Development of capabilities, operational practices and interorganisational collaboration

*Eliciane Maria da Silva (*elicianems@gmail.com.br or eliciane.silva@unimep.br*)*
Unimep – Universidade Metodista de Piracicaba;Brazil

Ely Laureano Paiva (ely.paiva@fgv.br)
Fundação Getúlio Vargas, Brazil

Mario Sacomano Neto (msacomano@ufscar.br)
Universidade Federal de São Carlos, Brazil

Abstract

Our study presents the development of operational capabilities in the process of practices adoption and interorganisational relationships. Qualitative study with a multiple-case approach was employed. Then we developed a quantitative study to validate the variables and corroborate the results of the case studies using research hypotheses. 146 firms completed the questionnaire. We tested the hypotheses using ordinary least squares regression. Our study found that TQM has a positive and direct effect on capabilities of improvement, responsiveness and cooperation. Information technology practices showed positive and significant effects on responsiveness. The moderating effects of interorganisational collaboration on the relationship between operational practices and capabilities were positive and significant for IT and capabilities of customization, responsiveness and cooperation.

Keywords: supply chain management, case studies, survey, interorganisational relationships, interorganisational collaboration, operational capabilities

Introduction

The difference between operational practices and capabilities has been a frequent focus in studies in the operations management area and more widely in organisational strategy (e.g.Schroeder et al., 2002, Wu et al., 2012, Rockart and Dutt, 2015). From a management perspective, it is important to know whether investment practices lead to the development of capabilities, since companies achieve competitive advantage when they evaluate their operational capabilities better than their competitors (Kraaijenbrink et al., 2010). Lieberman and Demeester (1999), for instance, found that between Toyota and its suppliers, the reduction in inventory by means of just-in-time practices leads to productive gains, since they share knowledge and information for controlling inventory

Bromiley and Rau (2014) argued that the sharing of practices in interorganisational collaboration promotes the codification of tacit knowledge and reveals new opportunities, which lead to process improvements. This helps companies identify and

select new routines and capabilities. However, there is a lack of empirical studies on how capabilities can be developed through the adoption of operational practices. Wu, Melnyk and Flynn (2010) displayed a concern to distinguish concepts and avoid ambiguities in the terminology used in the manufacturing strategy area. However, they did not analyse the relationship between operational practices and operational capabilities in the supply chain.

Our article will extend these aspects by analysing the effects of supply chain practices in four fields on the four operational capabilities from the buyer's perspective. Furthermore, we analyzed the moderating effects of interorganisational collaboration on operational practices and capabilities. Therefore, this study will answer the following questions: (RQ1) *How do operational capabilities arise from operational practices in supply chains?* (RQ2) *How does interorganisational collaboration affect the development of operational capabilities in the practice-adoption process in supply chains*?

The other sections of this article are presented in the following sequence: theoretical review, research methodology, discussion of the results and conclusions.

Operational Capabilities and Practices

Operational capabilities are considered to be part of the organization's capabilities. They are the skills, processes and specific routines that are developed in operational systems and used in the solution of problems by means of operational resources (Wu et al., 2012).

Swink and Hegarty (1998) defined seven categories of operational capability and the Wu et al. (2010) and Wu et al. (2012) studies complemented the former, by clarifying the understanding of six categories. Table 1 presents a synthesis of the definitions of operational capabilities aimed at manufacturing processes. The capabilities presented in Table 1 are the basis of the empirical research data collected for this article.

Interorganisational collaboration bears a strong relationship with the development of capabilities. It can be expressed as ongoing participation by way of cross-functional teams (Monczka et al., 1998), goal congruence (Cao and Zhang, 2011), a long-term partnership or commitment (Sheu et al., 2006), or knowledge transfer (Grant, 1996).

Knowledge-sharing efforts between supplier and buyer have direct effects on the performance of suppliers and are related to investments in assets and capabilities in supplier firms (Mesquita et al., 2008).

At the root-level of the capabilities are the operational practices. The implementation of practices between firms provides a way of eliciting a firm's tacit knowledge that lies embedded in its existing routines. This process then helps identify opportunities for improvement and for selecting new routines (Bromiley and Rau, 2014).

Practices are activities that improve operational performance (Flynn et al., 1995, Wu et al., 2012). With an internal focus, we may include practices like just-in-time (JIT) (Flynn et al., 1995), total quality management (TQM) (Krause et al., 1998), practices based on information technologies (Frohlich and Westbrook, 2001) and practices related to integrated product development (Tan et al., 2007). In this study, we explored practices that combine both internal and external aspects. As a result, we focus on the relationship between buyers and suppliers. Past studies have analysed the extent of the integration of operational practices between suppliers and client firms (Rosenzweig et al., 2003, Flynn et al., 2010, Schoenherr and Swink, 2011). In this study, we adopted the perspective of Krause et al. (1998). These authors argued that there is an evolutionary path to the development of practices between buyer and supplier and two approaches to

conducting them: the *strategic approach* and the *reactive approach*. In the former, cross-functional teams develop supply chain practices with "*the intention to create a world-class supply base capable of providing a sustainable competitive advantage*" (Krause, et al. 1998, p.45). Regarding the second approach, the practices are adopted merely to remedy or control the production process. Table 2 presents a synthesis of the constructs and dimensions of operational practices and interorganisational collaboration in the supply chain, which were used as the basis for collecting the data in our empirical study.

Table 1- Definition and variables of operational capabilities

Definition	**Variables**
Operational improvement capabilities are specific abilities that create incremental improvement of operational routines and process.	Improve processes continuously, continuously reduce waste and variance, continuously standardize and simplify production processes, ability to impel human resource
Operational innovation capabilities are specific abilities that create new products and process implementation.	Change of technology trajectories, new methods and ideas, introduction of new products.
Operational customization capabilities represent abilities to know buyer´s requirement, to learning and to catch valuable information and to development proper process.	Inter-cross function team, sharing information, development of know-how, use of technology in the proper way, customization process
Operational control capabilities are abilities to direct and regulate the operating processes.	Knowledge of process manufacturing limits, assessment and feedback of manufacturing process, ability to fit adverse effects of operations
Operational responsiveness capabilities are abilities to easily alter the manufacturing process.	Flexible volume, flexible mix, reduction of uncertainty of equipment availability by quickly and easily changing the route, adjust for unexpected variations in components and material inputs easily and quickly
Operational cooperation capabilities are abilities to cooperate and create a stable relationship with intra and inter cross functional teams.	Ability for quick diagnostic and resolution problems, use of methods that motivate teamwork
Process Reconfiguration capabilities are abilities to re-establish and to fit the operational strategies, in accordance to market and environmental change, when there is unexpected interruptions.	Sense/aware of the change of the environment, adoption of new and better practices to respond to market change, reconfiguration (combine or release) resources to respond to market change, develop competence an skills to respond to market changes

Note: Swink and Hegarty (1998); Wu, Melnyk and Flynn (2010); Wu, Melnyk and Swink (2012)

Method

We followed a combination of qualitative and quantitative approaches. We analyse the operational capabilities arising from supply chain practices and the collaboration that is present in three industrial sectors in Brazil: chemical, automotive and electrical-electronic. The data were collected from June 2012 to February 2013. The supply chains selected for this study are related to multinational companies with plants in Brazil. We analyse the dyadic relationships between suppliers and clients, considering both first-tier and second-tier suppliers and the client firm. Three supply chains were analysed, involving a total of 12 firms and 17 interviews. We employed the interaction patterns of the collaborative relationship between firms, based on Hardy, Phillips and Lawrence (2003): (a) depth, which was classified as *shallow*, when interactions are restricted to

the manager at the buying firm and his/her counterpart at the supply firm; or *deep*, when the interactions extend to other personnel at both of the firms (buyers and suppliers); and (b) scope, which was classified as *narrow*, when interactions occur just in the supply chain analysed; or *broad*, when interactions occur with third parties (for example, a university and associate firms) as well. In order to analyse information-sharing we employed information flow patterns: unidirectional, bi-directional and multi-directional (Hardy et al., 2003) and type of knowledge transfer: explicit or tacit (Grant, 1996, Dyer and Nobeoka, 2000).

Then, we employed quantitative research in the same three sectors as the case studies. Companies were selected from three lists provided by sector associations: chemical (547 firms), automotive (332 firms) and electrical-electronic (247 firms).

Table 2 - Constructs and Dimensions of operational practices and interorganizational collaboration

	Construct/Dimensions	Authors
Operational practices	- *Quality management practices*: Lean Six Sigma; ISO/TS 16949, advanced product quality planning (APQP), production part approval process (PPAP), overall equipment effectiveness (OEE)	Krause et al. (1998); Wu et al. (2012); Timans et al. (2012); Sroufe and Curkovic (2008)
	- *Information technologies practices:* Continuous replenishment program to control stocks (Vendor Managed Inventory, VMI), Enterprise Resource Planning systems; semi automatic systems for joint production planning, telephone and e-mail	Frohlich and Westbrook (2001); Swink and Nair (2007); Kotha and Swamidass (2000)
	- *JIT flow practices:* Just-in-sequence, milk-run	Dong et al. (2001); Claycomb et al. (1999); Kaynak (2002);
	Integrated product development practices: technical knowledge exchange	Kotabe et al. (2003)
Interorganizational collaboration	- *Information sharing/Knowledge transfer*	Hardy et al. (2003) Cao and Zhang (2011) Dyer and Nobeoka (2000)
	- *Inter-cross function teams*	Monczka et al. (1998)
	- *Long term partnership*	*Cao and Zhang (2011) Sheu et al. (2006)*
	- *Goal congruence:* idea sharing, capacity planning, common strategic goals, demand planning, cost planning	Cao and Zhang (2011)
	- *Investments in proper tools and equipments* (Hardy et al., 2003)	Hardy, et al. (2003)
	- *Collaborative Communication*	*Cao and Zhang (2011)*

Results, analysis and the development of hypotheses

Our results show that four operational capabilities are developed as a result of a collaboration process and different practices in supply chain dyads. The dyads are analysed on the basis of the adoption of buyer-driven practices and also, the interorganizational collaboration of both firms with regard to the development of operational capabilities in the supplier firms.

The results of our study revealed three capabilities in the company dyads in Case 1: (a) the operational capability of improvement, which was only identified in the first supply link (T1←OEM); (b) the operational capability of customisation, which was identified in two supply links (T2←T1 and T1←OEM); and (c) the operational capability of cooperation, which was found between T1 and Distributor.

Two operational capabilities were found in the dyads in Case 2: (a) the operational

capability of improvement, which was developed in Supplier T2b (T2b←T1b) and (b) the operational capability of customisation (T2b→T1b). It is worth noting that operational capabilities occurred only in the relationship between Suppliers T2b and T1b.

The operational capability of responsiveness was found in the relationship between Supplier T1 and OEM on Case 3.

In our analysis of the operational capability of improvement that was identified in Cases 1 and 2, we noticed that this particular operational capability emerged from practices that involved the quality area and communication technologies (Lean Six Sigma and VMI in Case 1; OEE and Kaizen in Case 2). In both cases the focus on adopting these practices was at the strategic level.

In Case 1, this occurred in the first link in the supply chain between T1←OEM. There is a bargaining balance in the relationship between these firms because both are large multinational companies. The Lean Six Sigma practices proposed reducing costs and improving OEM's quality process. We noticed that there were mutual benefits in developing operational capabilities. The firms shared tacit and explicit knowledge (information sharing was bilateral). Consequently, there was an increase in operational competences due to Supplier T1 offering to train OEM's employees. There was also rapid access to market information relating to new products and competitors in the market, arising from the trust and long-term partnership established. We observe that TQM and NPD practices may affect the development of improvement capabilities.

In the automotive sector (Case 2, T2b←T1b; T1b←OEM and T2a←T1a; T1a←OEM), although some practices were present in the four dyads (for example, information technology practices, milk-run and quality management control practices), such practices were not enough for developing operational capabilities. The adoption of these practices was reactive, since the companies adopted them to control product quality and supplier stocks. In this case, there was a shallow collaborative relationship. T1b complained that OEM did not provide support for new investments and any improvements in product development or the manufacturing process are very slow.

Our results reveal that operational capabilities occurred only in the second link of the automotive supply chain (Supplier T2b←T1b), where there was a multinational company (T1b) and a local company (T2b). We identified a collaboration relationship that was both profound and close, including multifunctional teams and intra-firm communication. These collaborative relationships were aligned with supply chain practices, such as Kaizen, OEE and integrated product development. Therefore, there was tacit, unidirectional and bidirectional knowledge sharing in the processes analysed. The operational capability of improvement arises from unidirectional knowledge, since there was demand fluctuation and Supplier T1b supported Supplier T2b in the Kaizen and OEE programmes in order to increase production capacity and reduce waste. So the improvement capability resulted in increased competence, reduced waste and increased output. On the other hand, Supplier T1b increased its operational performance with low costs and responsiveness to buyer needs. Krause et al. (1998) stated that companies tread an evolutionary path to supplier development. The first step is the adoption of TQM practices, followed by supplier evaluation and a reduction in the number of suppliers, with the most advanced stage being related to supply development strategies. In Case 1 and Case 2, the operational capability of improvement resulted in quality management practices as well.

Additionally, in the T2b←T1b dyad (automotive industry), the operational capability of customisation was present in integrated product development. Supplier

T1b invested Supplier T2b with tools and devices for new product development. Both suppliers share knowledge to achieve robustness and low component costs.. In Cases 2 (T2b←T1b) and 3 (T1←OEM), investment in proper tools and equipment is a relevant action, as are investments in training by Supplier T1b for T2b.

We identified that all four operational capabilities resulted in profound and close supply chain collaboration between firms. The common supply chain collaboration method adopted in the development f these four capabilities involved cross-functional teams and collaborative communication. Krause and Ellram (1997) also found that involvement in buyer-supplier relationships and cross-functional teams is critical to supplier development. Moreover, there was bilateral knowledge transfer when firms learned from each other. These findings confirm Hardy, Phillips and Lawrence's (2003) suppositions regarding what involvement is necessary for first-order learning, allowing partners to identify key resources and, consequently, to develop core competences and achieve competitive advantage. Based on the previous literature and current findings, we suggest the following hypotheses:

- *Hypotheses* H1a to H3d: Supply chain practices of TQM, new product development and information technologies positively affect the development of the operational capabilities of (a) improvement, (b) customization, (c) responsiveness and (d) cooperation;
- *Hypothesis* H4a to H4d: Inter-organizational collaboration between buyers-suppliers positively affects the development of the operational capabilities of (a) improvement, (b) customization, (c) responsiveness and (d) cooperation;
- *Hypothesis* H5a to H7d*:* Inter-organizational collaboration between buyers-suppliers moderates the development of the operational capabilities of (a) improvement, (b) customization, (c) responsiveness and (d) cooperation based on supply chain practices of TQM, new product development and information technologies.

We tested our hypotheses using ordinary least squares regression, with moderated regression analysis being used to test for interaction effects. The results are presented in Table 3 (Appendix).

While prior studies have found TQM is a foundation for supplier development in strategic and reactive perspectives (Krause et al., 1998) and TQM affects supplier performance (Flynn and Flynn, 2005), our study found that TQM has a positive and direct effect on three operational capabilities (improvement, responsiveness and cooperation) (H1a, H1c and H1d).

From the case studies we observe the operational capabilities of improvement and responsiveness related to quality management practices: a) Case 1/ T1←OEM, operational capability of improvement in the buyer firm; b) Case 2/T2b←T1b, operational capability of improvement developed in Supplier T2b; and c) Case 3/T1←OEM, Operational Capability of responsiveness developed in Supplier T1. Firms in the global chain develop capabilities simultaneously in order to remain competitive. The adoption of quality management may well be the foundation for achieving other capabilities, such as improvement, responsiveness and cooperation (H1a, H1c and H1d). The operational capabilities of improvement and responsiveness can be achieved through quality management practices. Quality management practices reduce process variance, enable short batch and reduce the inventory cycle and rework. Consequently, the quality improvement process allows for a better schedule and a faster response to market demands.

This research extends the examination of NPD practices in the supply chain and

found that this practice has a positive and direct impact on four operational capabilities (H2a, H2b, H2c, H2d). When suppliers are involved with product and process development, they will have a faster product cycle and better product quality (Kotabe et al., 2003). Additionally, the relationship between buyers and suppliers over the last 2–3 years contributes towards improving performance and transferring knowledge between partners (Galbraith, 1990). Consequently, partners may transfer technologies and develop competences to design, modify and extend processes and products to better serve customer needs.

H3a to H3d proposed that information technology practices would have a direct and positive influence on four operational capabilities. However, our survey showed positive and significant effects only on responsiveness (H3c). In Case study 3, the operational capability of responsiveness was found in the electronics sector in periods of fluctuating demand. The electronics sector has shorter product cycles and employs information technologies for handling changes in operations planning in accordance with consumer needs (Catalan and Kotzab, 2003, Kapuscinski et al., 2004). Other studies have confirmed that agility in order and production planning can be improved by information sharing between members of the supply chain (Banerjee et al., 2012, Gligor and Holcomb, 2012, Roh et al., 2014).

Unlike prior studies, we analyses the moderating effects of inter-organizational collaboration by testing the relationship between operational practices and capabilities. The results indicate that the moderating effects of inter-organizational collaboration on the relationship between operational practices and capabilities were positive and significant for IT and three operational capabilities (customization, responsiveness and cooperation) (H7b, H7c and H7d). Surprisingly, collaboration weakens the relationship between NPD practices and the responsiveness and cooperation capabilities (H6c and H6d).

Our study shows that IT practices can work by way of interfirm collaboration for developing the operational capabilities of customization, responsiveness and cooperation. The operational capability of cooperation refers to skills in information sharing and decision-making for solving problems and settling inter-organizational conflicts during troubled periods (Wu et al., 2010). Firms need to cooperate in order to deal with problems that happen in a global environment, such as supplier diversity (number of suppliers, nature of the relationship with specific suppliers, location of suppliers) and labour diversity.

The results of our survey support the findings of Cases 1 and 3. In these cases, in periods of changing demand, view-sharing between first-tier suppliers and OEM was important for solving problems of inventory management and producing products on time. It was also relevant in negotiations with second-tier suppliers located in Asia. In Case 3, the first supplier and OEM should have dealt with the suppliers' cultural diversities in order to manufacture products on time when OEM's demands changed.

The results of the moderating effects of collaboration on the relationship between NPD practices and the operational capabilities of cooperation and responsiveness are negative. Although firms may collaborate very well during the product development process, the buyer's ability to improve responsiveness and cooperation capabilities remains limited, since these capabilities focus more on activities for improving volume capacity when there are fluctuations in demand and on the ability to solve problems in order to take decisions faster, etc. On the other hand, NPD practices concentrate more on supplier involvement in product design and on improving customer satisfaction by way of customised products. Therefore, the benefits of collaboration for achieving

responsiveness and cooperation capabilities are diminished.

Conclusion

This study advances in the findings of previous literature (Krause et al., 1998, Flynn and Flynn, 2004, Wu et al., 2010), since we analysed the relationship of three practices with four operational capabilities. We contribute to the development of new practices from a strategic perspective and on the view of capabilities as a specific set of skills, processes and routines. These practices allow for the development of the operational capabilities of improvement, customisation, responsiveness and cooperation. However, their effects on operational capabilities are different. Additionally, we investigate the moderating effects of interorganisational colaboration between operational practices and capababilities. Our study provides evidence that interorganisational collaboration has a positive and significant moderating effect on IT and three operational capabilities (customisation, responsiveness and cooperation). On the other hand, interorganisational collaboration weakens the relationship between NPD practices and the responsiveness and cooperation capabilities.

Acknowledgement: process nº 11/20341-1, Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP).

References

Banerjee, A., Sarkar, B. & Mukhopadhyay, S. K. (2012). "Multiple decoupling point paradigms in a global supply chain syndrome: a relational analysis". *International Journal of Production Research,* Vol.50 No.11**,** pp. 3051-3065.

Bromiley, P. & Rau, D. (2014). "Towards a practice-based view of strategy". *Strategic Management Journal,* Vol.35 No.8**,** pp. 1249-1256.

Cao, M. & Zhang, Q. (2011). "Supply chain collaboration: Impact on collaborative advantage and firm performance". *Journal of Operations Management,* Vol.29 No.3**,** pp. 163-180.

Catalan, M. & Kotzab, H. (2003). "Assessing the responsiveness in the Danish mobile phone supply chain". *International Journal of Physical Distribution and Logistics Management,* Vol.33 No.8**,** pp. 668-685.

Claycomb, C., Germain, R. & Dröge, C. (1999). "Total system JIT outcomes: inventory, organization and financial effects". *International Journal of Physical Distribution & Logistics Management,* Vol.29 No.10**,** pp. 612-630.

Dong, Y., Carter, C. R. & Dresner, M. E. (2001). "JIT purchasing and performance: an exploratory analysis of buyer and supplier perspectives". *Journal of Operations Management,* Vol.19 No.4**,** pp. 471–483.

Dyer, J. H. & Nobeoka, K. (2000). "Creating and managing a high-performance knowledge-sharing network: The Toyota case". *Strategic Management Journal,* Vol.21 No.3**,** pp. 345-367.

Flynn, B. B. & Flynn, E. J. (2004). "An exploratory study of the nature of cumulative capabilities". *Journal of Operations Management,* Vol.22 No.5**,** pp. 439-457.

Flynn, B. B. & Flynn, E. J. (2005). "Synergies between supply chain management and quality management: Emerging implications". *International Journal of Production Research,* Vol.43 No.16**,** pp. 3421-3436.

Flynn, B. B., Huo, B. & Zhao, X. (2010). "The impact of supply chain integration on performance: A contingency and configuration approach". *Journal of Operations Management,* Vol.28 No.1**,** pp. 58-71.

Flynn, B. B., Sakakibara, S. & Schroeder, R. G. (1995). "Relationship between JIT and TQM: practices and performance". *Academy of Management Journal,* Vol.38 No.5**,** pp. 1325-1360.

Frohlich, M. T. & Westbrook, R. (2001). "Arcs of integration: an international study of supply chain strategies". *Journal of Operations Management,* Vol.19 No.2**,** pp. 185–200.

Galbraith, C. S. (1990). "Transferring Core Manufacturing Technologies in High-Technology Firms". *California Management Review,* Vol.32 No.4**,** pp. 56-70.

Gligor, D. M. & Holcomb, M. C. (2012). "Understanding the role of logistics capabilities in achieving supply chain agility: A systematic literature review". *Supply Chain Management,* Vol.17 No.4**,** pp. 438-453.

Grant, R. M. (1996). "Prospering in Dynamically-competitive Environments: Organizational Capability as Knowledge Integration". *Organization Science,* Vol.7 No.4**,** pp. 375-387.
Hardy, C., Phillips, N. & Lawrence, T. B. (2003). "Resources, knowledge and influence: The organizational effects of inter Organizational collaboration". *Journal of Management Studies,* Vol.40 No.2**,** pp. 321-347.
Kapuscinski, R., Zhang, R. Q., Carbonneau, P., Moore, R. & Reeves, B. (2004). "Inventory decisions in Dell's supply chain". *Interfaces,* Vol.34 No.3**,** pp. 191-205+242.
Kaynak, H. (2002). "The relationship between just-in-time purchasing techniques and firm performance". *IEEE Transactions on Engineering Management,* Vol.49 No.3**,** pp. 205-217.
Kotabe, M., Martin, X. & Domoto, H. (2003). "Gaining from vertical partnerships: Knowledge transfer, relationship duration, and supplier performance improvement in the U.S. and Japanese automotive industries". *Strategic Management Journal,* Vol.24 No.4**,** pp. 293-316.
Kotha, S. & Swamidass, P. M. (2000). "Strategy, advanced manufacturing technology and performance: empirical evidence from U.S. manufacturing firms". *Journal of Operations Management,* Vol.18 No.3**,** pp. 257–277.
Kraaijenbrink, J., Spender, J. C. & Groen, A. J. (2010). "The Resource-based view: A review and assessment of its critiques". *Journal of Management,* Vol.36 No.1**,** pp. 349-372.
Krause, D. R. & Ellram, L. M. (1997). "Critical elements of supplier development: The buying-firm perspective". *European Journal of Purchasing and Supply Management,* Vol.3 No.1**,** pp. 21-31.
Krause, D. R., Handfield, R. B. & Scannell, T. V. (1998). "An empirical investigation of supplier development: Reactive and strategic processes". *Journal of Operations Management,* Vol.17 No.1**,** pp. 39-58.
Lieberman, M. B. & Demeester, L. (1999). "Inventory Reduction and Productivity Growth: Linkages in the Japanese Automotive Industry". *Management Science,* Vol.45 No.4**,** pp. 466-485.
Mesquita, L. F., Anand, J. & Brush, T. H. (2008). "Comparing the resource-based and relational views: Knowledge transfer and spillover in vertical alliances". *Strategic Management Journal,* Vol.29 No.9**,** pp. 913-941.
Monczka, R. M., Petersen, K. J., Handfield, R. B. & Ragatz, G. L. (1998). "Success factors in strategic supplier alliances: The buying company perspective". *Decision Sciences,* Vol.29 No.3**,** pp. 553-573.
Rockart, S. F. & Dutt, N. (2015). "The rate and potential of capability development trajectories". *Strategic Management Journal,* Vol.36 No.1**,** pp. 53-75.
Roh, J., Hong, P. & Min, H. (2014). "Implementation of a responsive supply chain strategy in global complexity: The case of manufacturing firms". *International Journal of Production Economics,* Vol.147, Part B**,** pp. 198-210.
Rosenzweig, E. D., Roth, A. V. & Dean Jr, J. W. (2003). "The influence of an integration strategy on competitive capabilities and business performance: An exploratory study of consumer products manufacturers". *Journal of Operations Management,* Vol.21 No.4**,** pp. 437-456.
Schoenherr, T. & Swink, M. (2011). "Revisiting the arcs of integration: Cross-validations and extensions". *Journal of Operations Management,* Vol.30 No.1-2**,** pp. 99-115.
Schroeder, R. G., Bates, K. A. & Junttila, M. A. (2002). "A resource-based view of manufacturing strategy and the relationship to manufacturing performance". *Strategic Management Journal,* Vol.23 No.2**,** pp. 105-117.
Sheu, C., Yen, H. R. & Chae, B. (2006). "Determinants of supplier-retailer collaboration: Evidence from an international study". *International Journal of Operations and Production Management,* Vol.26 No.1**,** pp. 24-49.
Sroufe, R. & Curkovic, S. (2008). "An examination of ISO 9000:2000 and supply chain quality assurance". *Journal of Operations Management,* Vol.26 No.4**,** pp. 503-520.
Swink, M. & Hegarty, W. H. (1998). "Core manufacturing capabilities and their links to product differentiation". *International Journal of Operations and Production Management,* Vol.18 No.4**,** pp. 374-396.
Swink, M. & Nair, A. (2007). "Capturing the competitive advantages of AMT: Design–manufacturing integration as a complementary asset". *Journal of Operations Management,* Vol.25 No.3**,** pp. 736-754.
Tan, K. C., Kannan, V. R. & Narasimhan, R. (2007). "The impact of operations capability on firm performance". *International Journal of Production Research,* Vol.45 No.21**,** pp. 5135–5156.
Timans, W., Antony, J., Ahaus, K. & Van Solingen, R. (2012). "Implementation of Lean Six Sigma in small- and medium-sized manufacturing enterprises in the Netherlands". *Journal of the Operational Research Society,* Vol.63 No.3**,** pp. 339-353.
Wu, S. J., Melnyk, S. A. & Flynn, B. B. (2010). "Operational capabilities: the secret ingredient". *Decision Sciences,* Vol.41 No.4**,** pp. 721-754.

Wu, S. J., Melnyk, S. A. & Swink, M. (2012). "An empirical investigation of the combinatorial nature of operational practices and operational capabilities: Compensatory or additive?". *International Journal of Operations and Production Management,* Vol.32 No.2**,** pp. 121-155.

Appendix –

Table 3: Moderated regression analysis results (n=146)

DV: Operational Capabilities of Improvement:	**Model 1(Step1)**		**Model 2 (Step 2)**		**Model 3 (Step 3)**	
Direct effects	Beta	FIV	Beta	FIV	Beta	FIV
VI1-Total quality management (TQM) (H1a)	0.24***	1.69	0.21**	1.82	0.19**	2.15
VI2-New product development practices (NPD) (H2a)	0.60***	2.68	0.58***	2.74	0.60***	2.84
VI3-Information technologies (IT) (H3a)	-0.06	1.97	0.03	2.10	-0.05	2.33
VM-Inter-organizational collaboration (IOC) (H4a)			0.11*	1.65	0.11*	2.13
Moderating						
TQM X IOC (H5a)					-0.74	2.41
NPD X IOC (H6a)					0.01	3.71
IT X IOC (H7a)					0.03	3.13
Adjusted R^2	0.61		0.62		0.61	
F	76.63***		58.92***		33.31***	
DV: Operational Capabilities of Customization:	**Model 1(Step1)**		**Model 2 (Step 2)**		**Model 3 (Step 3)**	
Direct effects	Beta	FIV	Beta	FIV	Beta	FIV
VI1-Total quality management (TQM) (H1b)	0.08	1.69	0.06	1.82	0.06	2.15
VI2-New product development practices (NPD) (H2b)	0.56***	2.68	0.55***	2.74	0.55***	2.84
VI3-Information technologies (IT) (H3b)	0.17**	1.97	0.07*	2.10	0.10	2.33
VM-Inter-organizational collaboration (IOC) (H4b)			0.08	1.65	0.10	2.13
Moderating						
TQM X IOC (H5b)					-0.03	2.41
NPD X IOC (H6b)					-0.11	3.71
IT X IOC (H7b)					0.22**	3.13
Adjusted R^2	0.55		0.55		0.56	
F	61.58***		46.13***		27.61***	
DV: Operational Capabilities of Responsiveness:	**Model 1(Step1)**		**Model 2 (Step 2)**		**Model 3 (Step 3)**	
Direct effects	Beta	FIV	Beta	FIV	Beta	FIV
VI1-Total quality management (TQM) (H1c)	0.29**	1.69	0.26***	1.82	0.27***	2.15
VI2-New product development practices (NPD) (H2c)	0.24**	2.68	0.26***	2.47	0.25**	2.84
VI3-Information technologies (IT) (H3c)	0.28**	1.97	0.20***	2.1	0.19**	2.33
VM-Inter-organizational collaboration (IOC) (H4c)			0.13*	1.65	0.06	2.13
Moderating						
TQM X IOC (H5c)					0.00	2.41
NPD X IOC (H6c)					-0.37***	3.71
IT X IOC (H7c)					0.22**	3.13
Adjusted R^2	0.50		0.48		0.55	
F	49.98***		39.02***		26.58***	
DV: Operational Capabilities of Cooperation	**Model 1(Step1)**		**Model 2 (Step 2)**		**Model 3 (Step 3)**	
Direct effects	Beta	FIV	Beta	FIV	Beta	FIV
VI1-Total quality management (TQM) (H1d)	0.47***	1.69	0.38***	1.82	0.38***	2.15
VI2-New product development practices (NPD) (H2d)	0.42**	2.68	0.37***	2.74	0.37***	2.84
VI3-Information technologies (IT) (H3d)	-0.03	1.97	-0.11*	2.10	-0.14**	2.33
VM-Inter-organizational collaboration (IOC) (H4d)			0.29***	1.65	0.24**	2.13
Moderating						
TQM X IOC (H5d)					-0.04	2.41
NPD X IOC (H6d)					-0.38***	3.71
IT X IOC (H7d)					0.29***	3.13
Adjusted R^2	0.62		0.67		0.73	
F	81.30***		76.95***		56.38***	

Note: *p<0.10; **p<0.05; ***p<0.01.