INVOLVING SUPPLIERS IN A LEAN TRAINING PROGRAM

Peter Manfredsson
AB Ludvig Svensson, Bangatan 8, SE-51182, Kinna,
Sweden E-mail: peter-manfredsson@ludvigsvensson.com

Per Hilletofth
Department of Supply Chain and Operations Management, Jönköping University,
Sweden, E-mail: per.hilletofth@ju.se

Ewout Reitsma
Department of Supply Chain and Operations Management, Jönköping University,
Sweden, E-mail: ewout.reitsma@ju.se

ABSTRACT

The purpose of this study is to investigate the outcomes of a manufacturer involving its suppliers in their lean training program. A single in-depth case study is conducted to examine a lean training program that was offered by Scania to five suppliers. Semi-structured interviews were conducted at Scania and these suppliers to explore the outcomes of the training program. The interview findings were triangulated by completing observations and focus groups at the suppliers. Four main outcomes are identified after the completion of the training program. First, the suppliers became easier to collaborate with due to better internal ways of working and more trust in terms of reliability. Second, the suppliers improved their ability to identify possible problems that could jeopardize deliveries. Third, the suppliers improved their delivery precision. Fourth and finally, financially unstable suppliers were less perceptive to the lean training program than financially stable suppliers. This study also proposes avenues for future research.

Keywords: Lean training program, implementation, suppliers, development, collaboration, culture, quality management

1. INTRODUCTION

In the automotive industry, manufacturers are striving for higher levels of performance by implementing lean practices. These practices aim at eliminating waste and result in manufacturers using pull-based production and supply chain systems (Holweg & Miemczyk, 2002). A pull system has a lower capital tied-up level and a lower inventory level than a push system (Zhang & Chen, 2006). However, when looking at companies downstream and upstream in a manufacturer's supply chain, the tied-up capital level and inventory level tend to be radically higher. This indicates that a manufacturer can be efficient, while other companies in the supply chain are not. The result is sub-optimal supply chain performance. The three main causes for this sub-optimal performance include the location of the customer order decoupling point, the bullwhip effect, and the level of customer-supplier relationship (Hilletofth, 2010; Seguel et al, 2010; Liu, 2004; Daaboul et al, 2010; Jammernegga & Reiner, 2007; Jonsson, 2008; Hilletofth, 2008).

A manufacturer can combat these causes by creating a lean supply chain. Since the efficiency of a manufacturer's lean practices is heavily dependent on long-term and reliable relationships with suppliers, it is vital for a manufacturer to closely collaborate with its supplier(s) when implementing lean practices (Liker, 2004). For example, all companies in a manufacturer's supply chain can work

together to eliminate waste by using value mapping (Rother & Shook, 2003). This approach requires the removal of barriers that have been erected historically between companies (Krizner, 2001). Tearing down company barriers has become increasingly important due to the outsourcing trend (Hines & Taylor, 2000; Bhasin & Burcher, 2006).

Manufacturers with useful lean knowledge can promote collaboration in the supply chain by exploiting those knowledge assets within their supplier network. Knowledge transfers from a manufacturer to its suppliers can build relationship-specific production capabilities on the part of suppliers (Dyer & Hatch, 2006). The establishments of links and close collaboration is mutually beneficial, and manufacturers benefit from training their suppliers (Adler et al, 1999; Bicheno, 1999; Henderson et al, 1999). The purpose of this study is to investigate what the specific outcomes are of a manufacturer providing lean training to its suppliers. This purpose is realized through a single in-depth case study that analyzes a lean training that Scania offered to five of its suppliers. On-site semi-structured interviews with each of the involved companies were conducted for data collection. These interview findings were triangulated by completing observations and focus groups at the suppliers.

2. RELATED LITERATURE

Despite lean practices being implemented frequently by manufacturers, no common definition of lean can be found within the literature (Pettersen, 2009). Shah and Ward (2007) argue that lean cannot be equated solely to waste elimination or continuous improvement, which constitute its guiding principles, nor to JIT, pull production, Kanban, TQM, or employee involvement, which make-up some of its underlying components. The authors do propose that a lean system includes the following ten aspects:

- Supplier feedback: provide regular feedback to suppliers about their performance
- JIT delivery by suppliers: ensure that suppliers deliver the right quantity at the right time in the right place
- Supplier development: develop suppliers so they can be more involved in the production process of the focal firm
- Customer involvement: focus on a firm's customers and their needs
- Pull: facilitate JIT production including Kanban cards which serves as a signal to start or stop production
- Continuous flow: establish mechanisms that enable and ease the continuous flow of products
- Set up time reduction: reduce process downtime between product changeovers
- Total productive/preventive maintenance: address equipment downtime through total productive maintenance and thus achieve a high level of equipment availability
- Statistical process control: ensure that each process will supply defect free units to subsequent process
- Employee involvement: employees' role in problem solving, and their cross-functional character

According to Hines et al (2004), two main streams of thought exist within the lean literature. Within the first stream, it is argued that lean practices develop over time. Within the second stream, it is argued that lean practices can be pursued at different levels within a company, at a strategic level (lean thinking) and at an operational level (tools) (Hines et al, 2004). At an operational level, the lean tools enable companies to make improvements that are in line with the implemented strategic views.

At a strategic level, lean thinking entails that manufacturers need to ensure that lean principles cover the entire supply chain, not only their own company (Bhasin & Burcher, 2006).

This also relates one of the ten lean aspects proposed by Shah and Ward (2007), which entails that a manufacturer should ensure that suppliers deliver the right quantity at the right time in the right place. This means that when a manufacturer strives to implement lean practices, they need to involve their suppliers (Dyer & Hatch, 2006). A manufacturer needs to cover the whole value chain by involving its supplier base and by seeing the supply chain as a complete system. From an inbound perspective, lean is about building long-term relationships and partnerships with the suppliers (Naylor et al, 1999; Pettersen, 2009). Lean may in this context be called lean supply, where the responsibility of value creation is shared amongst the different actors in the supply chain (Lamming, 1996).

The extension of lean beyond the company's boundaries is emphasized in one of the 14 management principles of Toyota's production system (TPS), where is stated: '(…) Respect your extended network of partners and suppliers by challenging them and helping them improve' (Liker, 2004). Japanese automotive manufacturers seem to follow this principle more closely than US manufacturers. In a survey of the two groups of manufacturers, the suppliers of the Japanese manufacturers were, according to the metric applied, leaner. A key difference was that the Japanese manufacturers work together with their suppliers when developing lean capabilities (Liker & Wu, 2000). For example, Toyota systematically works with their suppliers to implement lean practices and engages in long-term relationship. Toyota also takes a role in the development of suppliers by supporting and teaching them lean practices (Marksberry, 2012). Dyer and Hatch (2004) also investigated how Toyota helps their suppliers to implement lean practices. Their study describes that Toyota sends in-house experts to suppliers, sometimes for months at a time, to help those suppliers solve problems in implementing the TPS. This approach resulted in suppliers appreciating how important it is, as a Toyota supplier, to keep up the pace. They become aware that the profit- creating potential of past productivity enhancements declines steadily, and they know they are in a learning race with suppliers because business from Toyota is allocated based on relative performance improvements. In short, Toyota and its suppliers acknowledge that the establishment of effective interorganizational knowledge sharing processes can be crucial for any company trying to stay ahead of its competitors.

MacDuffle and Helper (1997) investigated how another Japanese firm, Honda, has also taken the step of working extensively with their suppliers to teach them lean practices. To do so, Honda sends their own employees into supplier plants for weeks or months to redesign work stations, reorganize process flow, modify equipment, and establish problem-solving groups. Honda employees and staff members from the suppliers (e.g., vehicle quality, process engineering) form a team to work for several weeks at the supplier's facility. The main goal of this approach is to teach suppliers their kaizen philosophy of continuous improvement and how to put it into action. Suppliers ideally should see lean practices as part of their identity, by finding a way to make it with their organizational structure, culture, and history. Honda's choice of which suppliers to teach their philosophy was based on the following criteria: willingness to learn, willingness to make their operations completely accessible, and willingness to not lay off employees. MacDuffle and Helper (1997) describe possible positive outcomes of Honda teaching their supplier lean practices. These outcomes include operational improvements, the development of internal capabilities for transferring these improvements to other plants and divisions, and the strengthened relationship with an important supplier.

Suppliers that develop lean practices will tend to perform better than suppliers that do not (Cudney & Elrod, 2011). In terms of business metrics, Wu (2003) states that better performance

values for on-time delivery, inventory, and logistics costs can be connected with suppliers that implemented lean practices. Studies also suggest that companies pursuing a lean approach will improve business metrics such as delivery speed, delivery reliability, quality and cost (Hallgren & Olhager, 2009; Narasimhan et al, 2006). The benefits of lean are not only connected to large enterprises. There is also a strong relationship between lean practices, strategic collaboration, and operational performance in small and medium sized enterprises (Koh et al, 2007).

3. METHOD

The purpose of this study is to investigate the outcomes of a manufacturer involving its suppliers in their lean training program. This issue is examined through an exploratory in-depth case study that analyzes Scania's lean training program. First, the inductive approach is appropriate since knowledge on this study's topic is limited (Yin, 2009). Second, this approach makes it possible to gather rich descriptions and explanations (Eisenhardt, 1989). Third and finally, the single case study is a powerful method when exploring and describing a phenomenon (the lean training program) in its local context (Scania Sweden) (Eisenhardt & Graebner, 2007).

Scania's lean training program ran from 2010 to 2012 and included five of Scania's suppliers (hereafter named Supplier A, B, C, D, and E for anonymity). The training was similar to the one used internally at Scania and is based on their production system (Scania Production System). Although each supplier operates in several industries, the automotive industry is their main source of income. The chosen suppliers are medium-sized with 100 to 200 employees and have a total turnover that ranges from 40 to 70 million SEK. Their largest customers are operating in the automotive industry, where Scania represents between 20 and 30 percent of the total business. The suppliers also deliver components to the Scania's competitors.

To identify the outcomes of a manufacturer involving its suppliers in their lean training program, this study selected individuals with relevant expert knowledge to act as 'key informants' (Eisenhardt, 1989; Eisenhardt & Graebner, 2007). On-site in-depth and semi-structured interviews were conducted with these individuals at Scania and its suppliers. Five interviews were conducted with four supply development managers and one procurement manager at Scania, each lasting for 45-60 minutes. The interviews at each of the five suppliers included people from all levels in the organization, from senior managers to manufacturing staff. More than six semi-structured interviews were conducted at each supplier, each lasting for 45-60 minutes. Before conducting these interviews, a factory tour was completed to observe the outcomes of the lean training. This allowed the researchers to formulate additional interview questions. After completing the interviews, an additional factory tour and a focus group was completed to validate the respondents' answers.

The interviews at Scania and its suppliers were recorded and in most cases two researchers participated; one leading the interview and discussion, the other taking notes. The collected data were compiled and analyzed after each interview day and, if necessary, the interview form was adjusted (Lantz, 2008). Afterwards, the data were matched with the observations made at the suppliers and related to this study's literature review. The quality of the data and its interpretation is further ensured by allowing key informants to continuously review reports, transcripts, and findings. The entire data collection process was completed in 2012, which is two years after the lean training program started.

4. FINDINGS

Even though Scania provided its suppliers with the same lean training program, the outcomes of the program vary between the different suppliers. While some of the suppliers used the training to make significant changes internally, others only made minor changes. This chapter explores this variation by highlighting the view of Scania and the suppliers towards the lean training program.

4.1 The view of Scania

Scania views the outcomes of the training program as both negative and positive. Some suppliers (A, C, D) made minor changes to their operations, while others made significant changes (B, E). Scania suggests that more progress is made with suppliers where senior managers are committed to change. Especially senior management of suppliers B, C, and E show clear commitment and changes were made as a result of the training. These managers triggered change programs that affect the internal structures of production control, improvement work, and the view of flows and quality. At suppliers A and D, however, a lack of senior management commitment resulted in lean practices being implemented to a lower extent. In these cases, senior management blames Scania for problems in the production system and want Scania to change the design of products. In turn, Scania claims that these managers have problems in understanding that they can make improvements on their own. Lower management of these two suppliers agree that the training did not trigger the desired change. A possible reason for the lack of senior management commitment at suppliers A and D is that they implemented lean practices during a time of financial recession. This resulted in the suppliers dealing with severe financial issues and even going into bankruptcy prior to the lean training program. Senior management was in these cases prioritizing short-term activities to boost the result of their organization.

The specific outcomes of lean training program identified by Scania relate to collaboration, problem solving, and actual performance. Most of the suppliers (A, B, D, E) changed their internal ways of working after the training and employees at Scania state that they collaborate better with these suppliers. They feel that there is more trust in terms of reliability. According to Scania, the changes made at the suppliers create a base for improvements that will help them in the future. Scania also notices that four suppliers (B, C, D, E) improved their ability to identify possible problems that could jeopardize deliveries. For instance, suppliers that completed the lean training program tend to escalate possible delivery problems much earlier than before. Additionally, Scania calculated that the delivery precision improved of all suppliers involved in the lean training program. Even though it is difficult to assess how the training program contributed to this improvement, Scania considers it as a potential contributor to the improvement. Therefore, Scania regards the lean training program as a success and will continue to include their suppliers in their training programs. Scania also proposes possible future training topics. Since most of Scania's suppliers use batch production, it will be relevant to discuss how set-up, work in process, and lead-time can be reduced in the system.

4.2 The view of the suppliers

The suppliers of Scania believe that the lean training program was well-structured. Combining short theory sessions with real-life examples in a workshop format, and reflection at the supplier's location are key factors for this success. This approach to training made it possible to familiarize suppliers with lean practices in a context that they could relate to. All suppliers state that the trainers from Scania were highly skilled, both in terms of theoretical knowledge and practical knowledge. In some cases, they were perceived as know-it-alls who are inflexible to other views and definitions. Four suppliers (B, C, D, E) suggest that the training can be improved by including the product perspective and by extending the timeframe of the training. They also propose the introduction of a follow-up phase after the completion of the training, as they believe this will enable them to better utilize the training. However, all suppliers believe that the training was educational and that it met their expectations. They also do not mind that the trainers were from Scania, as this enabled them to discuss specific challenges due to having a good and mutual understanding of the suppliers' processes. All suppliers also identify this as an enabler for better collaboration in terms

of relations and understanding between Scania and the suppliers. Therefore, a first outcome of the training is that the staff at all suppliers believe it is now easier to make contact with Scania regarding different issues and questions.

A second outcome of the program is increased knowledge of lean practices at four suppliers (B, C, D, E). This knowledge relates to tools, which includes both theoretical knowledge (facts and origin of lean practices) and practical knowledge (how to use the tools). At every supplier, a third outcome is identified, as the training program facilitated an increased engagement regarding the application of the newly obtained knowledge. More specifically, the suppliers started to use tools that were showed during the training. Two suppliers (B, E) started to apply all tools that were showed during the training, while three suppliers only use some of them (A, C, D). Supplier A uses the tools sporadically. The suppliers that started to apply all tools upon completion of the training program already had previous experience in implementing lean practices. It was possible to validate whether suppliers (B, D, E) use their newly obtained knowledge by conducting a focus group discussion and by assessing changes to production flows and layouts during site visits. Even though no tangible measurements (e.g., financial figures) were used, internal lead-time and non-value adding time during operations seem to be reduced.

A third outcome identified at all suppliers is that the training program acted as a boost for motivation and engagement. This was in several cases a trigger for short-term changes. For instance, at three suppliers (B, C, E), the training was a trigger to start improving their processes and culture. These suppliers are now aware of the fact that their understanding of lean practices can be increased by more training. Supplier D is another example, where changes are made with regard to quality responsibility. Where before the quality department was mainly responsible for quality, now everyone at the supplier is made responsible.

A fourth outcome identified at three suppliers (B, D, E) is the initiation and implementation of a structured way of working for continuous improvement after the training program. In order to realize this, the suppliers use a visual management system that utilizes boards and displays information as a meeting point for improvement meetings. It is further observed that lean practices are incorporated into the daily work and duties of employees, which can be seen as the first step towards cultural change.

The fifth identified outcome relates to the production and material handling operations of the suppliers. Prior to the lean training program, the suppliers regarded each production operation as a standalone operation. Also, surroundings (e.g., shelves and movements) were not included in any change or improvement initiative. After the lean training program, four suppliers (B, C, D, E) started to view the production and material handling operations as one system.

Scania's lean training program mainly focused on continuous improvement of internal structures of suppliers, and during the program, several tools associated with lean practices (e.g., value stream mapping) were discussed. After the training, all suppliers made changes or started new structures to adopt the new ideas, ways of working, and mindset related to continuous improvement in their operation. Hence, the usage of these tools can be seen as an outcome of the training program. However, the aforementioned identified outcomes highlight that extent to which suppliers changed their way of working after the training varies. At the suppliers that implemented tools, clear examples of improvements can be given. These suppliers understand that the discussed tools support change and improve performance. They also state that the tools match with their view on production, production flows, and material handling. Thus, these suppliers see a benefit in adopting a value stream perspective. These results indicate that Scania's lean training program has been successful in terms of changes made at suppliers on an organization level.

5. CONCLUDING DISCUSSION

The purpose of this study is to investigate the outcomes of a manufacturer involving its suppliers in their lean training program. This study shows that, by training its suppliers to implement lean practices, Scania strengthened their relationship with its suppliers. This finding validates the study of Adler et al (1999), who argue that providing suppliers with training is a critical factor to consider when a manufacturer wants to reap the benefits of implementing lean in the supply chain. More specifically, the case study findings show that the lean training program had three positive outcomes. First, Scania and their suppliers started to collaborate more closely due to suppliers improving their internal ways of working and the establishment of more trust in terms of reliability. Suppliers initiated changes to internal structures that could ultimately strengthen the supply chain on the long-term. Improvement structures, value flow perspectives, and how the production is planned and performed are examples of areas where changes are identified. Second, Scania's suppliers improved their ability to identify possible problems that could jeopardize deliveries. The suppliers are now better at identifying possible risks and working together with Scania to eliminate these risks before a disturbance in the supply chain occurs. Third, the suppliers improved their delivery precision, which resulted in the supply chain of Scania performing better after the lean training program. These findings validate the work of MacDuffle and Helper (1997), who propose that lean suppliers improve their operational capabilities and are easier to collaborate with.

The current lean literature indicates that senior management support and commitment is important when implementing lean (Mann, 2009; Marodin & Saurin, 2013). The case study findings show that the extent to which suppliers started to implement lean practices after the training program varied due to varying levels of senior management commitment. A lack of senior management commitment in financially unstable suppliers could be the reason for those suppliers being less perceptive to the training program than financially stable suppliers. This finding highlights that Scania could have assessed their suppliers better with regard to financial performance before commencement of the training. This complements the work of MacDuffle and Helper (1997), who suggest that suppliers should be assessed based on the following criteria: motivation to learn, willingness to make their operations accessible, and willingness not to lay off employees.

This study can help manufacturers and suppliers to better understand the possible outcomes of supplier involvement in a lean training program. The presented findings and conclusions support previous studies that stress the importance and effects of supplier training. As in all research, it is important to acknowledge its limitations. One limitation of this study is that its findings are based on a single in-depth case study. This makes it not possible to generalize the findings to other companies or industries. Furthermore, this study only involves one Scania and its five suppliers. Another limitation is that all the involved companies originate from Sweden. These limitations should be considered when researchers attempt to replicate or further test the reported findings, and each of these limitations can be readily addressed by further research.

There are several possible avenues for future research. First, future research can focus on how the type of supply chain collaboration discussed in this study evolves over time. This makes it possible to study the long-term outcomes of a manufacturer involving its suppliers in their lean training program. Second, since Dyer and Hatch (2006) empirically show that companies with structurally equivalent (supplier) networks can still achieve differential benefits through those networks, another research avenue would be to extend this research beyond the supplier-manufacturer dyad and study the matter from a network perspective. Third, organizational context (e.g., supplier size and age) matters with regard to implementation of lean practices (Shah & Ward, 2003). Older suppliers are less likely to implement lean practices relative to younger suppliers. More evidence exists supporting the idea that large suppliers are more likely to possess the resources to

implement lean practices than smaller suppliers. Therefore, future research that investigates the involvement of suppliers in a manufacturer's lean training program should account for the organizational contexts of these suppliers.

6. REFERENCES

Adler, P. S., Goldoftas, B., and Levine, D. I. (1999). Flexibility Versus Efficiency? A Case Study of Model Changeovers in the Toyota Production System. *Organization Science* 10(1), 43-68.

Bhasin, S., and Burcher, P. (2006). Lean viewed as a philosophy. *Journal of Manufacturing Technology,* 17(1), 56-72.

Bicheno, J. (1999). The new Lean toolbox. London, UK: PICSIE.

Cudney, E., and Elrod, C. (2011). A comparative analysis of integrating lean concepts into supply chain management in manufacturing and service industries. *International Journal of Lean Six Sigma,* 2(1), 5-22.

Daaboul, J., Laroche, F., and Bernard, A. (2010). Determining the CODP position by value network modelling and simulation, ICE conference.

Dyer, J. H., and Hatch, N. W. (2004). Using Supplier Networks to Learn Faster. MIT Sloan Management Review Spring, pp. 57-63.

Dyer, J. H., and Hatch, N. W. (2006). Relation-specific capabilities and barriers to knowledge transfers: creating advantage through network relationships. *Strategic Management Journal,* 27(8), 701-719.

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *The Academy of Management Review* 14(4), 532-550.

Eisenhardt, K. M., and Graebner, M. E. (2007). Theory Building from Cases: Opportunities and Challenges. *The Academy of Management Journal*, 50(1), 25-32.

Hallgren, M., and Olhager, J. (2009). Lean and agile manufacturing: external and internal drivers and performance outcomes. *International Journal of Operations and Production Management,* 29(10), 976-999.

Henderson, B., Larco, J. L., and Martin, S. (1999). Lean transformation: How to change your business into a lean enterprise. Oaklea Press, Richmond, VA, USA.

Hilletofth, P. (2008), Differentiated supply chain strategy: Response to a fragmented and complex market, Licentiate thesis, Chalmers University of Technology, Gothenburg, Sweden.

Hilletofth, P. (2010), Demand-supply chain management, Doctoral thesis, Chalmers University of Technology, Gothenburg, Sweden.

Hines, P., and Taylor, D. (2000). Going lean. Lean Enterprise Research Centre, Cardiff, pp. 3-43.

Hines, P., Holweg, M., and Rich, N. (2004). Learning to evolve: a review of contemporary lean thinking. *International Journal of Operations and Production Management*, 24(10), 994-1011.

Holweg, M., and Miemczyk, J. (2002). Logistics in the 'three-day car' age: Assessing the responsiveness of vehicle distribution logistics in the UK. *International Journal of Physical Distribution and Logistics Management,* 32(10), 829-850.

Jammernegga, W., and Reinder, G. (2007). Performance improvement of supply chain processes by coordinated inventory and capacity management. *International Journal of Production Economics*, 108, 183-190.

Jonsson, P. (2008). Logistics and supply chain management. OH, USA: McGraw-Hill Higher Education.

Koh, S. C. L., Demirbag, M, Bayraktar, E., Tatoglu, E, and Zaim, S. (2007). The impact of supply chain management practices on performance of SMEs. *Industrial Management and Data Systems,* 107(1), 103-124.

Krizner, K. (2001). Manufacturers adopt a lean philosophy. *Frontline Solutions*, July, pp. 1-5.

Lamming, R. (1996). Squaring lean supply with supply chain management. *International Journal of Operations and Production Management*. 16(2), 183-196.

Lantz, A. (2008). Intervjumetod. Studentlitteratur, Lund, Sweden.

Liker, J. K. (2004). The Toyota way – 14 management principles from the world's greatest manufacturer. New York, US: McGraw-Hill, New York.

Liker, J. K., and Wu, Y.-C. (2000). Japanese automakers, U.S. suppliers and supply-chain superiority. *MIT Sloan Management Review,* 42(1).

Liu, J. (2004). Study on the positioning and form selection of decoupling point in postponed manufacturing. *Jiangsu Commercial Forum 1*, pp. 69-70.

MacDuffle, J. P., and Helper, S. (1997). Creating Lean Suppliers: Diffusing Lean Production Through The Supply Chain. *California Management Review,* 39(4), 118-151.

Mann, D. (2009). The missing link: Lean leadership. *Frontiers of health services management*. 26 (1), 15- 26.

Marksberry, P. (2012). Investigating 'The Way' for Toyota suppliers: A quantitative outlook on Toyota's replicating efforts for supplier development. *Benchmarking: An International Journal,* 19(2), 277- 298.

Marodin, G. A., and Saurin, T. A. (2013). Implementing lean production systems: Research areas and opportunities for future studies. *International Journal of Production Research,* 51(22), 6663-6680.

Narasimhan, R., Swink, M., and Kim, S. W. (2006). Disentangling leanness and agility: An empirical investigation. *Journal of Operations Management,* 24(5), 440-457.

Naylor, J. B., Naim, M. M., and Berry, D. (1999). Leagility: Integrating the lean and agile manufacturing paradigms in the total supply chain. *International Journal of production economics,* 62(1), 107-118.

Pettersen, J. (2009). Defining lean production: Some conceptual and practical issues. *The TQM Journal*, 21(2), 127-142.

Rother, M., and Shook, J. (2003). Learning to see: Value Stream Mapping to create value and eliminate Muda. Lean Enterprise Institute.

Seguel, R., Eshuis, R., and Grefen, P. (2010). Architecture support for flexible chain management. Proceedings of the 5th SIKS/BENAIS Conference on Enterprise Information Systems.

Shah, R., and Ward, P. T. (2003). Lean manufacturing: context, practice bundles, and performance. *Journal of Operations Management*, 21, 129-149.

Shah, R., and Ward, P. T. (2007). Defining and developing measures of lean production. Journal of Operations Management, 25, 785-805.

Wu, Y. C. (2003). Lean manufacturing: a perspective of lean suppliers. *International Journal of Operations and Production Management,* 23(11), 1349-1376.

Yin, R. K. (2009). Case study research: Design and methods (4th ed.). Thousand Oaks, CA: Sage.

Zhang, X., and Chen, R. (2006). Forecast-driven or customer order-driven? An empirical analysis of the Chinese automotive industry. *International Journal of Operations and Production Management*, 26(6), 668-688.