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Lean Supply Chain Practices and Performance in the Context of Malaysia

Azman Daud and Suhaiza Zailani
Graduate School of Business,
Universiti Sains Malaysia, 11800, Penang,
Malaysia

1. Introduction

Supply chain nowadays becoming a vital entity to the organizations performance measurement and metrics, has received much attention from researchers and practitioners. To support this, Gunasekaran, Patel (2001) and McGaughy (2004) have discussed that the role of these measures and metrics in the success of an organization cannot be overstated because they affect strategic, tactical and operational planning and control. Some more, the revolution of SCM in the last decade has testified that an increasing number of companies seek to enhance performance beyond their own boundaries (Boyson et al., 1999; Proirier, 1999). Supply chain has been viewed on every perspective. According to Agarwal & Shankar (2002), a supply chain is an inter-linked set of relationships connecting customer to supplier, perhaps through a number of intermediate stages such as manufacturing, warehousing and distribution processes.

Accordingly, Harland (1996) have clearly stated that supply chain also often refers either to a process-oriented management approach to sourcing, producing, and delivering goods and services to end customers or, in a broader meaning, to the co-ordination of the various actors belonging to the same supply chain. Intense competition compels companies to create close relationships with their upstream and downstream partner (Togar & Ramaswami, 2004). In the competitive environment, most leading edge companies realized that by transferring costs either upstream or downstream, they are actually not increasing their competitiveness, since all costs ultimately make their way to consumers (Cigolini, Cozzi & Perona, 2004). Hence, Cigolini, Cozzi and Perona (2004), have mentioned that supply chain management guides firms to co-operate with a common goal to increase the overall channel sales and profitability, rather than competing for a bigger share of a fixed profit. One strategy for coordinating within and between firms with a focus on achieving efficiency, eliminating waste or overburden and creating value in products is the concept of lean management (Womack & Jones, 1996). Consequently, Vonderembse, Uppal, Huang, and Dismukes (2006), highlighted on the strategies and methodologies for designing supply chains that meet specific customer expectations. According to them, three different types of supply chains can be defined:

1. A lean supply chain, which employs continuous improvement efforts which focuses on eliminating waste or non-value steps along the chain.

2. An agile supply chain, which responds to rapidly changing, continually fragmenting global markets by being dynamic, context-specific, growth-oriented, and customer focused.
3. A hybrid supply chain, which combines the capabilities of lean and agile supply chains to create a supply network that, meets the needs of complex products.

Lean thinking is focused on eliminating waste from all processes while enhancing material and information flow along the supply chain (McCullen & Towill, 2001). The impact of lean thinking as a strategy for the supply chain and not just manufacturing is important and has received a lot of interest from both industry (including service) and academia. Hence, the purpose of this paper is to explore the implementation of lean supply chain management practices in manufacturing industry in Malaysia, and identifies the impact of these practices on lean supply chain performance.

2. Literature review

2.1 Lean basics

There are lots of definitions available to define "Lean". For example, The National Institute of Science and Technology (NIST/MEP, 1998) defines Lean as "A systematic approach to indentifying and eliminating waste (non-value added activities) through continuous improvement by following the product at the pull of the customer in pursuit of perfection"(Buzby, Gerstemfeld, Voss & Zeng, 2002). Simply, lean means to create more value for customers with fewer resources, in other words, the fundamental ideas is to maximize customer value while minimizing waste. Actually, the word "Lean" was first used in the Future Car Investigation by MIT professors to interpret Japan's new production system that do away with mass production (Womack et al., 1991; Macduffie & Helper, 1997; Conti et al., 2006) since it produces much waste. "Waste" is defined as anything that interferes with the smooth flow of production (Macduffie & Helper, 1997). The eight wastes highlighted in TPS are overproduction, waiting, conveyance, over processing, excess inventory, movement, defects and unused employee creativity, and the biggest one being overproduction (Monden, 1998; Liker, 2004).

Wu and Wee (2009) concluded that the term "lean" means a series of activities or solutions to eliminate waste, reduce non-value added (NVA) operations, and improve the value added (VA). This VA and NVA concept were derived mainly from TPS. A lean organization understands customer value and focuses its key processes to continuously increase it. The ultimate goal is to provide perfect value to the customer through a perfect value creation process that has zero waste. To make Lean success, level of thinking need to be change in order to focus of management from optimizing separate technologies, assets, and vertical departments to optimizing the flow of products and services through entire value streams that flow horizontally across technologies, assets, and departments to customers (Lean Enterprise Institute, 2009). Eliminating waste along entire value streams, instead of at isolated points, creates processes that need less human effort, less space, less capital, and less time to make products and services at far less costs and with much fewer defects, compared with traditional business systems. Companies are able to respond to changing customer desires with high variety, high quality, low cost, and with very fast throughput times.

According to Anand and Kodali (2008), only in recent times, researchers have emphasized that the theory and principles of lean and its associated tools, techniques, practices and

procedures can be extended outside the boundaries of an organization to its supply chains. However, the concept of lean supply chain was proposed in 1994, when the proponents of lean manufacturing, Womack and Jones (1994) envisioned the concept of 'lean enterprise'. The supply chain management concept has evolved with it through the five distinct stages shown in Figure 1 below.

Source: McKee & Ross (2009)

Fig. 1. Evolution of SCM

2.2 The Concepts and importance lean supply chain

Several researchers, such as Lee *et al*. (1997) and Lummus *et al*. (2003), explained that the information transferred from one stage to another in supply chain tends to be distorted and can misguide upstream members in the production decisions, resulting in wastes, thereby affecting the coordination between the different stages of a supply chain. Lean supply chain continuous improvement processes to focus on the elimination of waste or non valued-added functions. These waste and non value-added stops across the supply chain and reduce set of times to allow for the economic production of small quantities. Gordon (2008) came out with his points that strongly support on lean supply chain best practices and performance. Accordingly, there is a research by Accenture, INSEAD and Stanford University show correlation between companies with a successful supply chain strategy and significant financial success. The correlation focuses on four lean supply chain perspectives: How organizations keep goods and services flowing in a smooth, uninterrupted and cost-effectives fashion from suppliers to customer firms end to end. Inventory perspectives; How do we keep minimal, but sufficient inventory in the supply chain pipeline in order to provide good service levels without interruptions. Lean procurement; how can procurement scale and improve its processes to minimize transactions, reduce total cost and work with the best possible suppliers who meet its requirements, Adopting lean within customer and supplier firms; how can business work to eliminate waste while adding value to its customers. Bozdogan (2002) emphasized that the successful of lean supply chain management principles derive from 10 Basic Lean Principles:

- Focus on the supplier network value stream

- Eliminate waste
- Synchronize flow
- Minimize both transaction and production costs
- Establish collaborative relationships while balancing cooperation and competition
- Ensure visibility and transparency
- Develop quick response capability
- Manage uncertainty and risk
- Align core competencies and complementary capabilities
- Foster innovation and knowledge-sharing

Bozdogan (2002) has illustrated the differentiation between conventional versus lean model adapted into lean supply chain management based on 22 characteristics identified. Refer to table 1.

ILLUSTRATIVE CHARACTERISTICS	CONVENTIONAL MODEL	LEAN MODEL
Number & structure	Many; vertical	Fewer; clustered
Procurement personnel	Large	Limited
Outsourcing	Cost-based	Strategic
Nature of interactions	Adversarial; zero-sum	Cooperative, positive-sum
Relationship focus	Transaction-focused	Mutually-beneficial
Selection length	Lowest price	Performance
Contract length	Short-term	Long-term
Pricing practices	Competitive bids	Target costing
Price changes	Upward	Downward
Quality	Inspection-intensive	Designed-in
Delivery	Large quantities	Smaller quantities (JIT)
Inventory buffers	Large	Minimized, eliminated
Communication	Limited; task-related	Extensive; multi-level
Information flow	Directive; one-way	Collaborative; two-way
Role in development	Limited; build-to-print	Substantial
Production flexibility	Low	High
Technology sharing	Very limited; nonexistent	Extensive
Dedicated investments	Minimal-to-some	Substantial
Mutual commitment	Very limited; nonexistent	High
Governance	Market-driven	Self-governing
Future expectations	No Guarantee	Considerable

Source: Bozdogan (2002)

Table 1. The Comparison between Conventional and Lean Model

2.3 The lean supply chain's practices

From the earlier analysis by (APICS, 2004; Manrodt, et al., 2005) and Aberdeen Group (2006), there are significant differences between these two researches. APICS, 2004; Manrodt et al (2005) focused more on lean supply chain level of practices ("Poor Practice", "Inadequate

Practice", "Common Practice", "Good Practice" and "Best Practice") while Aberdeen Group (2006) is focused more on level of adoption ("laggards", "industry norm" and "best in class") of lean supply chain implementations. In conjunction to the objectives of the study, the APICS, 2004; Manrodt et al (2005) research framework on level of lean supply chain practices seems to the perfect match and suitable to be used in order investigate the extent of lean supply chain practices towards performances in Malaysia. If we go back to the research objectives, four objectives related to the lean supply chain practices which are first, to investigate the extent of implementation for lean supply chain practices in Malaysia and second, to examine the effects of lean supply chain practices on the performance of the lean and lean supply chain in Malaysia. Additionally the study is to examine the mediating effect of lean performance. This argument perfectly supported the importance of framework selected.

Generally, from the literature review, there are four significant main practices of lean supply chain such as demand management, standardization, waste management and organizational behavior. The study however, will focus only two lean supply chain key principles that have been identified and being grouped. This is due to the reason that the study is focus on the outbound supply chain rather than inbound. Improving outbound supply chain efficiencies has become a top priority for companies seeking to increase their bottom line (Norek, 2002). The two main areas of improvement mentioned are Demand Management (Demand Management together with Cost Management) and Waste (Waste Management). These two main areas of lean supply chain key principles will be use to investigate the best practices and effects of lean supply chain implementations and practices in Malaysia. For every particular areas of improvement, the continuous of details discussion of the subsequences will be the main agenda of the best practices study. For example, Demand Management will be focused on Demand Signal, Demand Collaboration, Sales and Operation Planning and Inventory Management Practice. Waste will be discussed on waste management and value added activities and environmental issue awareness. The study then will continue to focus on the lean supply chain performance.

2.4 Lean performances

Lean performance is total internal lean optimization process. To develop a lean supply chain, there is need to apply lean to the supply chain as a system (Phelps, 2004). Lean is an approach that identifies the value inherent in specific products, identifies the value stream for each product, supports the flow of value, lets the customer pull value from the producer, and pursues perfection. It is through this holistic, enterprise-wide approach to lean implementation that the theory extends beyond functional strategy to a broader supply chain strategy employed by the company (Goldsby, 2005). The strengths of lean approach are lean's more immediate and practical focus on waste, flow and flexibility (Industry Week, 2010). A lean organization optimizes the flow of products and services to its customers. It delivers customer value by:

- Reducing lead times
- Improving quality
- Eliminating waste
- Reducing the total costs
- Engaging and energizing people (Industry Week, 2010).

Continuous Business Improvement (2010) has introduced 20 keys to world class competitiveness and total workplace improvement which are derived to the lean performances on better quality, faster throughput and cheaper cost.

2.5 Framework and hypotheses

As lean practices will be the core component of organizations business performances, these variables may also significantly influence the lean performance, which need to be focus in this study. Therefore, this theoretical framework (Figure 2) is served to investigate the performances rate of independent variables (lean practices).

Fig. 2. Proposed Theoretical Framework

2.6 Hypothesis

2.6.1 Lean supply chain practices and lean performance

In term of demand management, it is very important that how well firms manage the demand signal, demand collaboration, sales and operation planning and inventory management is also reflected in how a lean supply chain system view as a system (Phelps, 2004; APICS, 2004; Manrodt et al, 2005). Lean performance is total internal lean optimization process; therefore demand management is vital to play their role to accept the concept of lean performance within their processes subsets. The strengths of lean approach are leanness are more immediate and practical focus on waste, flow and flexibility (Industry Week, 2010), therefore, supply chain partners including the upstream suppliers and downstream customers can work together as a team to provide value to the end-user customer (APICS, 2004; Manrodt et al., 2005). Some internal issuses like "offset" of Bill of Materials (BOMs)'s explosions; can be handle effectively by better understand the "real" demand they are projecting (APICS, 2004; Manrodt et al., 2005) in making used the approaches of lean performances like Reducing lead times, improving quality, eliminating waste, reducing the total costs, engaging and energizing people (Industry Week, 2010).

In the perspectives of waste management, lean performances are important to generate flexibility in order to control organization waste; the focus is to reduce waste; not costs, (APICS, 2004; Manrodt et al 2005). Anything that delays or impedes supply chain's flow must be analyzed as a potential non-value added activity (Craig, 2004). Some of the lean performances initiatives can be taken such as Engaging and energizing people (Industry Week, 2010) and supply chain partners have to work together and individually to eliminate wasteful processes and excess inventory across the chain. This elimination of waste should have a significant by-product: a reduction in cost for the supply chain. Therefore, the following hypothesis is proposed;

H1: Organizations that practice the lean supply chain practices are significantly impact lean performance.

3. Methodology

3.1 Research design

In this study, the units being analyzed which are comprise of electrical, electronics and electronics manufacturing services companies in Malaysia. These manufacturing industries recorded the fastest growth rate in terms of its growth of industry by sub-sectors. Sampling

is an option and one of the efficient process that been using by a quantitative research of selecting a sufficient number of data and information from the selected population. By selecting the right sample, it is possible to capture the characteristics of the data or information to the population elements (Sekaran, 2003). The sampling technique used for this research is based on proportionate stratified random sampling. According to FMM, 2010, there are over 1,000 manufacturers and supporting industries in the Electrical & Electronics Industry. 551 companies' related companies have been identified including MNC and SME sectors which are suitable for the test case in order to study and investigate the lean supply chain practices and performances metrics.

The data collection of this study will be carried out by using email, hand distribution and mailing to the respondent. As suggested by Sekaran (2003), the analysis samples should be at least ten times the number of variables in a study. Thus, 40 respondents are targeted in this study, as there are a total of four variables. Roscoe's (1975) rule of thumb suggest samples sizes that are greater than 30 and less than 500 should be appropriate for most research. The minimum sample should be at least 10 times than the number of variables. From the respondents received, 114 out of 551 targeted questionnaires responded.

3.2 Development of questionnaire

In this study, measures of variables were developed based on the literature review in addition to the survey. To date, very few large scale studies were conducted regarding lean supply chain practices, lean performances, and lean supply chain performances(Aberdeen Group (2006); APICS, 2004; Manrodt, Abott &Vitasek, 2005). Therefore, few reliable and validated measures were found in the literature. Accordingly, the study depends on the available that are derived from the issues and questions raised in the literature. The questions were taken directly from the past questionnaires with few modifications made to the model requirements (APICS, 2004; Manrodt, Abott &Vitasek, 2005).

In this study, lean supply chain practices have two dimensions of the independent variables which are: demand management and waste management, mostly following the similar study on lean supply chain practices (e.g., Aberdeen Group (2006); APICS, 2004; Manrodt, Abott &Vitasek, 2005). The study uses a 5-point Likert as point of scales for all dimensions of lean supply chain practices. The scale ranges from 1= low extent to 5= very high extent. In this study demand management is defined as how effectively the lean organizations handle their operations by moving to a pull system (Ducharme and Lucansky (2002), that is, products or services are pulled when requested by the final customer. There are four important facets need to be tested under demand management which are including of demand signal, demand collaboration, sales and operations planning, and inventory management practices (APICS, 2004; Manrodt, Abott &Vitasek, 2005).

In this study waste management is defined as to eliminate activities that do not add value (waste) in the manufacturing processes and increase the value-added activities which are those contribute to the highest level of efficiency in placing the final product at the customer In addition, it is about identifying and eliminating waste; as measured in time, inventory and cost across the complete lean supply chain. This requires continuous effort and improvement (Craig, 2004; Ilyas, Shankar & Banwet, 2008). There are two important facets need to be tested under waste management which are including of demand signal, demand collaboration, sales and operations planning, and inventory management practices (APICS, 2004; Manrodt, Abott &Vitasek, 2005).

Lean performances communicate through strengths of lean approaches, which are lean's more immediate and practical focus on waste, flow and flexibility (Industry Week, 2010). In this study, base on (Continuous Business Improvement, 2010) 20 keys to world class competitiveness and total workplace improvement frameworks suggested that the total performances comes from three important facets; which are better quality, faster throughput and cheaper cost.

4. Analysis

4.1 Profile of organizations

The profile data has been surveyed into four major sectors which are variables, categories, frequency of profiling attempts and percentage. For the number of full time employees data, the range of > 150 employees shows the highest (82%) and follow by 5-50 employees (9.6%) and the lowest is < 5 employees which is 10(8.8%). Most of the companies best categorized fully owned by foreign company (63%), is a large type of size (68%). Data shows that Penang state contributed the highest data (33%) and Pahang (1.8%) contributed as the lowest for state profile. Here, we can conclude that Penang is the most state with the Electrical &Electronics and Electronics Manufacturing Services companies on most of manufacturing kind of operations in Malaysia. The highest age of firm is 11 years – 15 years (33%) operating in Malaysia and the newest which are < 5 years is the lowest, contribute to 9.6% on profile rate.

The profile data mostly covers all general data of the gender, age, race and marital status. The interesting is to know the level of educations and positions profile among respondents to see whether the survey is suitable to be focused to the target segments. For the highest academic qualification, bachelor degree contributed the highest score which is 47.4%, follows by master degree which is 42.1%. The lowest is diploma holder with 10.5%. For positions in the current organizations, the highest score is Middle Management (Manager, Senior Engineer /Executive) with the score of 71.9% and follows by Lower Management (Executive, Engineer, and Supervisor), 21.9% and the lowest is Top Management equivalent to 6.1%.

4.2 Regression for demand management

To test the hypotheses generated from the tested variables, a multiple regression analysis was used. The results are presented in Table 2. The R^2 was 0.15 indicating that 15 percent of the variation of better quality can be explained by the demand management and the F-value of 4.568 was significant at the 0.01 level. Demand collaboration ($\beta = 0.237$; $p<0.05$) and sales and operations planning ($\beta = 0.262$; $p<0.01$) were positive and significantly related to better quality. However, the demand signal ($\beta = -.033$; $p>0.05$) and inventory management practice ($\beta = -.030$; $p>0.05$) were found no relationship with better quality.The R^2 was 0.27 indicating that 27 percent of the variation of faster throughput can be explained by the demand management and the F-value of 9.990 was significant at the 0.001 level. Sales and operations planning ($\beta = 0.394$; $p<0.001$) and inventory management practice ($\beta = 0.325$; $p<0.001$) were positive and significantly related to faster throughput. Demand signal ($\beta = 0.057$; $p>0.05$) and demand collaboration ($\beta = -.038$; $p>0.05$) were found no relationship with faster throughput. The R^2 was 0.44 indicating that 44 percent of the variation of faster throughput can be explained by the demand management and the F-value of 21.055 was significant at the 0.001 level. Demand collaboration ($\beta = 0.462$; $p<0.001$) and sales and operations planning

(β = 0.302; p<0.001) were positive and significantly related to cheaper cost. Demand signal (β = 0.109; p>0.05) and inventory management practice (β = 0.036; p>0.05) were found no relationship with cheaper cost.

Variables	*Better Quality*	*Faster Throughput*	*Cheaper Cost*
	β	β	β
Demand Signal	-0.033	0.057	0.109
Demand Collaboration	.237*	-0.038	.462***
Sales & Operations Planning	.262**	.394***	.302***
Inventory Management Practice	-0.03	.325***	0.036
R^2	0.146	0.272	0.44
Adjusted R^2	0.114	0.245	0.42
F	4.568**	9.990***	21.055***

Note: *p<0.05; **p<0.01; ***p<0.001

Table 2. Regression analysis between Demand Management and Lean Performance

4.3 Regression for waste management

The results are presented in Table 3. The R^2 was 0.272 indicating that 27 percent of the variation of lean performance can be explained by the waste management and the F-value of 4.226 was significant at the 0.001 level. Waste (β = 0.639; p<0.01) and value added activities (β = 0.444; p<0.05) were positive and significantly related to lean performance.

Variables	*Better Quality*	*Faster Throughput*	*Cheaper Cost*
	β	β	β
Waste	0.169	.242**	.639***
Value Added Activities	0.156	.444***	-0.086
R^2	0.071	0.331	0.377
Adjusted R^2	0.054	0.319	0.365
F	4.226*	27.191***	32.616***

Note: *p<0.05, **p<0.01, ***p<0.001

Table 3. Regression Analysis between Waste Management and Lean Performance

5. Discussions

This study has shown that demand collaboration, sales and operation planning, inventory management practices, waste and value added activities are the most influence lean supply chain practices for lean performances, regardless of the demand signal, which has no influence data survey limitation. Hence, this information can be utilized to promote the acceptance and implementation of lean supply chain practices. Related government bodies for manufacturing and operation such as FFM, SMIDEC and MPC can therefore focus on these factors for further research development of lean supply chain practices and performances. These organizations can organize more training and seminars to smaller manufacturing companies to expose the concept of lean supply chain upfront, as the concept

can consider new, limits to off resources. From an organization point of view, attention should be given to improve employee participation and quality department should play a proactive role in practicing the lean supply chain as a strategic tool.

One of the limitations of this study is that the conclusion drawn from the survey was principally due to the variety of interpretations of what the term and concepts of "lean supply chain performances" actually means. Since, this is a newly concept that need to adapt, it's possible that the lean practitioners should have a solid knowledge before implement it. It's a waste of multiple of resources if doing it wrongly. From the data interpretation, it is resulting that the survey has a good trend of lean supply chain practices towards performances. New hypotheses able to generate which are more specific in term of sub variables interpretations. Even though, there is a concept of mediating being implement in the research, the study able to show up with an excellence result compare to Malaysian geographical area and small scope of manufacturing operations. The sample size of this study is rather small. Although the survey shows consistency of reliability, validity has proven that improvements like supplier engagement and collaboration is not surely clear. To be significant, it is always better to subject the model to a larger sample size. Other alternative like to carry out an external validity by checking with other set of samples in order to strengthen the arguments. The findings of this study have shown that there is a relationship between industry and lean supply chain practices and performances. It's also shows some of the lean supply chain concept is extents, therefore, it is recommended to extend the framework to a more distinguished like standardization of the process and organizational issues handling lean (Aberdeen Group (2006), APICS (2004). Furthermore, the scope of the study can be extended into clustered at certain geographical areas as a result from the critical mass. There will be wider, and the characteristics and practices business unit under test might vary owing to business environment differences.

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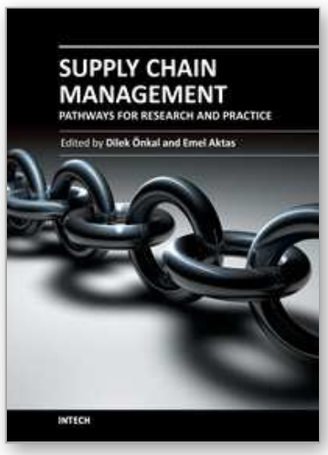

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Challenges faced by supply chains appear to be growing exponentially under the demands of increasingly complex business environments confronting the decision makers. The world we live in now operates under interconnected economies that put extra pressure on supply chains to fulfil ever-demanding customer preferences. Relative attractiveness of manufacturing as well as consumption locations changes very rapidly, which in consequence alters the economies of large scale production. Coupled with the recent economic swings, supply chains in every country are obliged to survive with substantially squeezed margins. In this book, we tried to compile a selection of papers focusing on a wide range of problems in the supply chain domain. Each chapter offers important insights into understanding these problems as well as approaches to attaining effective solutions.

InTech Europe
University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
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