Edith Cowan Peer Reviewed Journals & Books Publishers

Edith Cowan Journal of Procurement & Supply Chain
ISSN:
Vol.4, Issue No.1, pp 1-19.

Supply management, supply flexibility and performance outcomes: An empirical investigation of manufacturing firms

[1]Aurell Mugambi
[1]Department of management science, University of Nairobi, University Way.
Corresponding author's e-mail: maxgeof@gmail.com

ARTICLE INFO

Article history:
Received Date: 2nd Nov 2021
Revised Date: 2nd Jan 2022
Accepted Date: 3rd Mar 2022

Keywords:
Supply flexibility, Supply management practice, Supply chain performance

ABSTRACT

Purpose: Increasingly, the global market environment is becoming more turbulent, complex and uncertain. Literature has explored the importance of supply management and its direct impact on performance. However, the nature of strategic supply management and its impact on supply flexibility needs further clarification in the context of the use of supplier resources and supplier network coordination. This research presents a model of supply management, supply flexibility and supply chain performance. In this study, we examine the relationships between supply management and supply flexibility, and extend the concept of supply flexibility in terms of supplier flexibility and supply network flexibility on relevant supply chain performance measures.

Design/Methodology/ Approach: Data for the study were collected from 201 manufacturing firms, and the measurement scales of supply flexibility were tested and validated using structural equation modeling.

Findings: The results indicate strong, positive and direct relationships between supply management practices and supply flexibility, and between supply flexibility and supply chain performance.

Contribution to Policy and Practice: The study recommends the management of manufacturing firms to recognize the interdependence of different components of the supply chain, and the need to focus on improving the entire system, rather than just individual components and to invest in practices that enhance supply flexibility, such as demand forecasting, risk management, and supplier relationships.

Background

To deal with the growing complexity and uncertainty of today's dynamic business environment, firms continue to explore ways of developing flexibility, which is the ability to change or respond to environmental uncertainty. Many firms recognize that supply chain flexibility is crucial to building a sustainable competitive edge in an increasingly turbulent marketplace. Fashion, mobile phones and the bicycle industry are examples of industries that have attempted to implement supply chain flexibility strategies with varying degrees of success (Catalan & Kotzab 2003; Christopher, Lowson & Peck 2004). Far beyond just internal operational effectiveness, firms today emphasize the ability of responsive sourcing for value creation and delivery within the supply chain. Firms use their flexible networks of suppliers to deliver a wide range of products (Mason *et al.*, 2002).

In this context, supply flexibility is becoming a critical competitive priority in dealing with the complexity and uncertainty associated with the changing needs of customers. Increasingly, dynamic and responsive market demands require that firms strategically manage their upstream supply chain. The expanding use of information technology and outsourcing trends motivate firms to explore supply management as a means to create greater synergy across the supply chain (Gunasekaran 1999; Narasimhan, Talluri & Das 2004). Cross-functional and inter-organizational collaborative efforts are dedicated to increasing flexibility for rapidly changing market 6 Volume 46, Number 3 requirements in terms of variety and speed (McKoneSweet & Lee 2009). Despite the existence of considerable supply management literature, there is little empirical investigation of the role of supply management in building supply flexibility for greater business performance. There are three specific gaps in the literature. First, while most companies recognize that flexibility is key to success, many have not yet examined the role of supply management as a driver of supply flexibility. Supply flexibility does not occur randomly. It is the strategic result of investments over years. Second, supply flexibility from the resource-based view (RBV) has not been comprehensively examined. Supply flexibility is typically regarded as one dimension of supply chain flexibility, but studies on supply flexibility are rare.

The theoretical underpinnings of the concept of supply flexibility have not yet been well developed. Third, there is a need for empirical investigations of the dynamic relationships between supply management and supply flexibility. Many of the studies on supply flexibility have used a case study methodology, but a cross-industry empirical study designed to validate the concept of supply flexibility and relationships among supply management, supply flexibility and performance would be valuable in contributing to both operational theory and practice. The purpose of this study, therefore, is to address these research gaps through insights drawn from the RBV and strategic flexibility to extend our understanding of supply flexibility. Based on these research results, both managers and researchers can benefit from a deeper understanding of how various supply management practices contribute to building supply flexibility; how supply flexibility affects business outcomes; and how supply flexibility develops according to different business environment.

Literature Review

Supply Management

The concept of supply management extends beyond the typical transaction focus of purchasing and encompasses the more comprehensive evolution to a strategic focus of procurement. Supply management has become increasingly integrated with company strategic plans in order to maximize firm responsiveness. Supply management plays a key liaison role between external suppliers and internal organizational operations by creating and delivering time-based value to customers (Novack & Simco 1991). Supplier selection, development and supplier strategic alliances have been recognized as crucial roles in supply management (Christopher 2000; Narasimhan *et al*. 2004; Singh & Sushil 2004). Supplier Selection. Supplier selection refers to the criteria used to evaluate and select suppliers in order to configure and establish a supply chain for long-term competitive advantage (Choi & Hartley 1996; Vonderembse & Tracey 1999). Supplier selection is important because it can impact the performance of ensuing activities in the supply chain. Supplier performance can also have a direct financial and operational impact on the business (Ittner, Larcker, Nagar & Rajan 1999; Bailey, Farmer, Jones & Jones 2005). Therefore, the ability of a supply chain to react to market demand on a timely basis is dependent on the reaction capability of suppliers to make changes accordingly. Supplier Development.

Supplier development is defined as the practices that facilitate the continuous improvement of suppliers for establishing and sustaining competitive advantage (Krause & Ellram 1997; Scannell, Vickery & Droge 2000). Firms encourage supplier development to ensure that supply sources can provide goods and services with value and that they can maintain a network of capable suppliers that will support a long-term competitive advantage (Hahn, Watts and Kim 1990; Watts & Hahn 1993). The supply chain management literature has stressed the importance of supplier development in supporting a firm's time-based strategy by ensuring that suppliers' performance and capabilities meet the needs of the buying firm (Hartley & Choi 1996; Krause & Ellram 1997). Strategic Supplier Alliances. Strategic supplier alliances refer to close and long-term relationships with suppliers (Hines 1994; Macbeth & Ferguson 1994). Strategic supplier alliances provide a framework for strategic collaboration, ensuring open communication channels and faster resolution of problematic issues and higher responsiveness (Mentzer, Foggin & Golicic 2000). A strategic alliance emphasizes direct long-term associations that encourage mutual planning and problem-solving efforts between the firm and its suppliers (Gunasekaran, Patel and Tirtiroglu 2001; Li, Ragu-Nathan, Ragu-Natha & Rao 2006). Supply Flexibility although the conceptualization of flexibility varies based on context, previous studies are fairly clear and consistent with regard to the resource-based nature of flexibility (Sanchez 1995; Lau 1996; Schroeder, Bates & Junttila 2002). The fundamental premise of flexibility is that resources can be deployed and coordinated; thus, they can be bundled to form capabilities.

From the RBV, supply flexibility should enable firms to adapt to environmental changes by building and applying resources residing in the supply base. Sanchez (1995) discusses strategic flexibility in the forms of resource flexibility and coordination flexibility. Resource flexibility refers to the extent of responsive ability through the use of organization-specific knowledge and physical assets. It is the nature and design of resources that constrain the ways in which firms can use them. However, not all resource capabilities automatically Supply Management, Supply Flexibility and Performance Outcomes July 2010 7 flow to the company that "owns" the resource. Therefore, the concept of coordination flexibility was developed to address the extent of responsiveness from the use of cross-functional collaborative capabilities. Strategic flexibility alone is no longer adequate for building competitive advantage in a dynamic environment. It only reflects a firm's ability to respond to uncertainty with the support of its own superior knowledge and capabilities, but remains somewhat lacking. Looking beyond the borders of the firm and recognizing the role of resources in flexibility, supply flexibility is defined as the extent of responsive ability through the use of supplier-specific capabilities and the use of inter-organizational collaborative capabilities.

This study extends the understanding of strategic flexibility by developing the concept of supply flexibility in terms of supplier flexibility and supply network flexibility. In maintaining a responsive supply based, a firm must emphasize two primary aspects: using responsive supplier-specific capabilities (supplier flexibility) and using collaborative capabilities (supply network flexibility). Supplier Flexibility. Supplier flexibility refers to the extent of responsive abilities through the use of supplier-specific capabilities. Recent developments in RBV suggest that firms emphasize the linkage between internal resources and performance and then generate value from their alliances with suppliers (Holcomb & Hitt 2007; Azadegan, Dooley, Carter & Carter 2008; Yao, Dresner & Palmer 2009). That is, firms use both firm-specific resources and firm-addressable resources outside the firm as the basis for developing capabilities. Lavie (2006) proposes that organizational competitive advantage combines the focal organization's resources with the resource endowments of supply chain partners. A firm's unique supply resources and capabilities then determine the level of consistent performance across time. Firms can be responsive to

changing customer needs by spreading and sharing the responsibility throughout the supply base since "it is the ability of the suppliers that limits the ability of a manufacturer to respond rapidly to customer requirements" (Christopher 2000). Suppliers without ability to react to variances effectively and with efficient utilization of resources will limit the flexibility potential of even those capable firms. Resources and capabilities accrued from suppliers help firms to better manage pressures from environmental uncertainties. Supply Network Flexibility. Supply network flexibility is defined as the extent of responsive ability through the use of collaborative capabilities to reconfigure the supply base effectively and efficiently (Duclos, Vokurka & Lummus 2003; Pujawan 2004). This concept is derived from coordination flexibility and explains why some competitors are more responsive and profitable than others. In network competition, competing on resources implies that the resources need to be improved and expanded in accordance with environmental changes. The supply network structure influences information and material flows along the supply chain (Skilton & Robinson 2009). Better structuring, coordinating and managing of the supply network leads to better utilization of supply base resources. In the context of supply chains, Ketchen and Hult (2007) and Miles & Snow (2007) extend the RBV and propose that network structures may complement internal resources of organizations with differential access to external resources. Competitive advantage derived from networked collaborative capability is difficult for others to imitate. These networked resources constitute an important component of sustainable competitive advantage. Thus, the success of a firm depends on expansive use of inter-organizational capabilities. Also from the RBV, firms must strive to respond to the dynamic nature of the business environment by continuously learning how to better configure and assemble chains of resources, because all resources depreciate. Flexibility in supply networks implies achieving the multiple performance requirements (e.g., speed, ease and cost) by managing new knowledge, new technologies, market changes or other development needs in the course of creating and delivering value (Sanchez 1995; Conner & Prahalad 1996; Sanchez & Perez 2005). Therefore, the design of the supply network anticipates changes by which a focal firm may effectively configure its entire supply chain. Interrelationships between Supplier Flexibility and Supply Network Flexibility While supplier flexibility and supply network flexibility are distinct, they are also interdependent. Either aspect could be a constraining factor that limits the firm's ability to benefit from its supply base.

Supplier flexibility is the capability associated with a firm's current resources in the supply chain, which can be regarded as a relatively static capability. On the other hand, supply network flexibility reflects a firm's ability to incur low costs when changing the uses to which its resources are applied. This aspect implies the dynamic efficiency and effectiveness needed to reassemble the resource chain. Supplier flexibility mutually supports and reinforces supply network flexibility. However, even if a firm's supply network flexibility is high, the current supplier's limited capability could constrain the kinds of responsiveness it could successfully bring to a changing environment. The higher the adaptability of the resources on the supply side, the better the resource chain may be reconfigured and redeployed. It does not necessarily follow that all suppliers must be flexible in order to achieve supply flexibility. A firm can either develop resource deployment capabilities for acquiring and configuring supply resources or seek a complementary set of supplier capabilities to create additive value synergies. Capable firms, such as Cisco and Journal of Supply Chain Management 8 Volume 46, Number 3 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). Supply Chain Performance Supply chain performance refers to the extent to which a supply chain meets end-

customer requirements, and contains operational efficiencies which can deliver that performance (Hausman 2005).

This definition implies that supply chain performance measures effectiveness and efficiency by how well these two goals are met. In this study, supply chain performance is measured by four dimensions:

(1) Time-based performance indicates the extent to which a supply chain is improving in speed and responsiveness,

(2) Reliability defines the extent to which a supply chain is performing promised activities and services dependably and accurately,

(3) Supplier performance measures the overall suppliers' tangible and intangible outcomes including product quality, reliable services and dependable relationship and

(4) Cost performance refers to the effectiveness in managing costs associated with operating the supply chain. Each of these four aspects captures the effectiveness and efficiency of a supply chain and reflects the inter-organizational characteristics of supply chain performance measurement

Materials and Methods

Measure Development We developed multiitem scales of supply flexibility (SF) through a review of the flexibility and strategy literature. According to Garavelli (2003), supply chain configuration is flexible when suppliers are able to process a variety of products or components and deliver to multiple assemblers. Volberd (1996) defines the willingness of suppliers to adjust to changes, without resorting to a series of new contracts and renegotiations, as an indicator of a flexible supplier. Therefore, supplier flexibility (SF/ SPL) is captured by two Liker-scale items: the willingness and ability of suppliers to accommodate changes that buyers have requested. The measurement items of supply network flexibility (SF/NET) build on the pioneering works of Lummus, Duclos and Vokurka (2003), Pujawan (2004) and Duclos *et al*. (2003) by taking a flexible perspective in designing supply networks. Referring to studies on manufacturing, product development flexibility and limited empirical studies on supply chain flexibility, supply network flexibility is operationalized by four attributes.

These four attributes are the following: (1) the number of alternate supply sources (Pujawan 2004) that captures the supply range attribute of supply network flexibility, (2) the time incurred for switching supply sources which represents the mobility attribute of supply network flexibility, (3) the cost incurred for switching supply sources which also represents the mobility attribute and which reflects the ease with which the supply network moves from one Journal of Supply Chain Management 10 Volume 46, Number 3 state to another (Otto & Kotzab 2003) and (4) the extent of how the incoming material's quality and delivery performance is affected by switching supply sources (Pujawan 2004), which addresses the attribute of performance consistency despite changes. A more flexible supply network will exhibit less fluctuation in performance outcomes. The measures of supply management (SM) and supply chain performance (SCP) used in this study were mostly drawn from existing scales found in previous research studies on supply chain management and supply management. Supply management was assessed with the scale selected and modified from those developed by Humphreys, Li and Chan (2004) and Li *et al*. (2006). Supply chain performance was assessed with items selected and modified from those developed by Beamon (1999) and Gunasekaran *et al*. (2001). All the measurement items are listed in Appendix A.

Data Collection

The data were collected using a Web-based method. Because this research focuses on supply chain management practices and flexibility, we decided to direct the survey to the VPs, directors or managers of supply chain, purchasing, logistics or operations, as well as leaders in strategic development and planning or other leaders in the firm who have clarity and visibility of supply chains, logistics and purchasing strategies and operations. An email list of 6,273 names was obtained from two providers of an executive contact database: RSA Teleservices and Lead411. The participants represent six industries, defined 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." This e-mail list was then further refined through the following steps: (1) if some names were shown more than once, only one of the names was kept and the duplicate names were removed and (2) because the large-scale survey was implemented using online data gathering, names with no e-mail address were removed. The refinement resulted in a list of 5,147 names. An e-mail was sent to the entire sample population of 5,147 inviting them to participate in the study with a brief description of the research. Willing participants were directed to reply with a blank e-mail thus implying their consent of participating in the study. We then sent a follow-up e-mail in which the respondents were directed to respond to the survey in three ways: (1) by selecting the link that would take them to the online questionnaire, (2) by fax by selecting the link that would take them to the PDF format of the questionnaire on the Web site or (3) by requesting a hard copy from the researcher. After three waves of invitation, a total of 288 respondents either agreed to participate or received the questionnaire for consideration, yielding 201 usable responses. The response rate compares closely to that reported in recent supply management and operations management papers. Table I summarizes characteristics of respondents and companies.

Comparisons between the sample of 5,147 and the respondents of 201 indicated no significant group differences regarding the proportion of industry representation (w2 57.52, df56, p40.1). In addition, by performing w2 tests, no significant differences were found (1) between early respondents from the initial wave and those who responded in the second wave (w2 59.42, df56, p40.1) and (2) between those who responded in the second wave and late respondents from the third wave in terms of the proportion of SIC codes (w2 53.96, df56, p40.1). All of these tests suggest that nonresponse bias was not a problem. Measurement Validation After potential items of supply flexibility were generated through a literature review and from construct definitions, eight individuals (three professors in operations and supply chain management, two supply managers and three Ph.D. candidates in manufacturing management) were selected as participants in a pretest. The respondents were asked to provide feedback about question clarity and consistency with construct definitions. By incorporating their feedback, measurement items were modified, discarded or added to strengthen the constructs and content validity. Confirmatory factor analysis (CFA) was conducted to assess the measurement properties of the SF scale. Firstorder factor models are those in which correlations among the observed variables can be described by a smaller number of latent variables, each of which may be considered to be one level; these factors are termed primary or first-order factors.

TABLE I

Demographics Information of Samples

Characteristics	Percentage
Job title	
CEO/President	33.83
Director	23.38
Manager	24.38
Others	18.41
Job functions (respondents marked all that apply)	
Purchasing	35.32
Transportation	18.41
Manufacturing/operations	34.83
Distribution	10.95
Supply chain management	24.88
Logistics	29.85
Sales	31.34
Other	14.93
Years worked at the organization	
< 2 years	13.43
2–5 years	24.88
6–10 years	16.92
> 10 years	44.28
Industry type of your company — SIC code	
Apparel and other textile products (23)	1.99
Rubber and plastics (30)	2.99
Fabricated metal products (34)	5.47
Industrial and commercial machinery (35)	22.89
Electronic and other electric equipment (36)	49.75
Transportation equipment (37)	6.97
Others	9.95
Number of employees in your company	
< 100	26.87
101–250	18.41
251–500	11.94
501–1,000	11.44
> 1,000	30.85
Average annual sales of your company	
< U.S.$10 million	18.41
U.S.$10–U.S.$24 million	13.43
U.S.$25–U.S.$49 million	9.45
U.S.$50–U.S.$99 million	10.45
> U.S.$100 million	45.77

As shown in Table II, the additional model fit indices indicate that the measurement model for supply flexibility has a good fit (w2 /df50.754; second-order model suggest a good fit with the data (w2 /df51.124; RMSEA50.025, GFI50.97, AGFI50.95, NFI50.98 and CFI51.00). The test of second-order constructs also validates that supplier flexibility and supply network flexibility form a higher-order construct (supply flexibility). Referring to studies on supply chain flexibility, which has been well recognized as a multidimensional concept, we felt it appropriate to incorporate two interrelated dimensions of supply flexibility in the conceptual framework in order to provide sound implications to practitioners and set a basis for future research extensions. Figure 2 presents the estimation results for the second-order model. RMSEA< 0.001, GFI50.99, AGFI50.97, NFI50.99 and CFI51.0). We next tested supply flexibility as a second-order confirmatory factor model. Supply flexibility is considered a multidimensional concept and is measured by SF/ SPL and SF/NET and each of these subconstructs is measured by several indicators. The first-order factors have loadings of 0.84 and of 0.58 on the second-order factor. All loadings are significant (p< 0.05). The fit indices for this

TABLE II

Supply Flexibility (SF) — Validity and Reliability

Constructs/Items	Standardized Loading	Cronbach's α
Supply network flexibility		0.91
SF/NET1	0.82	
SF/NET2	0.90	
SF/NET3	0.89	
SF/NET4	0.83	
Supplier flexibility		0.89
SF/SPL1	0.92	
SF/SPL2	0.92	
Cumulative % of variance	82.31	
Overall model fit: χ^2/df=0.754; RMSEA < 0.001, GFI=0.99, AGFI=0.97, NFI=0.99 and CFI=1.0.		

Finally, the reliability of the items comprising each dimension was examined using Cronbach's a. Reliability is an assessment of the degree of internal consistency between multiple measurements of a variable. The generally agreed upon lower limit for Cronbach's a is 0.70 (Robinson, Shaver & Wrightsman 1991). The reliability values found here are both 40.85, which are considered very acceptable (Table II). CFA was conducted to examine the convergent validity of the measures of SM and SCP. Respectively, two and four items were dropped from the initial SM and SCP measurement models due to significant cross loadings or model fit improvement. All of constructs/subconstructs exhibited good internal consistency, as demonstrated by the reliability scores. The additional fit indices indicate that the measurement models of both SM and SCP have a satisfactory fit. Tables III and IV provide additional information about the psychometric properties of the measurement scales. Discriminant validity refers to the independence of variables (O'Leary-Kelly and Vokurka 1998). It is assessed by showing that the correlations among variables are significantly different from 1.0 (Bagozzi, Yi, and Phillips 1991). In summary, all factor intercorrelations were significantly different from 1.0 at the 0.05 significance level (Table V). Several tests were used to assess common method variance (Podsakoff & Organ 1986).

First, the correlation matrix (Table V) does not show any exceptionally correlated variables. Second, all principal constructs are entered into a principal components factor analysis. The highest factor from the principal component factor analysis was added as another independent variable. This independent variable did not significantly increase the variance explained in the dependent variable. These tests indicate a lack of severe common method bias. The second test also shows all items loaded well on their hypothesized constructs, which suggests unidimensionality for the multidimensional constructs of supply management, supply flexibility and supply chain performance.

FIGURE 2
Supply Flexibility: Standardized Coefficients for the Higher-Order CFA Model

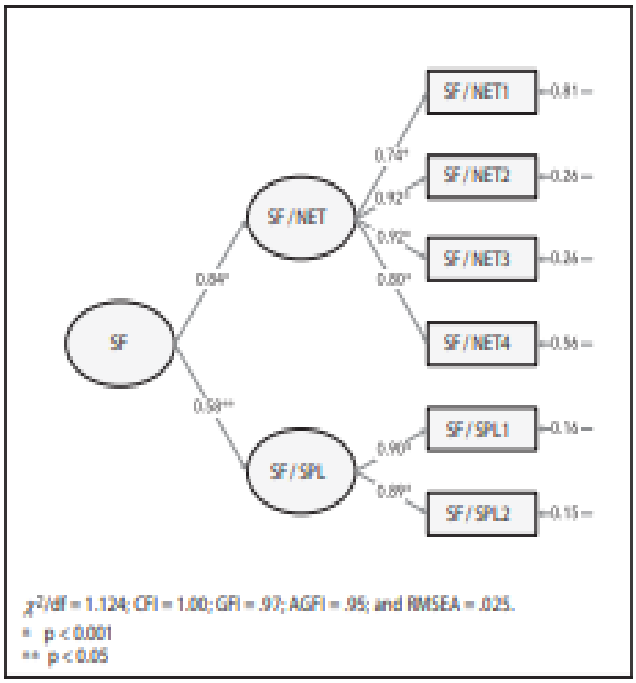


TABLE III
Supply Management (SM) — Validity and Reliability

Supply Management	Standardized Loading	Cronbach's α
Supplier selection		0.80
SM/SS1	0.82	
SM/SS2	0.69	
SM/SS3	0.84	
SM/SS4	0.71	
Supplier development		0.75
SM/SD1	0.76	
SM/SD2	0.83	
SM/SD4	0.69	
Strategic supplier alliance		0.86
SM/SP1	0.74	
SM/SP2	0.77	
SM/SP3	0.66	
SM/SP4	0.84	
SM/SP6	0.78	
Cumulative % of variance	65.8	
Overall model fit: χ^2/df=2.053; CFI=0.95; GFI=0.92; AGFI=0.88; RMSEA=0.073.		

Multigroup Comparison

To determine whether the final model differed based on firm size, the overall sample was split into two groups based on firm size. Firm size was measured by the number of employees, a commonly used measure of size in management research. Generally, a business with fewer than 250 employees is classified as a small and medium enterprise (SME) (www.insme.info/page.asp); this resulted in 91 SMEs and 110 large firms for our sample. A multigroup comparison was then conducted to determine whether supply flexibility has the same theoretical structure for each size group. No significant differences between the constrained and unconstrained models were identified, indicating that the model is valid for both large-sized firms and small and medium-sized firms: Dw2 (df55)54.487, DCFI5 0.001, DTLI5 0.001 and DRMSEA50.009.

Hypothesis Testing

The conceptual model illustrated in Figure 1 demonstrates four hypothesized relationships among the variables of supply management practice, supply flexibility and supply chain performance. The structural model was assessed by examining the path coefficients, their statistical significance and the overall model fit. Figure 3 displays the path diagram resulting from the structural modeling analysis using AMOS. The results exhibit that all the measurements have significant loadings to their corresponding second-order construct. Overall, the model has a satisfactory fit (w2 /df52.40; GFI50.90, AGFI50.86, CFI50.93 and RMSEA50.08). The relationship proposed in Hypothesis 1 was found to be significant (g50.48, p< 0.001), indicating that there is a positive relationship between supply management practices and supply network flexibility. The importance of supply management in striving toward a flexible supply base has received considerable support in the literature (Christopher 2000; Van Hoek, Harrison and Christopher 2001; Christopher *et al*. 2004). However, no empirical evidence has been previously shown.

TABLE IV

Supply Chain Performance (SCP) — Validity and Reliability

Supply Chain Performance	Standardized Loading	Cronbach's α
Supplier Performance		0.91
SCP/SL1	0.78	
SCP/SL2	0.81	
SCP/SL3	0.83	
SCP/SL4	0.88	
SCP/SL6	0.70	
SCP/SL8	0.78	
Time-based performance		0.72
SCP/TB2	0.71	
SCP/TB4	0.65	
SCP/TB5	0.71	
Cost		0.76
SCP/CT1	0.70	
SCP/CT2	0.68	
SCP/CT3	0.80	
SCP/CT4	0.74	
Reliability		0.83
SCP/RL1	0.78	
SCP/RL2	0.80	
SCP/RL3	0.82	
Cumulative % of variance	68.3	
Overall model fit: $\chi^2/df=1.773$; CFI=0.95; GFI=0.90; AGFI=0.86; RMSEA=0.062.		

The statistical significance of Hypothesis 1 verifies that better supply management will improve the flexibility of sourcing with respect to changes. Hypothesis 2 was supported as well. As

expected, supplier selection, development and alliances have a direct and strong positive effect on supplier flexibility. The path coefficient of this relationship is 0.59 with a p-value < 0.001. Supply management today should therefore reflect a growing emphasis on the importance of suppliers. For instance one criterion of supplier selection should be the ability and willingness to respond to company changes. Efforts must be made to build up alliances with major suppliers so that they would be able to respond to and coordinate with changes if it is deemed necessary. Our results also indicate that a higher level of supply network flexibility and supplier flexibility may lead to improved supply chain performance. Both relationships are found to be statistically significant (b50.15, p50.05; b50.47, p< 0.001), which supports the idea that flexible suppliers and a flexible supply base both contribute to supply chain performance. Supply chain performance reflects the results of cross-functional collaboration (i.e., within flexible suppliers) and interorganizational coordination (i.e., in a well-integrated supply base). In addition, the ability to change supply networks over time and in response to competitors' changes allows network participants to take advantage of opportunities to improve their individual positions and performance. As a result, one would expect improvements on each node with a flexible supply chain and even better supply chain performance to be achieved. Supply network flexibility also enables companies to tap into a responsive supply base to ensure reliable product supply. Therefore, companies can restructure the supply flows of their materials to gain efficiency. Time-based performance improvement comes from supply flexibility because the volume and mix variations with respect to market changes can be absorbed by the flexible supply side.

Moderating Effect of Firm Size

Some studies have investigated the differences between SMEs and large enterprises for supply chain management practices such as a strategic focus and control structure (Hong and Jeong 2006), relationship development (Claycomb and Frankwick 2004) and integration (Harland, Caldwell, Powell and Zhang 2007). While large firms offer a much greater scope of products and services, have more complex supply networks and tend to be more active in exploiting supply base capabilities, SMEs are potentially significant in enhancing the overall supply chain performance. Because of limited resources, it is very important for SMEs to strategically compete in their specialized niche markets and through their unique competencies in supply management (Lee, Lim and Tan 1999; Hong and Jeong 2006). However, the findings of istency in their adoption of SCM practices and outcomes (Wong 2005; Maguire and Koh 2007; Vaaland and Heide 2007; Pedersen 2009). Consequently, we determined it would be worthwhile to perform a post hoc analysis to investigate if firm size would influence the pattern of building flexibility into the supply base. Two additional structural models were analyzed for groups of SMEs and large enterprises (Figure 4). The results further validate the positive effect of supply management on supplier flexibility, and supplier flexibility on supply chain performance. These two effects are both positive and significant in the two submodels. Both large firms and SMEs are utilizing supply management to develop flexibility capabilities of their suppliers. Following Kei *et al.*'s (2000) work to compare the path coefficients between large and small/medium groups, the results reveal that the path coefficient from supply management to supplier flexibility in the structural model for large firms is significantly stronger than the corresponding path coefficient in the model for SMEs (t5104.42, p < 0.001). Conversely, the path coefficient from supplier flexibility to supply chain performance is significantly stronger in the model for SMEs when compared with that in the large firms group (t53381.18, p < 0.001). However, the mediating role of information sharing presents a far different effect. The mediating effect of supply network flexibility between supply management and supply chain performance is not significant for SMEs. In other words, Hypotheses 1 and 3 are not fully supported for SMEs.

TABLE V
Correlation Matrix

		Mean	Standard Deviation	1	2	3	4	5	6	7	8	9
1	Supplier selection	3.85	0.84	1.00								
2	Supplier development	2.95	1.29	0.35**	1.00							
3	Strategic supplier alliance	3.70	0.91	0.36**	0.46**	1.00						
4	Supplier flexibility	4.02	0.82	0.24**	0.28**	0.32**	1.00					
5	Supply network flexibility	3.30	1.13	0.29**	0.26**	0.21**	0.44**	1.00				
6	Supplier performance	4.00	0.68	0.35**	0.19*	0.32**	0.25**	0.21**	1.00			
7	Time-based performance	3.73	0.85	0.26**	0.18*	0.21**	0.26**	0.28**	0.36**	1.00		
8	Cost	3.31	0.85	0.13	0.18*	0.31**	0.33**	0.24**	0.35**	0.45**	1.00	
9	Reliability	4.36	0.67	0.16*	0.20**	0.21**	0.26**	0.19*	0.41**	0.52**	0.30**	1.00

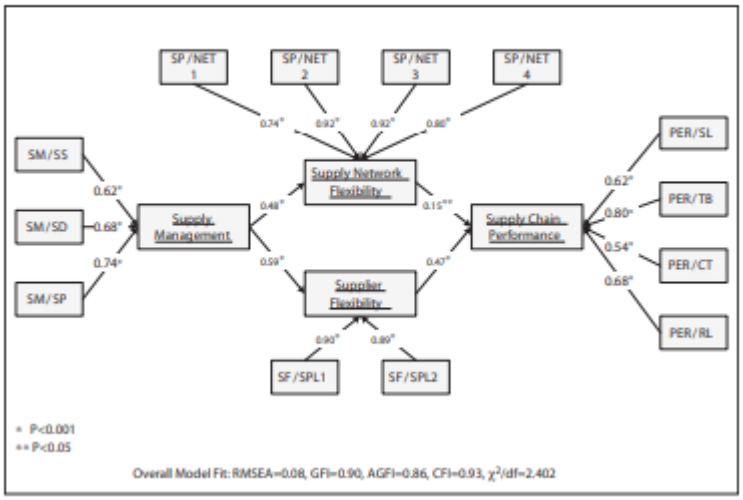
**Significant at the 0.01 level.
*Significant at the 0.05 level.

DISCUSSION

Theoretical Contribution

In light of a growing research interest in flexibility in the context of supply chains, this study contributes to theory by investigating supply flexibility based on the RBV. From an academic perspective, our research specifically developed the concept of supply flexibility by recognizing the role of resources in supply flexibility. Two distinct but interdependent dimensions were investigated: supplier flexibility and supply network flexibility. With the developed instruments of supply flexibility, future efforts can further explore complexity in supplier networks in an effort to gain a greater understanding of supply flexibility's contribution to sustainable competitive advantage. For instance, the answers to the question of "do improvements in supply flexibility affect improvements in manufacturing and product development flexibility?" will be meaningful to practitioners when they design their supply chain flexibility strategy.

FIGURE 3
Results for Structural Model



By combining internal resources/capabilities with their supply network, firms can obtain sustainable competitive advantage as supply chains increasingly compete against supply chains. Specialized capabilities across the supply chain may be better leveraged if supply partners make appropriate and coordinated process adjustments. Our findings also demonstrate the relationships among supply management, supply flexibility and supply chain performance. Companies can improve their present performance in turbulent business environments by linking their supply management practices and supply network flexibility capabilities. With simultaneous trends of increasing outsourcing and the growing complexity of supply networks, the current study joins a limited number of empirical research efforts that investigate key interorganizational collaboration phenomena. The post hoc analysis of the moderating effect of firm size offers specific findings that should inform and influence future research.

Practical Implications

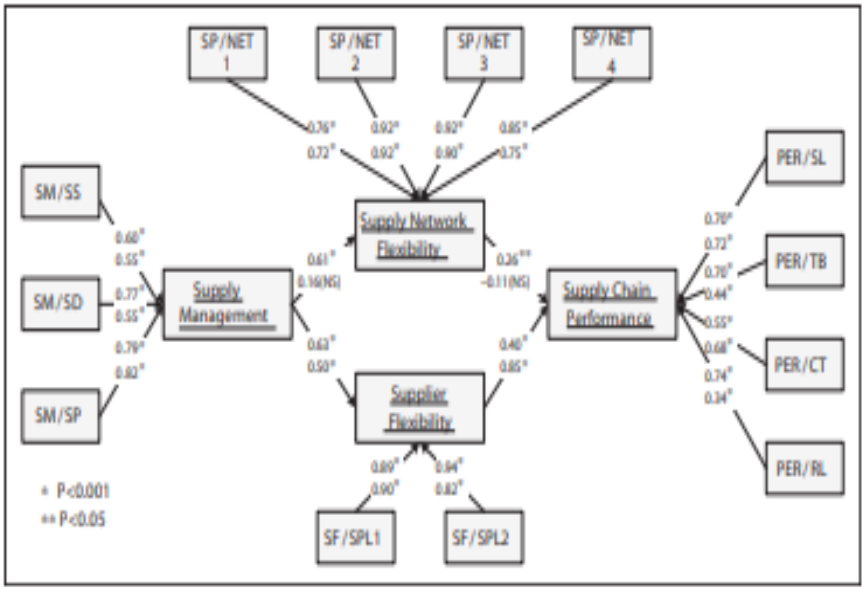
This research should be of interest to firms that consider developing realistic survival strategies to combat downturns. Supply chain executives need to devise survival strategies in times of financial crisis, while simultaneously planning a turnaround strategy that requires the contributions of their supply base. Practitioners currently interested in implementing flexibility strategy should understand that supplier flexibility and supply network flexibility are complementary. If current suppliers do not have enough capabilities to respond to changes and uncertainties, it becomes critical for firms to build flexibility into the supply base by relying on the ability of reconfiguring the supply base. Hence, the value of supply network flexibility diminishes because firms may tend to explore capabilities from additional suppliers instead of focusing on their current supply base.

Besides pursuing two approaches for building flexibility into the supply base, managers need to understand the positive impact that supply management practice has on supply flexibility, which constitutes an additional insight concerning the strategic importance of the supply management function. Therefore, adapting to the business strategy of flexibility, the supply management professional's responsibilities must change accordingly. Additionally, the findings of this paper suggest that toplevel supply chain management efforts should focus heavily on the development of current suppliers, and devote significant resources to strengthening current suppliers and improving their just-in-time capabilities. Because unanticipated changes in a customer's production plans and schedules can affect supplier schedules, sourcing executives at the buying firm should assure that supplier development practices and collaborative relationship s result in a supplier's ability to adjust production volumes with short notice and remove inventory from the chain.

The measurement instruments of supply flexibility developed in this study might be a valuable tool for companies to evaluate and compare their current sourcing-related capabilities. Finally, the post hoc analysis provides a number of insights into how managers in SMEs and large firms develop supply flexibility and further improve supply chain performance. Practically speaking, the significant effect of supply network flexibility on the relationships between supply management and supply chain performance indicates that SMEs do not need a complex supply base to be responsive to environmental changes. Considering the stronger effect of supplier flexibility on supply chain performance for SMEs than large firms, SMEs rely more on supplier's capabilities or business partners' resources and capabilities in order to adapt to environmental changes. Utilizing suppliers' capabilities and willingness to adapt to changes on a timely basis will help an SME develop the competencies of trust and committed value, which can be added to the supply chain. It is recommended that SMEs actively build up a capable supply base that allows

them to solve problems as a team, make collaborative production and logistics planning, coordinate replenishment scheduling and work together to improve quality and cost performance. Comparatively, supply network flexibility plays an important role in supply chain performance improvement for large firms. The complexity of products and services offered by large firms requires designing a supply network to accommodate dynamic operations and market changes. In brief, it is imperative for large firms to direct their strategic efforts and deploy their financial/ operational resources toward developing and enhancing supply flexibility; otherwise, they may lose a key element of their sustainable competitive advantage.

FIGURE 4
Structural Model Results (Large-Size Firms: Bold; Small and Meidum-Size Enterprises: Italic)



Future Research Directions

As flexibility has become a key strategic issue for many industries, the operationalization of supply flexibility is only a first step toward a better understanding of the impact that supply flexibility has on performance. Future research attention may focus on identifying and measuring the cause-and-effect relationships between supply flexibility and other dimensions of flexibility across the supply chain. It will be quite interesting to explore how supply flexibility contributes to the improvement of flexibility capabilities in other processes across the supply chain and, eventually, leads to ways to increase supply chain performance. For example, it is worthy to examine how improvements in supply flexibility affect the level of manufacturing and product development flexibility. Additional research may consider other supply chain management practices (beyond the three practices discussed in this paper) for building flexibility into the supply side. Additional empirical study is needed to identify contingency factors, both within and outside the company. For instance, the interactive effects of environmental uncertainty and supply flexibility on performance are vague. There is still a need to link supply flexibility, as a critical response to environmental uncertainty across industries, to the benefits they carry across the supply chain.

Conclusion

Supply flexibility plays a critical role in the environment of serious market uncertainty. Supply flexibility reflects both supplier flexibility and supply network flexibility. Many companies today tend to focus on optimizing their supply networks by reducing the size of the supply base. This study suggests that the flexibility of a supply network is not easily replaceable as firms reduce the size and scope of their supply base. The findings suggest that it is essential to retain suppliers that are willing and capable of adapting to changes and challenges. These suppliers may share in the responsibilities of dealing with dynamic environmental uncertainties and speed of changes — particularly in economic downturns. Overall, sustainable competitive advantage requires that companies adapt their sourcing strategy to be more flexible and responsive through the effective use of their potential internal resources and their network capabilities.

Reference List

Azadegan, A., K.J. Dooley, P.L. Carter and J.R. Carter. "Supplier Innovativeness and the Role of Interorganizational Learning in Enhancing Manufacturer Capabilities," Journal of Supply Chain Management, (44:4), 2008, pp. 14-35.

Bagozzi, R.P., Y. Yi and L.W. Phillips."Assessing Construct Validity in Organizational Research," Administrative Science Quarterly, (36:3), 1991, pp. 421-458.

Baier, C., E. Hartmann and R. Moster. "Strategic Alignment and Purchasing Efficacy: An Exploratory Analysis of their Impact on Financial Performance," Journal of Supply Chain Management, (44:4), 2008, pp. 36-52.

Bailey, P., D. Farmer, D. Jones and D. Jones. Purchasing Principles and Management, Prentice Hall, London, 2005. Beamon, B.M. "Measuring Supply Chain Performance," International Journal of Operations & Production Management, (19:3), 1999, pp. 275-292.

Catalan, M. and M. Kotzab."Assessing the Responsiveness in the Danish Mobile Phone Supply Chain," International Journal of Physical Distribution & Logistics Management, (33:8), 2003, pp. 668-685.

Choi, T.Y. and K.J. Dooley. "Supply Networks: Theories and Models," Journal of Supply Chain Management, (45:3), 2009, pp. 25-26. Choi, T.Y. and J.L. Hartley. "An Exploration of Supplier Selection Practices Across the Supply Chain," Journal of Operations Management, (14:4), 1996, pp. 333- 343.

Christopher, M. "The Agile Supply Chain Competing in Volatile Markets," Industrial Marketing Management, (29), 2000, pp. 37-44.

Christopher, M., R. Lowson and H. Peck. "Creating Agile Supply Chains in the Fashion Industry," International Journal of Retail & Distribution Management, (32:8), 2004, pp. 367-376.

Claycomb, C. and G.L. Frankwick. "A Contingency Perspective of Communication, Conflict Resolution, and Buyer Search Effort in Buyer–Supplier Relationships," Journal of Supply Chain Management, (40:1), 2004, pp. 18-34.

Conner, K.R. and C.K. Prahalad."A Resource-Based Theory of the Firm: Knowledge Versus Opportunism," Organization Science, (7:5), 1996, pp. 477-501.

Duclos, L.K., R.J. Vokurka and R.R. Lummus. "A Conceptual Model of Supply Chain Flexibility," Industrial Management & Data Systems, (103:6), 2003, pp. 446-456.

Fine, C.H. "Clockspeed-Based Strategies for Supply Chain Design," Production and Operations Management, (9), 2000, pp. 213-221.

Garavelli, A.C. "Flexibility Configurations for the Supply Chain Management," International Journal of Production Economics, (85:2), 2003, pp. 141-153.

Gonza´lez-Benito, J. "A Theory of Purchasing's Contribution to Business Performance," Journal of Operations Management, (25:4), 2007, pp. 901-917.

Gosain, S., A. Malhotra and O.A. Sawy."Coordinating for Flexibility in e-Business Supply Chains," Journal of Management Information Systems, (21:3), 2005, pp. 7- 45.

Gulati, R. "Social Structure and Alliance Formation Patterns: A Longitudinal Analysis," Administrative Science Quarterly, (40:4), 1995, pp. 619-652.

Gunasekaran, A. "Agile Manufacturing: A Framework for Research and Development," International Journal of Production Economics, (62), 1999, pp. 87-105.

Gunasekaran, A., C. Patel and E. Tirtiroglu."Performance Measures and Metrics in a Supply Chain Environment," International Journal of Operations & Production Management, (21:1/2), 2001, pp. 71-87.

Hahn, C.K., C.A. Watts and K.Y. Kim. "The Supplier Development Program: A Conceptual Model," International Journal of Purchasing and Materials Management, (26:2), 1990, pp. 2-7.

Harland, C.M., N.D. Caldwell, P. Powell and J. Zhang. "Barriers to Supply Chain Information Integration: SMEs Adrift of Elands," Journal of Operations Management, (25), 2007, pp. 1234-1254.

Hartley, J.L. and T.Y. Choi. "Supplier Development: Customers as a Catalyst of Process Change," Business Horizons, (39:4), 1996, pp. 37-44.

Hausman, W.H. Supply Chain Performance Metrics. The Practice of Supply Chain Management, Springer Science & Business Media, Inc., New York, 2005.

Hines, P."International and Localization of the Kyoryoku Kai: The Spread of Best Practice Supplier Development," International Journal of Logistics Management, (5:1), 1994, pp. 67-72.

Holcomb, T.R. and M.A. Hitt. "Toward a Model of Strategic Outsourcing," Journal of Operations Management, (25), 2007, pp. 464-481.

Hong, P. and J. Jeong. "Supply Chain Management Practices of SMEs: From a Business Growth Perspective," Journal of Enterprise Information Management, (19:3), 2006, pp. 292-302. Journal of Supply Chain Management 18 Volume 46, Number 3

Humphreys, P.K., W.L. Li and L.Y. Chan. "The Impact of Supplier Development on Buyer-Supplier Performance," OMEGA, (32:2), 2004, pp. 131-143.

Inkpen, A.C. and E.W.K. Tsang."Social Capital, Networks, and Knowledge Transfer," Academy of Management Review, (30:1), 2005, pp. 146-165. Ittner, C.D., D.F. Larcker, V.

Nagar and M.V. Rajan. "Supplier Selection, Monitoring Practices, and Firm Performance," Journal of Accounting and Public Policy, (18), 1999, pp. 253-281.

Kei, M., B.C.Y. Tan, K. Wei, T. Saarinen, V. Tuunainen and A. Wassenaar. "A Cross-Cultural Study on Escalation of Commitment Behavior in Software Projects," MIS Quarterly, (24), 2000, pp. 299-325.

Ketchen, D.J. and G.T.M. Hult. "Bridging Organization Theory and Supply Chain Management: The Case of Best Value Supply Chains," Journal of Operations Management, (25), 2007, pp. 573-580.

Krause, D.R. and L.M. Ellram. "Success Factors in Supplier Development," European Journal of Physical Distribution & Logistics Management, (3:1), 1997, pp. 21-31.

Kumar, V., K.A. Fantazy, U. Kumar and T.A. Boyle. "Implementation and Management Framework for Supply Chain Flexibility," Journal of Enterprise Information Management, (19:3), 2006, pp. 303-319.

Lau, R.S.M."Strategic Flexibility: A New Reality for Worldclass Manufacturing," SAM Advanced Management Journal, (61:2), 1996, pp. 11-15.

Lavie, D. "The Competitive Advantage of Interconnected Firms: An Extension of the Resource-Based View," Academy of Management Review, (31:3), 2006, pp. 638-658.

Lee, H.L. "The Triple-A Supply Chain," Harvard Business Review, (82:10), 2004, pp. 102-112. Lee, K., G. Lim and S. Tan. "Dealing with Resource Disadvantage Generic Strategies for SMEs," Small Business Economics, (12:4), 1999, pp. 299-311.

Li, S.H., B. Ragu-Nathan, T.S. Ragu-Natha and S.S. Rao. "The Impact of Supply Chain Management Practices on Competitive Advantage and Organizational Performance,"

OMEGA, (34), 2006, pp. 107- 124. Lummus, R.R., L.K. Duclos and R.J. Vokurka. "Supply Chain Flexibility: Building a New Model," Global Journal of Flexible Systems Management, (4:4), 2003, pp. 1-13.

Macbeth, D.K. and N. Ferguson. Partnership Sourcing, Prentice Hall, London, 1994.

Madhavan, R., B.R. Koka and J.E. Prescott. "Networks in Transition: How Industry Events (Re) Shape Interfirm Relationships," Strategic Management Journal, (19:5), 1998, pp. 439-459.

Maguire, S. and S.C.L. Koh. "The Adoption of e-Business and Knowledge Management in SMEs," Benchmarking: An International Journal, (14:1), 2007, pp. 37-58.

Mason, S.J., M.H. Cole, B.T. Ulrey and L. Yan."Improving Electronics Manufacturing Supply Chain Agility through Outsourcing," International Journal of Physical Distribution & Logistics Management, (32:7), 2002, pp. 610-620.

McCutcheon, D.M., R.A. Grant and J. Hartley. "Determinants of New Product Designers' Satisfaction with Suppliers' Contributions," Journal of Engineering & Technology Management, (14:3/4), 1997, pp. 273-290.

McKone-Sweet, K. and Y.T. Lee. "Development and Analysis of a Supply Chain Strategy Taxonomy," Journal of Supply Chain Management, (45:3), 2009, pp. 3-24.

Mentzer, J.T., J.H. Foggin and S.L. Golicic."Collaboration: The Enablers, Impediments, and Benefits," Supply Chain Management Review, (4:4), 2000, pp. 52-57.

Miles, R.E. and C.C. Snow. "Organization Theory and Supply Chain Management: An Evolving Research Perspective," Journal of Operations Management, (25), 2007, pp. 459-463.

Narasimhan, R., S. Talluri and A. Das. "Exploring Flexibility and Execution Competencies of Manufacturing Firms," Journal of Operations Management, (22), 2004, pp. 91-106.

Novack, R.A. and S.W. Simco."The Industrial Procurement Process: A Supply Chain Perspective," Journal of Business Logistics, (12:1), 1991, pp. 145-167.

O'Leary-Kelly, S.W. and R.J. Vokurka. "The Empirical Assessment of Construct Validity," Journal of Operations Management, (16:4), 1998, pp. 387-405.

Otto, A. and H. Kotzab. "Does Supply Chain Management Really Pay? Six Perspectives to Measure the Performance of Managing a Supply Chain," European Journal of Operations Research, (144), 2003, pp. 306-320. P

edersen, E.R. "The Many and the Few: Rounding Up the SMEs that Manage CSR in the Supply Chain," Supply Chain Management: An International Journal, (14:2), 2009, pp. 109-116.

Podsakoff, P.M. and D.W. Organ. "Self-Reports in Organizational Research: Problems and Prospects," Journal of Management, (12), 1986, pp. 69-82.

Pujawan, I.N. "Assessing Supply Chain Flexibility: A Conceptual Framework and Case Study," International Journal of Integrated Supply Management, (1:1), 2004, pp. 79-97.

Robinson, J.P., P.R. Shaver and L.S. Wrightsman. Measures of Personality and Social Psychological Attitudes, Harcourt Brace Jovanovich, San Diego, CA, 1991. Sanchez, A.M. and M.P. Perez. "Supply Chain Flexibility and Firm Performance," International Journal of Operations & Production Management, (25:7), 2005, pp. 681-700.

Sanchez, R."Strategic Flexibility in Product Competition," Strategic Management Journal, (16:5), 1995, pp. 135- 159.

Scannell, T.V., S.K. Vickery and C.L. Droge. "Upstream Supply Chain Management and Competitive Performance in the Automotive Supply Industry," Journal of Business Logistics, (21:1), 2000, pp. 23-48.

Schroeder, R.G., K.A. Bates and M.A. Junttila. "A Resource-Based View of Manufacturing Strategy and Supply Management, Supply Flexibility and Performance Outcomes July 2010 19 the Relationship to Manufacturing Performance," Strategic Management Journal, (23), 2002, pp. 105-117.

Simatupang, T.M., A.C. Wright and R. Sridharan. "The Knowledge of Coordination for Supply Chain Integration," Business Process Management Journal, (8:3), 2002, pp. 289-308.

Singh, N. and J. Sushil. "Flexibility in Product Development for Success in Dynamic Market Environment," Global Journal of Flexible Systems Management, (5:1), 2004, pp. 23-34.

Skilton, P.F. and J.L. Robinson. "Traceability and Normal Accident Theory: How Does Supply Network Complexity Influence the Traceability of Adverse Events?," Journal of Supply Chain Management, (45:3), 2009, pp. 40-53.

Stevenson, M. and M. Spring. "Flexibility from a Supply Chain Perspective: Definition and Review," International Journal of Operations & Production Management, (27:7), 2007, pp. 685-713.

Tsai, W. "Social Capital, Strategic Relatedness and the Formation of Intraorganizational Linkages," Strategic Management Journal, (21:9), 2000, pp. 925-939.

Vaaland, T.I. and M. Heide. "Can the SME Survive the Supply Chain Challenges?," Supply Chain Management an International Journal, (12:1), 2007, pp. 20-31. Van Hoek, R.I., A.

Harrison and M. Christopher. "Measuring Agile Capabilities in the Supply Chain," International Journal of Operations & Production Management, (21:1/2), 2001, pp. 126-147.

Volberda, H.W. "Toward the Flexible Form: How to Remain Vital in Hyper-competitive Environments," Organization Science, (7:4), 1996, pp. 359-374.

Vonderembse, M.A. and M. Tracey. "The Impact of Supplier Selection Criteria and Supplier Involvement on Manufacturing Performance," Journal of Supply Chain Management, (35:3), 1999, pp. 33-39.

Watts, C.A. and C.K. Hahn. "Supplier Development Program: An Empirical Analysis," International Journal of Purchasing and Materials Management, (29:2), 1993, pp. 11-17.

Wong, K.Y. "Critical Success Factors for Implementing Knowledge Management in Small and Medium Enterprises," Industrial Management & Data Systems, (105:3), 2005, pp. 261-279.

Yao, Y., M. Dresner and J.W. Palmer. "Impact of Boundary-Spanning Information Technology and Position in Chain on Firm Performance," Journal of Supply Chain Management, (45:4), 2009, pp. 3-17.