Assessment of Supply Chain Strategies and Analysis on the Performance of Companies Deployed Strategy Using Activity Based Approach

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Abstract

Supply chain strategy aims to determine the benefit of operation, distribution, services and all activities an organization is using based on its specific strategy. With the high increasing rate of competitiveness in today's markets, companies must know about their supply chain strategy to survive and win the market versus their competitors. Studies about supply chain strategies mainly focus on each supply chain strategy's characteristic and the activities deployed by the company may be neglected in this condition. This study aims to determine companies' supply chain strategy using an activity based approach aligned with its main categories which are lean, agile and leagile. It is critical for any company to know about the activities related to each supply chain strategy and also the level of conformance between the supply chain strategy and deployed activities. A hypothesis test is used to examine the level of conformance between supply chain strategy and deployed activities at the final part of this study.

Keywords: Supply chain strategy; supply chain activities; supply chain strategy hypothesis testing

■1.0 INTRODUCTION

Supply chain contains all physical or non physical partitions involved, directly or indirectly, in satisfying a customer request. Supply chain covers the manufacturer and suppliers and also transporters, warehouses, retailers, and customers. Within any organization, whether manufacturing or service enterprises, the supply chain includes all activities involved in receiving and fulfilling a customer demand. These functions may include new product development, operation management, marketing, performance management, product distribution, financial analysis, and after sale service.

Supply chain management can be defined as "the design and management of seamless, value-added process across organizational boundaries to meet the real needs of the end customer" [Fawcett *et al*. 2007]. Strategy is a plan of action designed to achieve a vision. It derives from the Greek "στρατηγία" (strategia), office of general, command, and generalship [Henry George Liddell *et al*. 1980]. Supply chain strategy can be defined as a mix of ranked supply chain management objectives which supply chain aims to reach them and also ways of operating them [Mattias J. Schnetzler *et al*. 2004].

The major supply chain strategies in a supply chain are lean and agile [Intaher Marcus ambe, 2010]. Leanness in supply chain strategy means to develop a value stream that aims to eliminate wastes including time [Martin Christopher *et al*. 2000].A lean supply chain also aims to minimize costs [Yahya and Mohamad, 2011]. Agility in contrast means to use all the knowledge existing in the market and all the supply chain capabilities to behave in a way that profitable opportunities can be achieved [Naim *et al*. 2006]. A combination of these two strategies is considered as the third division named Leagile and developed by Naylor *et al*. (1999).

The comparison between the major characteristics of the Lean, Agile and Leagile strategies can be seen in the Table 1 proposed by Naylor *et al*. (1999). This table shows the market winners, market qualifiers and interior characteristics of each strategy.

Table 1 Comparison of lean, agile and leagile supply chain

Distinguishing attributes	Lean supply chain	Agile supply chain	Leagile supply chain
Market Demand	Predictable	Volatile	Volatile and unpredictable
Product variety	Low	High	Medium
Product Life cycle	Long	Short	Short
Customer drivers	Cost	Lead time and availability	Service level
Profit Margin	Low	High	Moderate
Dominant Costs	Physical Costs	Marketability Costs	Physical/Marketability cost
Stock out penalties	Long term contractual	Immediate and volatile	No place for stock out
Purchasing policy	Buy goods	Assign capacity	Vendor manage inventory
Information enrichment	Highly desirable	Obligatory	Essential
Forecast Mechanism	Algorithm	Consultative	Algorithm and consultative/ Algorithm or consultative
Typical Products	Commodities	Fashion goods	Product as per customer demand
Lead time compression	Essential	Essential	Desirable
Eliminate Muda	Essential	Desirable	Arbitrary
Rapid Reconfiguration	Desirable	Essential	Essential
Robustness	Arbitrary	Essential	Desirable
Quality	Market qualifier	Market qualifier	Market qualifier
Cost	Market winner	Market qualifier	Market winner
Lead Time	Market qualifier	Market qualifier	Market qualifier
Service Level	Market qualifier	Market winner	Market winner

Sources: Naylor *et al*. (1999), Mason-Jones *et al*. (2000a)

As it is clear above, all these factors determine the characteristics of each strategy and can be used for company strategy assessment. These characteristics can be supported by some related activities. Implementing lean and agile strategies needs some tools and techniques which are categorized in Table 2.

Table 2 Lean and agile supporting activities

Strategy	Supporting Activities
Lean	Just in Time, Toyota Production System, Total Quality Management, Total Productive Maintenance, Kaizen, 5S, Six Sigma, Kanban, Level Scheduling, Material Requirement Planning
Agile	Flexible Manufacturing System, TRIZ, Vendor Managed Inventory, Management Information System, Theory of Constraint

Sources: Mason-Jones *et al*. (2000)

■2.0 RESEARCH METHODOLOGY

Based on what mentioned about supply chain strategy, these concepts can be related to many factors and there are many methods for assessing supply chain strategy. The supply chain strategy drivers can be defined as all activities deployed by the company. Based on literature and what mentioned about activities related to lean and agile supply chain strategy, a questionnaire was designed and sent to three electrical single and medium case studies.

Companies were asked to answer questions about activities deployed in their company. A list of activities like Toyota production system (TPS) , Kaizen , 5 S , material requirement planning , just in time , level scheduling , Kanban , total quality management (TQM) , total productive maintenance , six sigma , enterprise requirement planning , TRIZ , flexible manufacturing system (FMS) , vendor managed inventory (VMI), managing information systems (MIS) and theory of constraints (TOC) were asked companies to respond. The classification of activities and the relationship between each activity and the supply chain strategy was not shown in the questionnaire and consequently there is no skew toward them. These activities can be related to main supply chain strategies which are lean and agile and the combination of them which is leagile.

■3.0 RESULTS AND DISCUSSION

3.1 Questionnaire Design

The questionnaire is designed and sent to companies and the expert opinions have been collected. The questionnaire is designed for different supply chain techniques in which each strategy can be determined based on the activity frequency of usage. The frequency of these techniques deployed by the company can be analyzed and it helps the study to have a better understanding about what is going on in the company and answer the question of whether the activities in the company are compatible to the supply chain or not. The range of ranks in the

designed questionnaire is from 1 to 5 (1 is the lowest amount and 5 is highest). The gathered data are shown in Figures 1, 2, and 3.

3.2 Case Study One: Lean Supply Chain Strategy

This company mainly deploys level scheduling to schedule its production. The company also uses 5S for environmental discipline, TQM for quality related activities and TPM for maintenance system. The company also uses 6 SIGMA for decreasing product variety which also relates to lean supply chain. To analize the company from agile supply chain strategy point of view, the company uses managing information system (MIS) for manufacturing and furthermore, uses the theory of constraint regard to the agile strategy. To be more detailed, activities deployed in the company are not very much related to agile supply chain and mainly focus on the lean supply chain.By considering all these characteristics, the main supply chain strategy for this case is agile. A chart is shown here to show its activity frequency graphically. The chart shows activities deployed by the company and is classified based on lean or agile. It also shows the ranks ranges which helps to have an understanding about the level of each activity usage in the company.
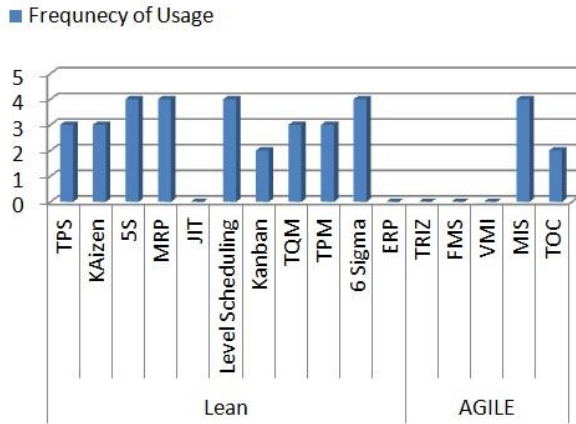

Figure 1 Case study one activity based supply chain strategy assessment

3.3 Case Study Two: Leagile Supply Chain Strategy

This company mainly uses TPS which is a lean based activity. The company also uses 5 S for environmental discipline, TQM for quality related activities and TPM for maintenance system.

The company also uses 6 SIGMA for decreasing product variety which also relates to lean supply chain. To analize the company from agile supply chain strategy point of view, the company uses a flexible manufacturing system (FMS) for manufacturing, vendor managed inventory (VMI) system for inventory procurement and MIS for IT related activities. Furthermore, the company uses the theory of constraints (TOC) regard to the agile strategy. To be more detailed, activities deployed by the company are not very much related to lean supply chain nor the agile supply chain. By considering all these characteristics, the main supply chain strategy for this case is leagile due to the combination of lean and agile supply chain strategy.

Same as what presented for the case study one, a chart is shown here to show what mentioned graphically. The chart shows activities done in the company and classified based on lean or agile. The chart also shows the frequency which helps to have an

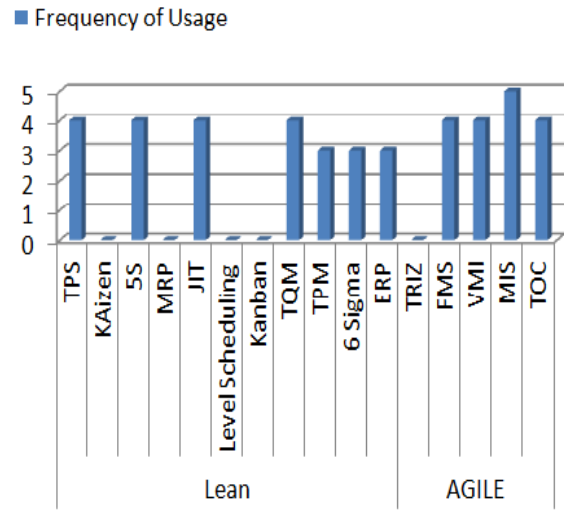understanding about the level of each activity usage in the company.

Figure 2 Case study two activities based supply chain strategy assessment

3.4 Case Study Three: Lean Supply Chain Strategy

The company uses Toyota Production System as its main manufacturing policy and other activities such as 5S, MRP, Level Scheduling, Kanban, TQM and TPM are also deployed in a high level. Then the main supply chain strategy for this company is lean, which is very clear from its activities. Figure 3 shows activities deployed in the company graphically.
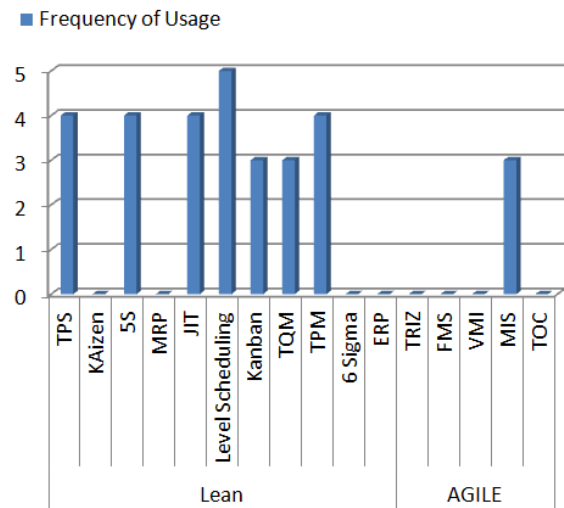

Figure 3 Case study three activity based supply chain strategy assessment

3.5 Hypothesis Test

A hypothesis is a special declaration of prediction. It identifies tangible (instead of hypothetical) circumstances what is predicted to occur in the study. In respect to Mentzer and Kahn (1995), hypotheses are scientifically testable assertions about non-observable constructs. Based on Popper (1959), all knowledge of

the nature of hypotheses and laws and regulations has a theoretical character .There is a high relationship between the company's supply chain strategy and the activities deployed by the company to achieve competitive strategy. Based on what mentioned about supply chain strategy supporting activities and the supply chain strategy assessment, companies' strategies can mainly divide into lean, agile and leagile. Many companies have defined their strategy lacking a proper knowledge about supporting activities and this can lead to nonconformity between the strategic policies and the activities which should support these decisions. The next problem about the unclear relationship between the supply chain strategy and deployed activities can be related to companies' future development due to the essential need of product development, new product introduction and process improvement. The nonconformity between supply chain strategy and deployed activities beside the growing need for product development in today's competitive market is a motivating factor to test the hypothesis of whether the company's supply chain strategy is compatible with the activities deployed or not. To reach this goal, the following hypothesis are examined using normal approximation of the binomial distribution.

H: The supply chain strategy deployed by the company is compatible with the company's activities

This is a qualitative hypothesis and a census was developed to understand the exact answer for this question. Doing a census considering all the people involved in the company is quite expensive and time consuming. Consequently, a sample test were developed to test the hypothesis.

The developed hypothesis is as follows:

H0: p = 0.667
H1: p > 0.667

Where P is defined as the proportion of the participant who think the company's deployed supply chain strategy is compatible with its activities

3.6 Assumption

Based on statistic 2/3 or 66.7% is majority and any amount higher than this value is considered a super majority[Engineering Statistics Handbook,2003]. So the null hypothesis mention that there is not a super majority, meaning that the proportion of the participant who thinks the company's deployed supply chain strategy is compatible with its activities do not contain the majority while the alternative hypothesis indicates a super majority, meaning that the company's deployed supply chain strategy is compatible with its activities.

3.7 Error

An error may occur when the research is going to judge about the entire population using a sample. The error in this study can be defined as follows:

- Type I error: Data support H1
- Type II error: Data support H0
- The probability of occurring type I error=α=0.05
- The probability of occurring type II error=β=0.95

3.8 Solution

The mean of the distribution can be calculated using the following equation:

$$\mu = np \quad (1)$$

The standard deviation can be calculated as follows:

$$\sigma = \sqrt{np(1-p)} \quad (2)$$

Using the equation (1) and (2):

$\mu = np = 30(0.667) = 20.01$

$$\sigma = \sqrt{np(1-p)} = \sigma = \sqrt{(30)(0.667)(1-0.667)}$$

$=2.5813$

The mean is equal to 20.01 and the standard deviation is 2.5813 and due to the number of samples which is equal to 30, the condition for using normal (Z) formula is provided.

$$Z = \frac{x-\mu}{\sigma} \quad (3)$$

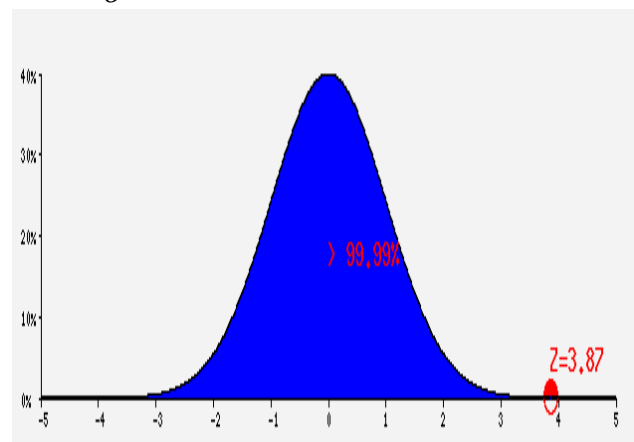$$Z = \frac{x-\mu}{\sigma} = \frac{30-20.01}{2.5813} = 3.8701$$

Figure 3 Normal distribution area

Using a normal distribution table and area to the right of mentioned z-value (hint: 1 – area to the left) is 0.00005, which is the p-value. Now the hypothesis should be analyzed using the following structure:

- The **p-value** is the probability of obtaining a test statistic at least as extreme as the one that was actually observed, assuming that the null hypothesis is true which is the probability of making a type I error.
- If p-value $\leq \alpha$, accept H1.

The p-value is equal to 0.00005 which is less than α=0.05 and as the result the H1 hypothesis is accepted. It means a super majority of participant believe that the company's deployed supply chain strategy is compatible with its activities.

All this hypothesis testing was developed for case study one and this approach should be done for other two remaining case studies. The result of each company hypothesis testing is independent from others and as a result there is no need for using the proportion concept. Proportion concept is suitable to compare two samples with different sample sizes. Using the same concept deployed in the case study one, the conformance of supply chain strategy and the activities deployed is accepted for other two case studies.

■4.0 CONCLUSION

Supply chain strategy affects all the activities deployed by the company due to the role it plays during both short term and long term scheduling. Understanding about the supply chain strategy is equal to understanding about what the company is going to reach and the way of achieveing. There are many companies knows about their supply chain strategy but the activities deployed by them is not proper to satisfy supply chain strategy. There is a significant relationship between company's supply chain strategies and its deployed activities because all these activities are key drivers to achieve supply chain strategy. This study used an activity based approach to assess supply chain strategy and matched each supply chain strategy to its classified activities extracted from literature. The main supply chain strategies are lean and agile and combination of them which is called leagile. Understanding about supply chain strategy is not equal to the accuracy of activities deployed by the company and as the result this study examined the conformance of companies' supply chain strategy to its deployed activities using a statistical hypothesis testing. The main contribution of this study is to assess companies' supply chain strategies using an activity based approach compared to other approaches which mainly consider supply chain strategies' characteristics rather than focusing companies' activities. Previous studies suffer from the lack of focusing on activities aligned with supply chain characteristics. Companies' deployed activities provide its performance about what the company is doing based on its predetermined goals extracted from its supply chain strategy.

References

[1]   Ambe, I. M. 2010. *Agile Supply Chain: Strategy for Competitive Advantage*. University of South Africa. 5–17.
[2]   Christopher, M. 2000. *The Agile Supply Chain Competing in Volatile Markets*. 44: 37–44.
[3]   Fawcet, S. E., Ellram, L. M. and Ogden, J. A. 2007. *Supply Chain Management: From Vision to Implementation*. Upper Saddle River, New Jersey: Prentice hall. Upper Saddle River, New Jersey: Prentice hall
[4]   Henry George Liddell, Robert Scott. 1900. A Greek-English Lexicon. : Perseus Digital Library Logistics. 16(1): 232.
[5]   Mentzer, J. T. and Kahn, K. B. 1995. A Framework of Logistics Research. *Journal of Business*.
[6]   Naim, M. M., & Gosling, J. 2011. Int. J. Production Economics on Leanness, Agility and Leagile Supply Chains. *International Journal of Production Economics*. 131(1): 342–354. elsevier. doi:10.1016/j.ijpe.2010.04.045.
[7]   Naylor, J. B., Naim, M. M., and Berry, D. 1999. Leagility: Integrating the Lean and Agile Manufacturing Paradigm in the Total Supply Chain. *Engineering Costs and Production Economics*. 62: 107–118.
[8]   Popper, K. 1959. *The Logic of Scientific Discovery*, Harper Torchbooks, New York, NY.
[9]   Mason Jones, R., Naylorz, B. E. N., & Towillz, D. R. 2000a. Lean, Agile or Leagile? Matching Your Supply Chain to the Marketplace. 4061–4070.
[10] Mason-Jones, R., Naylor, B., & Towill, D. R. 2000. Lean, Agile or Leagile? Matching Your Supply Chain to the Marketplace. *International Journal of Production Research*. 38(17): 4061–4070.
[11] Naylor, J. B., Naim, M.M., and Berry, D. 1999. Leagility: Integrating The Lean and Agile Manufacturing Paradigm in the Total Supply Chain. *Engineering Costs and Production Economics*. 62: 107–118.
[12] Schnetzler, M. J., Sennheiser, A., & Schönsleben, P. 2007. A Decomposition-based Approach for the Development Of A Supply Chain Strategy. International Journal of Production Economics. 105(1): 21–42. doi:10.1016/j.ijpe.2006.02.004.
[13] Yahya, M. A., & Mohamad, M. I. 2011. Review on Lean Principles for Rapid Construction. *Jurnal Teknologi*. 54: 1–11.