexibility and supply network flexibility has a positive effect on cost performance.
- **H3**: Complementarity of supplier flexibility and supply network flexibility has a positive effect on time-based performance.

METHODOLOGY

Data Collection

The data were collected by surveys conducted over the internet (the web-based method). Since the research focused on supply change management flexibility, surveys were sent to leaders of firms with responsibility for supply chain management, logistics or purchasing strategies and operations in the following industries identified at the two-digit SIC level: 23 Apparel and Other Textile Products; 30 Rubber and Plastics; 34 Fabricated Metal Products; 35 Industrial and Commercial Machinery; 36 Electronic and Other Electric Equipment; and 37 Transportation Equipment.

An email was sent to the target population describing the purpose of the research, and asking them to participate in the survey. To those who responded to the initial email, we sent a follow-up email with directions on how to complete and return the survey. Of the 5,707 targeted names, 560 messages were unable to be delivered, leaving a valid sample of 5,147. After three waves of invitation, a total of 288 respondents either agreed to participate or received the survey for completion, yielding 201 usable responses.
ANALYSIS AND RESULTS

In this study, content validity is ensured by using procedures of a comprehensive review of the literature (Nunnally, 1978). Beyond assurance of content validity, Convergent validity measures the extent to which the measurement items of a construct form a common dimension (Kerlinger, 1978). Convergent validity is typically assessed by how well the items load on their intended construct. All standardized item-factor loadings in the measurement models were above 0.70 except for items CP3 with marginal values at 0.68 (Figure 1). All factor loadings are significant at the 0.001 level, which confirms satisfactory discriminant validity. Average variance extracted (AVE) was also used to evaluate convergent validity. Value of 0.50 or higher of AVE indicates that the variance captured by the intended construct of the items is greater than the variance due to measurement error and, thus, suggests convergent validity (Fornell & Larcker, 1981). AVE values are all above .50, suggesting adequate convergent validity for these constructs. Based on all these evidences, we concluded that the measurement model had adequate convergent validity.

To fully satisfy the requirements for discriminant validity, the square root of AVE for each construct is greater than the correlations between the constructs and all the other constructs. In this study, the squared root of AVE for each construct is greater than the correlations between the constructs and all the other constructs. Therefore, discriminant validity is supported.

The values of Cronbach alpha for all variables in the model were greater than 0.70, indicating adequate reliability of the measurements (Robinson and Shaver, 1973).

To assess performance effect of a complementary system is to evaluate if full system effects outweigh the individual system component effects (Tanriverdi & Venkatraman, 2005). This study is to determine if performance is subject to the complementarity of supply flexibility system or whether each dimension of supply flexibility independently enhances performance. Following the work by Tanriverdi and Venkatraman (2005) and Malhotra and Mackelprang (2012), the SEM technique was used to assess research hypotheses. Figure 1 presents the complementarity model including second-order factor model of the supply flexibility synergy construct. Two dimensions of supply flexibility are modeled as predictor of complementarity construct. The complementarity model shows significant positive impact of complementarity of supply flexibility on reliability ($\gamma = 0.34$, $p < 0.05$), cost ($\gamma = 0.88$, $p < 0.001$) and time-based performance ($\gamma = 0.53$, $p < 0.01$). Conversely, neither supply flexibility component is significantly linked to performance (Figure 2). These findings provide full support for all hypotheses, which indicate that complementarity between supply network flexibility and supplier flexibility leads to improved performance in terms of reliability, cost and time-based performance.
CONCLUSION

This is a study to evaluate supply flexibility with respect to both network and firm-specific flexibility, which was not fully investigated in previous research. The findings in this show that the integration of supply network flexibility and supplier flexibility reinforce the main
effect of each individual flexibility capability on firm performance. When network flexibility and supplier flexibility are integrated together, they produce a resource bundle that is difficult to imitate and will lead to sustainable competitive advantages.

REFERENCES


Lau, R. S. M. (1994). Attaining strategic flexibility. 5th Annual Meeting of the Production


