Supplier Selection for Electrical Manufacturing Companies Based on Different Supply Chain Strategies

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Abstract

This study aims to select supplier for electrical manufacturing companies based on their different supply chain strategies. A balanced score card (BSC) approach is deployed to assess companies performance. The result of performance measurement is used to compare companies based on lean and agile manufacturer's supply chain strategy. Supplier selection task is done using analytical hierarchical process (AHP).

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Keywords

Introduction

Performance measurement is a critical activity that should be done in any association aiming to be triumphant and remains successful in today's competitive market [1]. It is critical for any association since the major target of performance measurement is to commence a perceptive regard to what is going on, what should be considered and how it should be considered. Performance measurement can be made in any association and has a long history. Performance measurement can be defined as a process looking for qualifying both efficiency and effectiveness of supply chain. The concept of performance measurement is not a new topic but particularly performance measurement in supply chains is a new one. It clearly plays an important role for selecting shareholders and suppliers. Today's competitive market has increased companies interest to assess their performance and also supply chain they are located in. This contest has altered all the bench markings and evaluations of companies or supply chains toward their performance. It is reasonable to declare that a company or supply chain has the right of selecting best supplier due to its importance for determining achievement or malfunction of a company or a supply chain.

The market condition has altered competition from company versus company to supply chain versus supply chain. Supplier selection can be made with the aim of supply chain performance measurement. The most important factor to be considered in supplier selection is the supply chain strategy deployed by the manufacturer. Supply chain strategy determines the overall policy of the manufacturer and is very important in supplier selection. This study aims to cover the gap of neglecting manufacturer's supply chain strategy in supplier selection decision process. This paper will provide a flexible supplier selection approach considering two different scenarios containing manufacturer's lean supply chain strategy and agile supply chain strategy.

Literature Review

Supply chain strategy is defined as a combination of graded supply chain management goals which supply chain aims to achieve them. It also shows ways

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to operating them [2]. A supply chain strategy aims to find benefits regard to operation, distribution, and services considering any strategy deployed by an organization [3]. The main supply chain strategies in a supply chain are lean and agility [4]. A lean supply chain strategy aims to develop a value stream seeking to eliminate wastes including time [5]. Agility in contrast aims to deploy all the information accessible in the market and all the supply chain capabilities to achieve profitable opportunities [6]. Leanness and agility in the concept of supply chain have absorbed many researcher's interest [7, 8]. Leagile is a combination of `Lean` and `Agile` supply chain strategies. It is combined at decoupling point for an optimal supply chain management [9]. Performance measurement seeks to evaluate the achievement of a group, program, individual, policy or a strategy using an evaluation between what it was supposed to do and what it achieved . The main objective of supply chain performance measurement is to remain competitive in today's world class market using its values and perceptions [10]. Supplier selection is an important task any corporation is facing in every minute of processing. Evaluation, selection and continuous performance measurement of suppliers are the most important activities in any company seeking success in today's competitive market. The challenge of selecting supplier will be increased when the company accepts the lack of a specific optimum way to select suppliers. A diversity of approaches can be deployed to achieve this goal. Supplier selection normally is divided into three main levels containing developing a survey, supplier inspection and selection and finally continuous supplier performance review. An established step by step process is developed for selecting the suppliers [11]. It contains three main steps; expand the survey, supplier assessment and selection and continuous supplier performance review. This study assessed three supplier's performance using balanced score card framework. The result of performance measurement is used to select the best supplier based on different manufacturer's supply chain strategies.

Methodology

This study aims to assess suppliers based on balanced score card framework and then find the best supplier using different manufacturer's supply chain strategies. At the first stage of this study, three suppliers are analysed based on balanced score card performance measurement framework. The next part is comparing suppliers based on different manufacturer's supply chain strategies which are lean and agile.

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The main perspectives considered in a balanced score card performance measurement framework are financial, customer, internal business and learning and growth perspectives. All these perspectives are also compared based on different manufacturer's supply chain strategies. The result of all pair wise comparisons and determinants (criteria) are used for different AHP stages and supplier selection task.

Case Studies

Three electrical suppliers have been selected as the main case studies of this study. Questionnaires have been sent to them to collect essential data and the data are then analyzed, verified and validated.

Balanced Score Card Perspectives and Metrics

Balanced score card is developed by Kaplan and Norton [12]. Metrics for evaluating internal business perspective may be varied due to the high availability of existing literature. Electrical industries have special characteristics which should be considered in balanced score card perspectives. To find critical common performance factors, a review was conducted using 50 electrical case studies available in the literature. The balanced score card developed for the aim of this study is shown in Table 1.

Supplier Selection Using AHP

This section mainly discusses about the supplier selection task using analytical hierarchical process (AHP) developed by Saaty [13]. AHP contains the following steps:

1. Decomposing the decision problem into a hierarchy

2. Systematically assess hierarchy's different elements by evaluating them to each other simultaneously, regard to their effect on an element on top of them in the hierarchy.

3. AHP converts these assessments to numerical values with the ability of processing and comparing over the whole range of the problem.

4. Finally, numerical priorities are considered for each of the decision alternatives. These numbers show the alternative's relative capability to attain the decision objective

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Table 1: *Balanced Score Card Perspectives*

Financial Perspective	Customer Perspective
Asset Turnover	Customer Satisfaction
Inventory Turnover	Customer Loyalty Level
Return on net asset	Length of Relationship
Return on equity	Number of Complaints
Return on common equity	Number of Return Products
Total share holder return	Customer Response Time
Equity Per share	Customer Loss Rate
Payment Ratio	Number of New Customers
Economic added ratio	
Current ratio	

Internal Business perspective	Learning and Growth Perspective
On time Deliveries	Employee Capabilities
Sigma Level	Team Performance
New Product development	Employee Satisfaction
Process Time	IT Infrastructure
Unpredicted Orders Response	Key Employee Turnover Ratio
Average Machine Breakdown	Employee Satisfaction
	Suggestions made and implemented

AHP is deployed to select best supplier based on its performance achieved from balanced score card perspectives. AHP contains three levels; decision phase showing the decision going to be made, determinant showing the main factor decision maker considers and the finally alternatives to choose from. Figure 1 shows the graphical AHP used to select best supplier.

Supplier Selection Based on Lean Manufacturer's Supply Chain Strategy

The main goal of this section is to select best supplier based on a lean manufacturer's supply chain strategy. The difference in supply chain strategies can shows itself in rating where the determinant should be compared in pair wise comparison matrices. AHP calculations start with determinant pair wise comparison presented in Table 2.
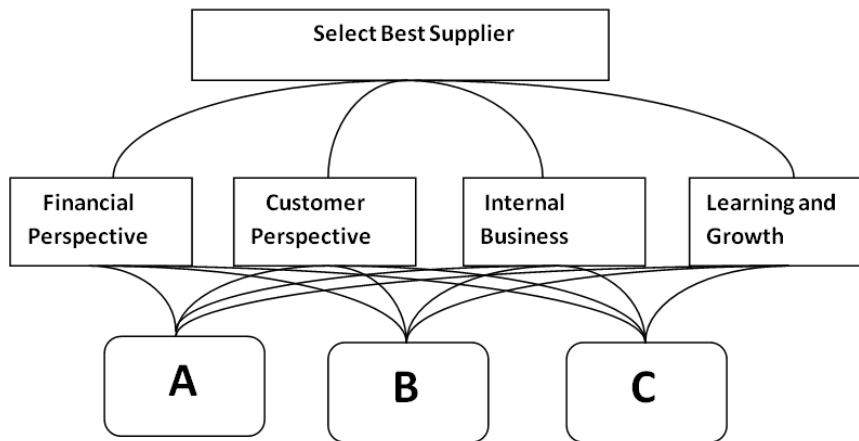
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Figure 1: *AHP Graphical Hierarchy*

Same as determinants, companies should be compared based on each cri-

Table 2: *Determinants Comparison Matrix*

Determinant	Financial	Customer	Internal	Learning
Financial	1	4	6	8
Customer	1/4	1	3	6
Internal	1/6	1/3	1	2
Learning	1/8	1/6	1/2	1

terion. This comparison is presented below in Table 3.

Then, companies are compared under customer perspective. Table 4 shows

Table 3: *Companies Comparison Matrix under Financial Perspective*

Financial	A	B	C
A	1	5	9
B	1/5	1	4
C	1/9	1/4	1

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the companies pair wise comparison under customer perspective.

Then, companies are compared under internal business perspective. Table 5

Table 4: *Companies Comparison Matrix under Customer Perspective*

Customer	A	B	C
A	1	4	8
B	1/4	1	5
C	1/8	1/5	1

shows the companies pair wise comparison under internal business perspective.

Finally, companies are compared under learning perspective. Table 6 shows

Table 5: *Companies Comparison Matrix under Internal Business Perspective*

Internal Business	A	B	C
A	1	1/5	4
B	5	1	8
C	1/4	1/8	1

the companies pair wise comparison under learning and growth perspective.

The final step in calculating AHP is composite score calculation. It can

Table 6: *Companies Comparison Matrix under Learning and Growth Perspective*

Learning and Growth	A	B	C
A	1	1/3	1/7
B	3	1	1/5
C	7	5	1

be calculated by multiplying the determinant's row average by the total pair wise comparison matrix extracted from each pair wise comparison matrix under four balance scorecard perspectives (refer Table 7, 8 and 9).

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As it is clear here, the company A is selected as the best company based on balanced score card frame work and a lean manufacturer's supply chain strategy.

Table 7: *Determinant's row average*

A	B	C	D
0.6045	0.2457	0.0954	0.0545

Table 8: *All four perspectives row average*

	A	B	C
Financial	0.7352	0.1994	0.0654
Customer	0.6893	0.2438	0.0669
Internal	0.2062	0.7234	0.0704
Learning	0.0833	0.1932	0.7235

Table 9: *Final composite score*

A	B	C	SUM
0.6380	0.2600	0.1020	1.0000

Supplier Selection Based on Agile Manufacturer's Supply Chain Strategy

Calculations under agile manufacturer's supply chain are same for all four perspectives done before for lean manufacturer's supply chain strategy. The main difference is in determinant's calculation and also total composite score which determines the best supplier. Table 10 presents determinant's comparison matrix under agile manufacturer's supply chain strategy.

As it is clear in Table 11, the customer perspective has a higher ranking comparing to other perspectives due to the characteristic of agile supply chain strategy. The final step for calculating AHP is calculating composite score.

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As it is clear here, the A company has also been selected as the best company based on balanced score card frame work and an agile manufacturer's supply chain strategy.

Table 10: *Determinants Pair wise Comparison Matrix*

Determinant	Financial	Customer	Internal	Learning
Financial	1	1/3	2	6
Customer	3	1	5	7
Internal	1/2	1/5	1	4
Learning	1/6	1/7	1/4	1

Table 11: *Determinant's row average*

A	B	C	D
0.2472	0.5586	0.1425	0.0517

Table 12: *All four perspectives row average*

	A	B	C
Financial	0.7231	0.2157	0.0612
Customer	0.6965	0.2316	0.0719
Internal	0.3022	0.6219	0.0759
Learning	0.1008	0.3761	0.5231

Table 13: *Final composite score*

A	B	C	SUM
0.6161	0.2908	0.09315	1.0000

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Consistency Test

When decision makers have to make lots of comparisons (i.e., three or more), the track of previous responses may get lost. It is compulsory that the rankings are valid and consistent. A preference determined for a set of pair wise comparisons needs to be consistent with another set of comparisons. It is necessary to do a consistency test for all steps of AHP calculation because it shows the level of steadfastness between data [14, 15]. Table 14 shows the consistency test calculation as mentioned in the previous section.

Table 14: *Consistency Test*

Criteria	Value	Status
Determinants under lean manufacturer's supply chain strategy	0.0440	Acceptable
Financial perspective	0.06245	Acceptable
Customer perspective	0.08244	Acceptable
Internal business perspective	0.08271	Acceptable
Learning and growth perspective	0.0504	Acceptable
Determinants under agile manufacturer's supply chain strategy	0.08576	Acceptable

Discussion and Conclusion

This study mentioned that selecting best supplier when there is not an alternative with the best performance in all four financial, customer, internal business and learning and growth perspectives is not accurate without knowing the manufacturer's supply chain strategy. A Supplier can have the best performance in both financial and customer perspective desired for both lean and agile manufacturer's supply chain strategy where Company A was selected under both lean and agile manufacturer's supply chain strategy. Measuring the performance based on balanced score card perspective gives the chance of classifying companies based on each four perspective and it can be used as a scenario based decision making for top management. AHP calculation is same for companies pair wise comparison based on four balanced score card perspective because the main factor affected by the manufacturer's supply

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chain strategy is determinant's ranking. Rankings in determinant's pair wise
comparison matrices are different based on different manufacturer's supply
chain strategy. In lean manufacturer's supply chain strategy, the financial
perspective is more important comparing to agile while the importance of
customer perspective is more significant in an agile manufacturer's supply chain
strategy It can influence all calculations of final supplier selection. The flowchart
shown in figure 2 describes the steps for selecting a supplier regarding to different
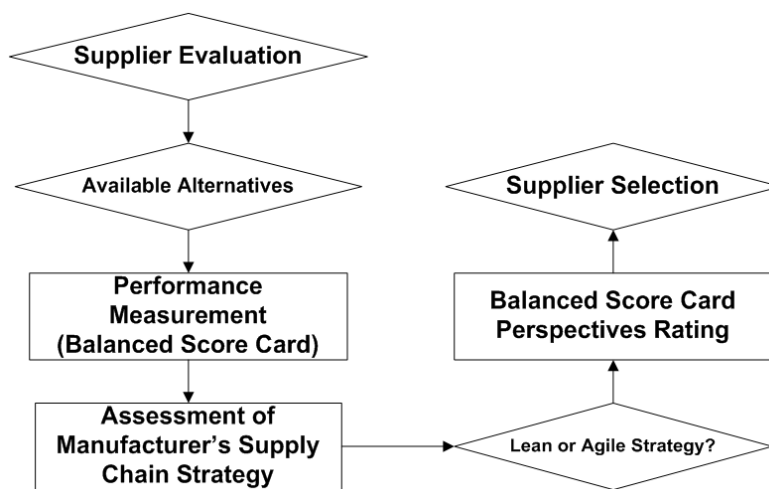manufacturer's supply chain strategy.

Figure 2: *Flowchart of the Summary of Supplier Selection Steps*

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