Review of Supplier Selection Models: Key Success Factors and Blueprint of Supply Chain Excellence

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Abstract

In turbulent economic situation, the cost of Production is the key to competitive advantage. To sustain competitive for the long term a firm need to focus on upstream Supply Chain. The Supplier selection has a critical impact on Cost of raw materials, which finally affect the Costs of goods sold. Every firm has their own set of parameters on which they select suppliers. Depending upon their strategies it could be either short/long-term contract which further depends upon suppliers overall performance and firm's operating model. Here the researcher aims to explore various possible supplier selection models depending upon the nature of the product. This paper reveals the findings of a wide ranging literature review of supplier selection models. The areas that have received less focus are also discussed.

Keywords: Supplier Selection, Competitive Advantage, Weighted Average Method, Total Cost of Ownership (TCO), Analytic Hierarchy Process (AHP), Optimization techniques.

1. Introduction

Supplier selection process has undergone sea changes during the past ten years. Procurement experts gather information from sources such as business to business trade magazines, reports, newspapers and web databases. Calling quotations, inviting tenders, describing elaborately the process of floating them, receiving them and processing them are the stages of purchasing activity. Comparative statements are prepared on the basis of offers received which must exhibit apart from the price differentials, a short history of their quality, dependability and delivery performance reliability. Critical examination of all the aspects based on available information is the route to select a supplier. The selected supplier is generally asked to supply initial sample and when it is approved by quality engineer; only then decision is taken to place the initial order. Site visit at the supplier's plant by quality controllers and engineers is necessary to conduct detailed study of the processes, system and other related factors. The total procedure would then form the basis supplier selection rather than by simply examining few samples. While selecting international suppliers generally PEST analysis tool is adopted to analyze political, economical, social and technological forces followed by other weighted parameters like Quality, Price, Delivery, Service and business record before entering into a short/long-term business contract. In this competitive environment, it is a challenge for manufacturers to produce low cost, high quality products without having a good base of reliable suppliers. The raw materials purchased by most Indian firms constitute 40-50% of cost of goods sold. Therefore supplier selection and maintenance of a competent group of suppliers is considered as a strategic area and therefore there is huge research scope to fill the existing gaps. The analysis of selection of criteria and evaluation of vendor performance has been the focus of industries and academics.

2. Research Objective

The main objective of the present research is divided into three broad sections as:

- To understand supplier selection methodology
- To identify supplier selection model which are widely adopted by various researchers in their scholastic works published in reputed Journals.

3. Literature Review

The objective of present literature review is to understand how various supplier selection models has been adopted by various researchers over the years. Here, researchers primarily present literature review to identify the various model's adopted by various researchers in recent published articles published in reputed refereed journals in tabulated form as Table 1 as shown below:

Table 1 Supplier selection models

Serial No.	Author(s)	Objective	Conclusion
	Tektas and Aytekin (2011)	The study objective is to select suppliers using multi-criteria decision making tool (AHP) in international environment.	AHP approach is one of the powerful techniques to select suppliers in international environment when multiple selection criteria are involved. AHP in this paper has been used to maximize Total Purchase Value (TPV).
2.	Garfamy (2011)	To empirically explore the relationship between supplier selection and business process improvement and aims to fill the gaps.	Results show that : • Quality • Service • Organization • Relationship and • Cycle time have relations to buyers improvement initiative whereas Supplier's cost have no relation to the Business Process Improvement factors.
3.	Deep et al. (2011)	Objective is to develop a method using genetic algorithm based Fuzzy weighted average technique for the ranking of alternatives on the basis of multi criteria	Multiple criteria decision making in fuzzy environment has wide application in real world decision making problems. LXPM algorithm is efficient and effective to find left and right bounds of FWA of each alternative and the final ranking order of alternatives is reliable.
4.	Ordoobadi and Wang, (2011)	The objective of this paper is to change the traditional supplier selection methods by shifting the emphasis from using a single model to using multiple models in the unstructured decision-making context and to provide a tool for decision makers to make informed decisions of supplier selection in the multiple perspectives.	The general finding from this study is that the multiple perspectives approach to supplier selection enables the decision makers to actively participate and fully understand the decision-making process through knowledge sharing which in turn ensures high quality of the final decisions.
5.	Chakraborty et al. (2011)	The study was conducted to solve vendor selection multi criteria decision making problem by using Optimization techniques and comparing the results.	Initially the problem was solved by using AHP .Thereafter the proposed heuristic algorithm has been utilised to improve the quality of the solution obtained from AHP. Simulation result obtained from the experimentation is compared and shown to outperform the AHP result in terms of quality of the solution.
6.	Maghool and Razme (2010)	Researcher(s) objective is to determine an appropriate set of suppliers and also to determine the order quantity placed on a supplier	A fuzzy bi-objective model has been proposed for single part, single period supplier selection problem under budget limitations, supply uncertainty and capacity constraint. Three different methods (an interactive fuzzy programming approach (TH method), augmented e-constraint method and (RLTP method) are proposed to solve the bi-objective model.

Table 1 Contd.

Serial No.	Author(s)	Objective	Conclusion
7.	Kesavan et al. (2010)	Multi criteria decision making (MCDM) technique which involves the Analytical Network Process (ANP) and Technique for Order Performance by Similarity to Idea Solution (TOPSIS) method has been used to select the best vendor.	Analytical Network Process mainly avoids arbitrary assignments of weights for the factors depending on the decision maker, and relative pair-wise comparison still makes the process more feasible and more accurate vendor rating can be obtained when compared to any other method.
8.	Liaoa (2010)	This paper presents an integrated modified Delphi technique, analytic hierarchy process (AHP) and Taguchi loss functions to evaluate and select suppliers.	The case selected the multiple criteria are: Quality Price Delivery Service Criteria weights are derived by AHP-based on pair-wise comparison to describe the decision makers' preference for each criterion. The performance of each criterion for each supplier has been transferred to quality loss by using Taguchi loss function. The results guide the decision makers to select the best supplier among the candidates.
9.	Enyinda et al. (2010)	This paper undertakes a case study on solving the supplier selection process problem in a generic pharmaceutical firm using the analytic hierarchy process (AHP) model and implemented with the support of the Expert Choice Software.	The AHP is considered a reliable methodology for developing a generic pharmaceutical firm strategic supplier selection and evaluation framework. Based on the research findings, the regulatory compliance selection criterion is most favored, followed by quality, risk, cost, supplier profile, and service.
10.	Kumar et al. (2009)	This study aims to contribute to the contemporary global issue initially by developing a multi-criteria hierarchical model for supplier international selection utilizing the analytical hierarchy process (AHP).	Author suggests that while large scale industries are the best alternative solution for the vendor selection problem, reliability of the vendor, product quality and the vendor experience are the top three issues in the vendor selection problem
11.	Thanaraksakul Phruksaphanrat (2009)	In this research a supplier evaluation framework based on Balanced Scorecard (BSC) with integrated Corporate Social Responsibility (CSR) has been developed from literature review of 76 related papers.	Evaluating suppliers using the proposed framework can be helpful for decision makers to qualify the most eligible supplier who can meet qualifications and buyers strategies as well as environmental and social responsibility issues.
12.	Kasirian and Yusuff (2009)	This study tried to identify the existence of interdependencies between and within attributes and how these influence the decision making process of decision makers in selecting suppliers	Results showed that there are several interdependencies among the attributes/criteria such as Total Cost of Supply Chain (TCS), Value Added Productivity (VAP) and Warranty Cost (WC) had influences on Cost of Goods sold (COGS)
13.	Mendoza and Ventura (2008)	The study is to find the best method that effectively integrates supplier selection and order quantity allocation.	Firstly, a list of potential suppliers is ranked and reduced (prescreening phase) to a manageable number by applying the Analytic Hierarchy Process (AHP). Then, based on the reduced list of suppliers, a mathematical model is used to properly allocate order quantities (order quantity allocation phase) while minimizing the ordering, holding and purchasing costs per time unit subject to suppliers' capacity and quality constraints.
14.	Tahriri et al. (2008)	The researcher aims to discuss different supplier selection methods and their advantages and disadvantages. Here mainly AHP is described and comparison is performed.	AHP and Fuzzy AHP as two precise methods for supplier selection decision making are believed to be useful for managers due to their simplicity in use.

Table 1 Contd.

Serial No.	Author(s)	Objective	Conclusion
15.	Sonmez (2006)	This study aims to provide an extensive literature review and critique of the studies related to various aspects of supplier selection process	The study revealed that during supplier selection more importance was placed on a) decision criteria and associated weightings and b) decision making tools used or proposed. This study also discloses that there is huge scope in future research for a detailed supplier selection process by considering all qualitative and quantitative criteria.
16.	Bhutta and Huq (2002)	The objective is to illustrate the two approaches i.e. AHP and TCO in supplier selection process and also to provide a comparison between the two approaches.	The rationale for focusing on these approaches is based on the practicality of the approaches.
17.	Frost and Long (2000)	This research study is a general survey into Western Australian businesses against the importance placed on ISO 9000 certification in comparison with the attributes traditionally used in supplier selection. Utilizing the means from this research study a comparison is made with the means found in Dickson's (1966) study to ascertain whether if the same importance is also placed on supplier selection criteria.	The results indicate the supplier attributes such as delivery, quality, prices and services are considered to be the most important when making a purchase that requires a large capital outlay. ISO 9000 certification is only given slight importance in the results of this survey. When comparing perception of marketing managers and procurement mangers there are no significant differences, except for reciprocal arrangements and industry position.
18.	Lee and Lee (2000)	The objective of the study is to use Activity-Based Costing(ABC) and Total Cost of Ownership(TCO) approach for selecting suppliers and further using an optimization technique(mixed integer programming) to determine the order quantities for selected suppliers.	The proposed method will help to make better supplier selection decision resulting in decreased overall costs.
19.	Weber et al. (1991)	This paper is an extensive literature review on the importance of supplier selection decision process, mainly focusing on the criteria and analytical methods used in the vendor selection process and also Just-In-Time (JIT) impact on vendor selection is conducted.	Strategic management decisions affect the relative importance that the various criteria have in the vendor selection process. Also multi objective programming techniques can prove to be useful in strategic planning
20.	Dickson (1966)	The research study aim to find the importance of twenty three vendor selection criteria	Ranking of criteria was done and criteria were grouped into extreme importance, considerable importance, average importance and slight importance categories.

4. Research Gap(s) Identified

The literature review reflects that every researcher has widely used AHP technique for selecting suppliers based on multiple criteria. The author has identified research gaps based on available literature are: (1) Literature available has not dealt with TCO (Total Cost of Ownership) approach till date. Though lot of authors has revealed the importance of TCO approach over price but couldn't develop methodology to capture actual life cost of component which purely based upon assumptions. (2) Green Purchasing is one of the missing links which has not been dealt comprehensively so far. Though there are literatures which have reflected the importance of green purchasing but does not provide concrete framework which incorporate this aspect into selection model. The quantification of this parameter is yet to be done. (3)The literature pertaining to Supplier Selection model fails to appreciate the importance of Supply Chain Surplus and Strategic Sourcing model has to be developed.

5. Research Methodology

This section focuses on:

- Understanding inter-relationships between theoretical concepts and principles in a conceptual framework
- Hypothesis development
- The measurement instrument development used to collect the data in the research
- The nature of collected data, and the main tools utilised in assessing the reliability and validity of the data

In this particular research author proposes:

Methodology 1

Optimisation model which aims to maximize Supply Chain Surplus for selecting suppliers. For this, author develops a template as shown in Table 2 and capture the value against each dimension from the respective company/firm and then put into the equation:-

Contribution = Price – Cost-to-Serve (Dubey & Singh, 2009)

Here, Cost-to-Serve = (Primary Freight + Secondary Freight + Warehousing Expenses + Packaging Charges + Excise Duty + VCOGS + Packaging Charges + VAT)

Here, VCOGS (Variable Cost of Good Sold) = Direct Material + Direct Labour + Overhead Expenses

This is essentially a case study approach as suggested by (Yin, 1984) and will be the appropriate strategy to carry out investigation to check the suitability of the model.

Table 2 Template for Optimisation exercise

	S1	*S2*	*S3*	*S4*
P1	=Price1-CTS1	=Price2-CTS2	=Price3-CTS3	=Price4-CTS4
P2	=Price5-CTS5	=Price6-CTS6	=Price7-CTS7	=Price8-CTS8
P3	=Price9-CTS9	=Price10-CTS10	=Price11-CTS11	=Price12-CTS12
P4	=Price13-CTS13	=Price14-CTS14	=Price15-CTS15	=Price16-CTS16
P5	=Price17-CTS17	=Price18-CTS18	=Price19-CTS19	=Price20-CTS20

This particular model is applicable when procurement decision is taken centrally from given suppliers which is represented as S1,S2,S3 and S4 for plants P1,P2,P3,P4 and P5 then the decision for procuring components is based upon maximum supply chain surplus. Here each suppliers deal with single component.

Methodology 2

Here, author has considered following parameters for selecting suppliers:

(1) Location, (2) Modes of Transportation Available, (3) Lead Time, (4) Life Cycle Cost, (5) Environmental Impact, (6) Resale Value

In this case, based on experience a weightage will be assigned to each variable and weighted score will be prepared for each suppliers based on score given against each parameters to each suppliers.

6. Conclusion

Earlier research studies revealed that type of product has a significant effect on how the purchasing decision is made in terms of choice criteria used and weights assigned to each criterion. Factors involve the nature of manufacturing and followed by the buyer firms which affect the supplier selection process. Single or multiple suppliers are selected based on the policy of the buyer organization. Other factors include preference towards location of suppliers, single/multiple members or departments involved in the supplier selection process. Research also shows that among the most important factors such as Quality, Cost, Delivery performance and service in selecting suppliers; overall the buyer organization valued supplier flexibility the most. Several conventional tools and techniques are commonly used by companies to assist the decision making process such as AHP, TCO, Weighted Average Method, Multiple Attribute Utility Theory, Value Chain Analysis, MCDM Methods, ANP model, Fuzzy Principle Component Analysis, Artificial intelligence and expert systems. Review of literature reveals that AHP approach is a very popular technique and also plays a vital role in case of international supplier selection. Even researchers tried to shift from a single model to multiple models while making decision making under uncertainty for selecting suppliers. Optimization techniques were also used in solving vendor selection MCDM problems but optimization techniques have certain limitations. Studies

have also been conducted to develop methodologies using operations research techniques such as Fuzzy weighted average technique to rank alternatives and was further tested and found reliable. Impact of Just-in-Time factor in supplier selection is also studied. The review revealed that more importance was given to decision criteria and allocated weights used to select suppliers. The already existing traditional supplier selection techniques use various methods as mentioned above, but none of the previous research combines these various techniques in a unique and comprehensive manner to generate an optimal rather than sub optimal solution. The findings of previous research indicate the importance of supplier selection factors does vary on the nature of product and competency of firm. Scope is there to study the relationship between the level of supplier selection factors and level of business process improvement factors. Many leading companies have adopted the best practices; some of which are:

- Establish a governing supply chain council;
- Properly align and staff the Supply Chain organization;
- Make technology work for you;
- Establish alliances with key suppliers;
- Engage in collaborative strategic sourcing;
- Focus on total cost of ownership, not price;
- Put contracts under the supply chain function;
- Optimize company-owned inventory;
- Establish appropriate levels of control and minimize risk;
- Take green initiatives and social responsibility seriously

7. Future Scope of Study

The study can be carried out to develop a framework which can help a firm to adopt TCO approach with minimum confusion. The green purchasing is the area which requires major attention from researchers.

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