

Empirical Evidence on Supply Chain Strategy Adoption and Selection of Performance Measures Metrics for Ketchup Companies in Malaysia

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Abstract

Organisations adopt different supply chain strategies based on their products and the competitive priorities amongst competitors in markets. It is vital for any companies to determine its critical performance metrics in order to remain competitive in today's global market. This paper covers the characterisation and categorisation of key performance measures related to different supply chain strategies. The alignment between supply chain strategy, product and competitive priorities help companies achieving their full potential and profit. Two manufacturing companies were selected as case studies in order to verify and validate the proposed metrics based on their alignment of supply chain strategies.

Keywords

Operation Research, Supply chain strategy, Performance metric

1. Introduction

There is no doubt that relationship between company firm performance and supply chain strategy is exists [1]. However, identification of the right variables to establish the relationship is still questionable. Previous researches [2, 3] attempt to measure company firm performance have ignored the extent of the impact of some important variables which are related to supply chain strategy adopted by companies. According to Naylor et al. (1999), companies with lean supply chain strategy should focus on cost reduction. Therefore, the supply chain performance metrics should be aligned with company's proximity to the same goal.

Previous researchers [2, 3] used to ignore the impact of supply chain strategy adopted by companies when measuring their company performance. They were incapable to introduce the accurate and relevant metrics for measuring the performance of company. As a result, this study aims to determine the critical performance measurement metrics which would be validated by relevant literatures and case studies conducted in Malaysia ketchup companies.

Next, related literature will be critically reviewed on the topics of supply chain strategy identification; characterisation and categorisation of key performance measures which related to two supply chain strategies namely lean and agile.

2. Literature Review

The literature review discusses on the concept of supply chains, existing of supply chain strategies and categorisation of performance metrics.

2.1 Supply Chain

Nagurney (2006) defined supply chain as:

“A system of organizations, people, technology, activities, information and resources involved in moving a product or service from supplier to customer. Supply chain activities transform natural resources, raw

materials and components into a finished product that is delivered to the end customer. In sophisticated supply chain systems, used products may re-enter the supply chain at any point where residual value is recyclable. Supply chains link value chains”.

Generally there are two types of supply chain strategies that concentrated on efficiency and responsiveness called ‘lean’ and ‘agile’ respectively [6]. A combination of these two strategies considered as a third division which identified by Naylor et al. (1999) named ‘leagile’.

Lean supply chain strategy is defined as developing a value stream to eliminate all waste, including time, and to ensure a level schedule [4]. On the other hand, the purpose of an agile supply chain is to understand customer requirements by interfacing with the market and being adaptable to future changes. It aims to produce products in any volumes and deliver into a wide variety of market niches simultaneously. It also provides customised products at short lead times (responsiveness), by reducing the cost of variety [7]. Leagile is a combination of lean and agile supply paradigms within a total supply chain strategy by positioning a decoupling point. The decoupling point suits the need for responding to a volatile demand downstream yet providing level scheduling upstream from the marketplace [4].

In order to examine the supply chain strategy adopted by companies, Table 1 illustrates the comparison of attributes between lean and agile supply chain strategies [8].

Table 1: Comparison of Lean, Agile and Leagile Supply: Distinguishing Attributes [8].

Distinguishing Attributes	Lean Supply Chain	Agile Supply Chain	Leagile Supply Chain
Typical Products	Commodities	Fashion Goods	Product as per customer demand
Marketplace demand	Predictable	Volatile	Volatile and unpredictable
Product Variety	Low	High	Medium
Product Lifecycle	Long	Short	Short
Customer Drivers	Cost	Availability	Service level
Profit Margin	Low	High	Moderate
Dominant Costs	Physical Costs	Marketability Costs	Physical/Marketability cost
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

Discussion on concept of performance measurement metrics related to each supply chain strategy is proposed in the next section.

2.2 Performance measurement

Performance measurement is defined as a process of quantifying the effectiveness and efficiency of action [9]. It is important for ongoing monitoring and reporting of program accomplishments, particularly progress towards pre-established goals. It is typically conducted by program or agency management [10].

Despite the undeniable efforts of previous researchers such as Barber et al., (1996); Fullerton et al., (2008); Agarwal et al., (2003); Inman et al.,(2007) on proposing lean and agile performance measures, many aspects of leagile supply chain like performance measures remained unsearched which requires more investigation and attention to be grouped as operational and financial measures. Many researches [Barber et al., (1996); Kochakulah et al. (2004); Biscontri et al. (2000); Fullerton et al. (2008); Duarte et al., (2011)] have been categorised the performance metrics related to lean supply chain strategy into operational and financial groups. Table 2 summarises the performance metrics related to lean supply chain strategy.

Table 2: Summary of proposed performance metrics of lean supply chain

Author(s)	Financial	Operational
Barber <i>et al.</i> (1996)	<ul style="list-style-type: none"> • Return on equity • Sales Growth • Sales Return 	<ul style="list-style-type: none"> • Employee Productivity • Gross Margin Ratio • Cash to Cash Cycle time • Total Cycle time • Inventory Cycle time • Payables Cycle time • Receivables Cycle time
Kochakulah <i>et al.</i> (2004)	<ul style="list-style-type: none"> • Income per employee • Revenue per employee • Return on capital • Return on assest • Stock performance • Cash flow • Quick ratio 	<ul style="list-style-type: none"> • Inventory turnover rate • Quality performance • Product delivery time • New product introduction time
Biscontri <i>et al.</i> (2000)	<ul style="list-style-type: none"> • Recievable turn over ratio • Current Ratio • Cost of good sold • Gross profit ratio • Inventory turn over ratio • Return on assests • Assest turn over 	<ul style="list-style-type: none"> • Productivity improvement • Percentage of non-value added activities • Plant utilization ratio • Operating profit • Return on investment in JIT
Fullerton <i>et al.</i> (2008)	<ul style="list-style-type: none"> • Return On Sale • Cash Flow Margin • Return On Assest 	<ul style="list-style-type: none"> • Shop-floor employee involvement • Inventory turnover • Equipment down time • On-time delivery • Manufacturing cycle efficiency
Duarte <i>et al.</i> , (2011)	<ul style="list-style-type: none"> • Return on assest • Return on investment • Total sales • Labour cost per hour • Revenue • Profit 	<ul style="list-style-type: none"> • Supplier development Ratio • Employee involvement Ratio • Set-up time reduction

Primary goal of agile supply chain strategy is to be responsive to volatile market demand in the shadow of incorporating flexibility into various activities which are performed over the entire supply chain [4, 16, 17]. Table 2 shows some of the metrics proposed by previous researchers in evaluating company's performance which adopted agile supply chain strategy.

3. Data Gathering and Analysis

This section explains data gathering, analysis and findings that responded to the objectives of the study. This study primarily focuses on determining the supply chain strategy adopted by two manufacturers who produce ketchup product in Malaysia. In the second part of questionnaire companies were asked to specify the important performance measures that are practically to measure regarding their supply chain strategies.

3.1 Case study

Two ketchup companies which are located in south part of Malaysia, Johor have been selected for case studies. Due to the agreement, the name of the companies will not reveal for publication. The companies are producing the same range of goods; moreover in terms of employees' population and annual sale are almost identical. Although, ketchup product is considered as a functional product in Malaysia and companies were expected to adopt lean supply chain strategy, structured questions were designed to accurately determine companies supply chain strategy.

Table 3: Summary of proposed performance metrics of agile supply chain

Author(s)	Financial	Operational
Yousef, et al., (2003)	<ul style="list-style-type: none"> • Change in sales turn over • Net profit • Market share growth • Proportion of sale from new product 	<ul style="list-style-type: none"> • Speed to market • Customized production ratio • Volume flexibility • Dependability
Agarwal et al., (2003)	<ul style="list-style-type: none"> • Return on investment • Return on sale • Share value 	<ul style="list-style-type: none"> • Market sensitiveness • Customer satisfaction • Delivery speed • Investment in IT tools • Investment in demand uncertainty reduction • Lead time reduction • Frequency of new product introduction
Inman et al.,(2007)	<ul style="list-style-type: none"> • Return on investment • Average profit • Profit growth • Average return on Sale • Average market share growth • Average sale volum growth • Average sale growth 	<ul style="list-style-type: none"> • Market sensivity capability • Flexibility in product model and rapid configuration • Fast response tounplanned customer order • Order lead time • On time delivery • New product introduction time

3.2 Supply chain strategy identification

The structured questions were developed based on the distinguishing attributes of each supply chain strategy as shown in Table 1 (section 1.1). There were 19 questions were asked to both respondents that indicate a degree of conformity, necessity and significance of their supply chain features with each statement. Five – point Likert scales were used for each question. The results revealed that both companies adopted lean supply chain strategy. Figure 1 and 2 illustrate the results of data analysis.

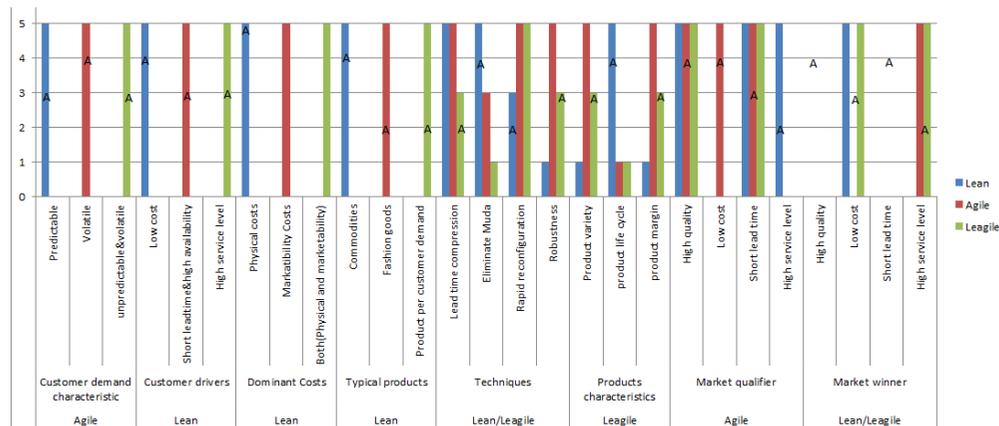


Figure 1: Ketchup Company A supply chain strategy

Figure 1 and 2 show the company's strategy with respect to various areas such as customer demand characteristics, customer drivers, dominant costs, typical products, techniques, product characteristics, market qualifier, and market winner. Blue, red and green lines mean attributes for lean, agile and leagile characteristics respectively. The letter 'A' and 'B' in each line in Figure 1 and 2 represent the rated given by the production managers for both companies based on five-Likert scale. If the rate is four out of five for lean attributes, the conclusion is the company adopted lean strategy for that particular attributes. If the rate is two or one for lean attributes mean the company adopted agile strategy. However if the rate is three for lean attributes, the company adopted leagile strategy. The same explanation is true for agile attributes, while for categorization for leagile strategy only valid for the rate three.

For example, company A rated the predictability of customer demand is 3, volatility is rated as 4 and unpredictability and volatility is rated as 3. The results mean that the customer demand characteristic of Company A is adopted agile supply chain strategy. In summary, the results show that customer driver for Company A is "low cost" which grouped company's strategy as lean strategy. Both physical costs and commodity products are characterized as lean strategy. Company A products have various attributes, for instance the product variety is classified as leagile strategy while the product lifecycle shows lean strategy has been adopted. Company A set high quality, low cost, short lead time and high service level as the market qualifiers as well as market winners.

The number of "A" characters on blue lines are outweighed the number of similar characteristics.. As mentioned on the right side of the chart the blue line is related to lean strategy; so, the strategy adopted by Company A can be regarded as lean supply chain strategy.

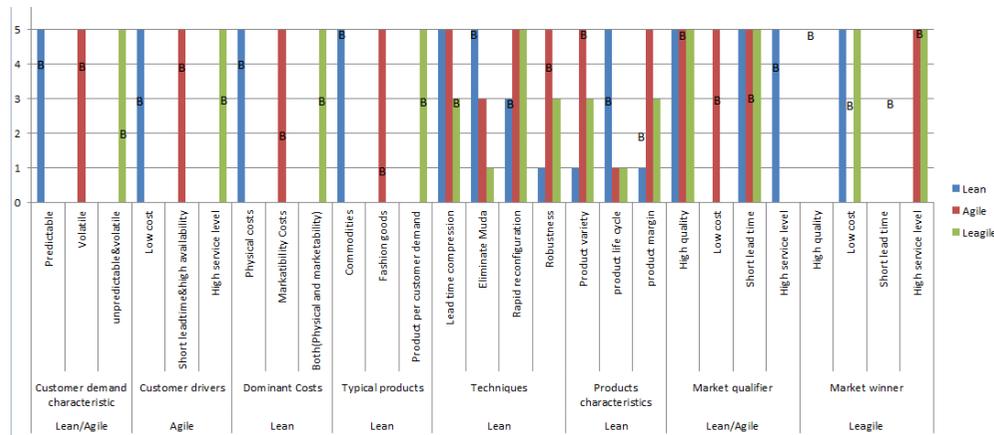


Figure 2: Ketchup Company B supply chain strategy

For Company B, six of supply chain attributes are adopted lean supply chain strategy while three of them have the agile manufacturing characteristics and only one can be regarded as leagile supply chain strategy feature. The lean attributes that adopted by Company B are demand is predictable, focus on physical costs, commodity products and eliminate muda as a manufacturing technique. Therefore, we can concluded that Company B is adopted lean supply chain strategy.

3.3 Critical performance metrics recognition

In the second part of questionnaire, a list of lean related metrics which was proposed by previous researches gathered and respondents were asked to define the most important and applicable metrics.

Based on the analysis in section 1.3.2, the adoption of supply chain strategy for both ketchup companies can be regarded as lean supply chain. We do expect that both companies will rate the high ranking to the performance metrics of lean strategy as summarized in Table 2. The results show that all of the metrics in lean strategy were implemented and measured for both companies except return on investment, operating profit, quick ratio, new product introduction time, quality performance, receivable cycle time for Ketchup Company A. On the other hand, the Ketchup Company B identified the receivable cycle time, asset turnover, quick ratio, new product introduction time and labor cost per hour as unimportant metrics.

The least insignificant metrics can be regarded as quick ratio, new product introduction time and receivable cycle time for both ketchup companies.

4. Conclusion and Recommendation

This paper highlights the importance of supply chain metrics regarding to supply chain strategies. It categorizes key performance metrics related to different supply chain strategies. In the end, the paper discusses two case studies to validate the proposed supply chain metrics.

Based on the data analysis, both responses show some similarities which lead to the conclusion that the least important metrics for ketchup companies in Malaysia which adopted lean supply chain strategy can be regarded as quick ratio, new product introduction time and receivable cycle time. The metrics such as return on investment, operating profit, quality performance, asset turnover, labor cost per hour also found as not important for the Company B.

The results of study justified the lean supply chain strategy measures which were proposed by previous scholars to the great extent. Although the study was limited to few numbers of cases with similar product types and geographical locations, the similar nature of ketchup manufacturing processes with stable market situation in Malaysia can generalize the results that the performance measures selected in ketchup companies are quite similar. The companies adopted lean supply chain strategy as the nature demand of the ketchup product is stable; therefore it is supported Fisher (1997), Huang et al (2002) and mason-Jones et al (2000) concepts.

The future researches can be conducted as a survey-based study to check the validity of proposed metrics and their significant level with companies' performance; this study provides justification for lean measures while the agile related metrics are still remained unchecked. So, it would be of value to increase the number and manufacturing diversity of cases in order to reach a more comprehensive outcome.

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