



Implementatipon of Hybrid Soft Model for Outsourcing Strategic Decision for Sustainable Manufacturing Environment

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Abstract — The supplier selection (SS) playing one the important role in supply chain and it is one of the key issue to smoothly running supply chain management. Paper covers a robust soft model for supplier selection by integrating MCDM and Mathematical Programming which will providing a practical used of model in various Industries. SS modeling carried out by integrated methodologies. Selection model cover three major steps: First step is to evaluation of weight of supplier criteria by expert opinion and past history with the help of Fuzzy Delphi; Fuzzy AHP used for ranking of supplier and in the last stage TOPSIS method is used to evaluate best supplier after selection process. This study will provide a better decision for supplier selection using appropriate qualitative techniques. The finding of the model indicates that the weights of supplier selection criteria evaluation, ranking, choosing best supplier one of the important decision of Purchasing department.

Keywords- Multi Attribute Decision Making (MADM), Machine Tool Selection, Decision Support System (DSS), Outsourcing strategy, Selection Methodology, Supplier Selection Problem (SSP)

I. INTRODUCTION

More than 70% of the Product cost due to the raw material and component parts, in the Manufacturing Industries and up to 50% of all quality defects can be traced back to purchase material. At early 1980's price considered as the significant criteria and early 1990's Time management and customer sensitivity added to the cost of product or services. In late 1990 & early 2000 flexibility becomes key criteria. The objective of the paper is to prepare a new generic model for supplier criteria evaluation, ranking of supplier, selection best supplier. Therefore, it is crucial to carry out in depth study on evaluation and selection of Suppliers, since they can perform a pivotal role in increasing customer satisfaction by improving the quality of the product, cost reduction and improve competitive ability, reduce the time for Supplier Selection process. Since the Quality and Cost both of the important criteria of the procured materials are influenced by appropriate selection of Supplier, therefore supplier selection plays an imperative role in the Supply Chain Management (SCM).

II. REVIEW OF SUPPLIER CRITERIA EVALUATION, RANKING AND FINDING BEST SUPPLIER

Supplier selection has received a significant converge in the field of purchasing and supply chain management literature [1, 2]. [2] has identified 23 criteria's which is to be considered at the time of purchasing any product with the supplier. Subsequently research work carried out to find the weight for criteria as per the requirement of the supplier. In the same year and investigate net price, delivery, and quality were the three most discussed criteria. They also reviewed the use of quantitative methods of vendor selection of these articles. Frequently discussed the "linear weighting scheme" and they found only 10 articles on mathematical programming.

[3] has investigated 85 different supplier selection criteria. Data collected and tabulated form with Grey Analysis & T-Test and found 21 most important criteria and rank each of criteria with mean, t-test, Grey no; Comparative graph of SS Criteria's. As the research works shows that in early 1980's price as the significant criteria and early 1990's time management and customer sensitivity added to the cost of product or services. In late 1990 & early 2000 flexibility becomes key criteria, then expert opinion and so many other factors considered for the selection criteria. Identify variables and effective criteria in supplier selection, with regards to this point, considering all criteria for supplier selection is impossible. The main Important Criteria have been extracted by expert opinion and judgments. In literature, [4] identified supplier selection has been treated as a MCDM and a wide range of mathematical methods have been undertaken to provide the problems with sufficient and more accurate solutions. Table 1 enlists and categorizes these methods for the SSP.

Table 1. Various categories of Selection Methodology

Category	Method	References
Mathematical Programming Methods	Linear Programming Models	[5], [6], [7], [8], [9]
	Data Envelopment Analysis	[10], [11]
	Non Linear Programming	[12], [13]
MADM/ MCDM	Analytical Hierarchy Programming (AHP)	[14], [15], [16],[17], [18],[19]
	Analytical Network Programming (ANP)	[20], [21] , [22]
	Techniques for the Order Performance by Similarity to Ideal Solution (TOPSIS)	[23], [24]
	Out Ranking Method, ELimination and Choice Expressing Reality (ELECTRE – I), Preference Ranking Organization Method for Enrichment Evaluations- 1, 2, (PROMETHE)- Multi Attribute Utility Technique (MAUT)	[25], [26], [27]
Artificial Intelligence	Case Based Reasoning	[28], [29]
	Genetic Algorithm	[30], [31]
	Artificial Neural Networks	[31], [32]

III. MODELING OF SUPPLIER SELECTION

From the literature insight to research gap found that none of the Studies have investigated how these selection criteria and evaluation techniques vary across the product complexity. [33] Shows the field of combined models for supplier selection with Fuzzy Delphi, Fuzzy AHP and Fuzzy TOPSIS stage wise not get in focus. Fig. 1 show the structure of Supplier Selection model which combine the Integrative methodologies of supplier evaluation and then as per manufacturing demand and supplier capacity by using the dynamic programming a mathematical tool used.

3.1 First step Fuzzy- Delphi approach

[34] Proposed the concept of integrating the traditional Delphi Method and the fuzzy theory to improve the vagueness of the Delphi Method. Membership degree is used to establish the membership function of each participant. The fuzzy theory applied into the Delphi Method and developed max-min and fuzzy integration algorithms. Fuzzy Delphi Method (FDM) was derived from the traditional Delphi technique and fuzzy set theory. Applying the FDM to group decision can solve the fuzziness of common understanding of expert opinions

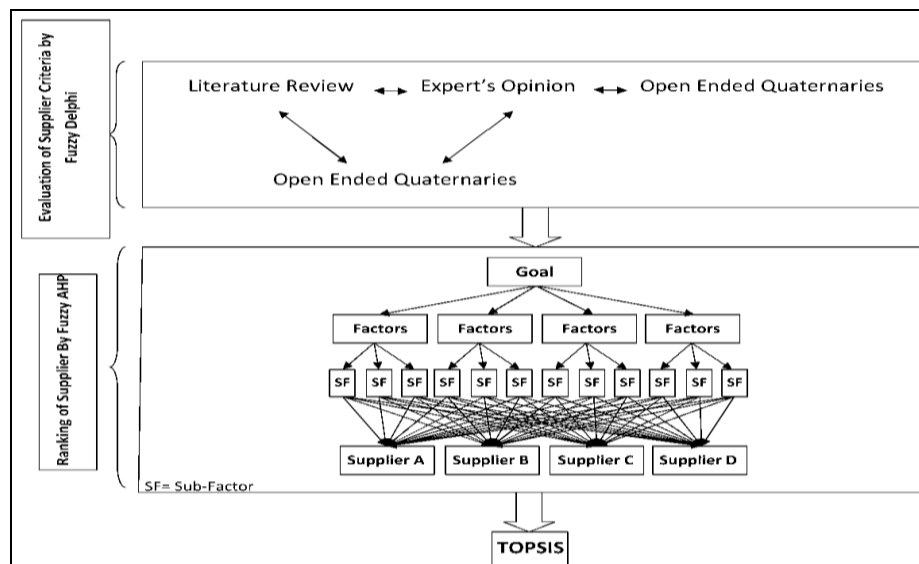


Figure 1: Soft Model for Hybrid MADM selection of Criteria, Ranking and Selection

3.2 Second step Fuzzy AHP:

[35] proposed the Fuzzy Analytic Hierarchy Process in 1983, which was an application of the combination of Analytic Hierarchy Process (AHP) and Fuzzy Theory. The linguistic scale of traditional AHP method could express the fuzzy uncertainty when a decision maker is making a decision. Therefore, FAHP converts the opinions of experts from previous definite values to fuzzy numbers and membership functions, presents triangular fuzzy numbers in paired comparison of matrices to develop FAHP, thus the opinions of experts approach human thinking model, so as to achieve more reasonable evaluation criteria. More number of researchers found that as there is a kind of uncertainty in expert's opinions, when doing pair comparisons and assigning ratio to them, the decision making would be imprecise and unreliable. [35] proposed the FAHP, which is to show that many concepts in the real world have fuzziness. Therefore, the opinions of decision makers are converted from previous definite values to fuzzy numbers and membership numbers in FAHP, so as to present in FAHP matrix. Therefore, in the proposed methodology, the Fuzzy extension AHP method namely Fuzzy-AHP, will apply to obtain more vital conclusion by prioritizing the selection criteria and weighting them in the presence of uncertainty.

3.3 Third step supplier evaluation by "Fuzzy TOPSIS":

The TOPSIS (Technique for order performance by similarity to ideal solution) is a solution to MCDM problem. In current issue the role of Fuzzy TOPSIS method is to assess of possible alternative for the continuous improvement of Supplier Performance. Fuzzy TOPSIS used for evaluation of supplier after selection process. According to this technique, the best alternative (product provide by supplier) would be the one that is nearest to the positive ideal solution (PIS) and farthest from the negative ideal solution (NIS). The PIS is a solution that maximizes the benefit criteria and minimizes the cost criteria and the NIS is vice versa. This fuzzy TOPSIS method fits human thinking under actual environment.

IV. CONCLUSION

The objective of the study is to develop a new generic model for supplier selection, which can use for the decision maker for any organization. These methodology is not only to select the supplier, but also it evaluate the supplier criteria including expert's opinion, rating of Supplier derived from pair wise comparisons with factors and sub-factors and then ranking of supplier, finally the assessment of possible alternatives for the continuous improvement of supplier performance. The frame work also facilitates the decision makers to better understand the complex relationships of the relevant supplier performance factors in decision making.

V. FUTURE SCOPE

Furthermore analysis needed for the effectiveness of the potential improvement opportunities as per the current requirement and strategies of the company. The same frame work also facilitates decision making to better understand the complex relationships of the relevant attributes, which may consequently improve the efficiency of the decision. This model will helpful to New Product Development (NPD), Vendor Manage Inventory (VMI), Reduce Risk Factors related imaging issues of supplier selection in the field of Supply Chain Management (SCM). Its application will be more appropriate for FMCG, SME types of Industries where rigorous purchasing criteria required.

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