

Supplier Selection Methods for Small Scale Manufacturing Industry: A Review

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Abstract: *The world today is facing a big challenge in the selection of an effective supplier in this competitive environment. The companies or departments involved in purchasing must be aware of different suppliers as such, they increase company's economic strength and profitability. Moreover speed of production, quality and cost of the product are some factors that should be taken care of for the effectiveness of the company. So supplier selection is a critical problem which involves various decisions, a fuzzy decision making model is proposed in supply chain management. The extent analysis and integral value calculation are some of the methods used in computing the priority, weights of criteria and alternatives. In this paper different selection methods were studied, their advantages and disadvantages were discussed based on that the result were compared. Focus of study is for Analytical Hierarchy Process method (AHP).*

Keywords: Analytic Hierarchy Process (AHP), supplier selection, qualitative and quantitative criteria.

1. Introduction

In most industries the cost of raw materials and component parts constitutes the main cost of a product, such that in some cases it can account for up to 70% (Ghodspour & O'Brien, 1998). In such circumstances decision making of purchasing management can play a key role in cost reduction. In today's highly competitive environment, an effective supplier selection process is very important to the success of any manufacturing organization (Liu & Hai, 2005). Selecting the suitable supplier is always a difficult task for buyers. Suppliers have varied strengths and weaknesses, which require careful assessment by the purchasers before ranking, can be given to them. The vendor selection process would be simple if only one criterion was used in the decision making process. However in many situations, purchasers have to take account of a range of criteria in making their decisions. If several criteria are used then it is necessary to determine how far each criterion influences the decision making process, whether all are to be equally weighted or whether the influence varies accordingly to the type of criteria (Yahya & Kinsman, 1999).

Supplier selection is becoming increasingly important as companies continue to develop more collaborative and long-term relationships with their suppliers. As discussed by Timmerman (1986), close working relationships with high performing suppliers are essential in modern production environments. The interaction between the organization and the suppliers should be two way so as to make the suppliers aware of their performance so that it would be helpful for them to cope up with the organization's need. When a supplier selection decision needs to be made, the organization should develop a set of evaluation criterions that can be used to evaluate the suppliers and to find out the potential suppliers by rating them. Traditionally, supplier evaluation models were based on financial measures with less emphasis on other tangible and intangible criteria. However, with the

widespread use of manufacturing philosophies such as just-in-time (JIT) emphasis has shifted to the simultaneous consideration of multiple supplier attributes in the supplier evaluation process. Application of various attributes varies with situations and the organization should give proper weightings to each attribute as per the situation. Proper evaluation and rating of suppliers helps the organization not only in benchmarking the suppliers but it also helps the organization to reduce purchase risk, maximize overall value to the purchaser.

A trade-off between these tangible and intangible factors is essential in selecting the best supplier (Farzad Tahriri et al, 2008). The work incorporates AHP in choosing the best suppliers. The results suggest that AHP process makes it possible to introduce the optimum order quantities among the selected suppliers so that the Total Value of Purchasing (TVP) become maximum. In this work, an AHP-based supplier selection model is formulated and then applied to a real case study for a small scale industry. The use of the proposed model indicates that it can be applied to improve and assist decision making to resolve the supplier selection problem in choosing the optimal supplier combination. The work represents the systematic identification of the important criteria for supplier selection process. In addition, the results exhibit the application of development of a multi-criteria decision model for evaluation and selection of suppliers with proposed AHP model, which by scoring the performance of suppliers is able to reduce the time taken to select a vendor.

2. Supplier Selection Methods

The methods chosen are extremely important to the overall selection process and can have a significant influence on the selection results. It is important to understand why a firm chooses one method (or a combination of different methods) over another. Several well-known selection methods have been developed and

classified by numerous scholars over the years. Certain methods have been popular selection choices for years, while other methods have only emerged recently. Usually when a company sets out to develop or choose a supplier selection method, the result is a combination of several different methods with different strengths suited to meet the company's specific selection needs. Therefore, it is important to explore a range of different selection methods and to discuss their different applications.

There are several supplier selection methods available in the literature. Some authors propose linear weighting models in which suppliers are rated on several criteria and in which these ratings are combined into a single score such as the categorical model. The categorical model is a simple method, but it is also the quickest, easiest, and least costly to implement. However, it may be influenced by recent events and usually implies a high level of subjectivity and therefore it is imprecise (Petroni, 2000).

The weighted point model is also easy to implement, flexible, and fairly efficient in the optimization of supplier selection decisions. It is more costly than the categorical method, but tends to be more objective, even though it relies on the buyer's Assessment of the supplier performance. Total cost approaches attempt to quantify all costs related to the selection of a vendor in monetary units. This approach includes cost ratio (Timmerman, 1986) and Total Cost of Ownership (TCO) (Ellram, 1990). The cost ratio method is very flexible. It is a complex method that requires a developed cost accounting system. The total cost model is precise, expensive to implement due to its complexity and requires more time and implies the ability to identify the more important elements. Mathematical programming models often consider only the more quantitative criteria; this approach includes the Principal Component Analysis (PCA) and the Artificial Neural Network (ANN). According to Bello (2003), the PCA method has two advantages that are accessible and capable of handling multiple conflicting attributes. The ANN model saves money and time. The weakness of this model is that it demands specialised software and requires qualified personnel who are expert on this subject. Over the years, researchers have begun to classify and group the individual supplier selection methods into a number of broader categories, with each classification having both advantages and disadvantages. The Multiple Attribute Utility Theory (MAUT) method has the advantage that it enables purchasing professionals to formulate viable sourcing strategies and is capable of handling multiple conflicting attributes. However, this method is only used for international supplier selection, where the environment is more complicated and risky (Bross and Zhao, 2004). According to Chen-Tung et al. (2006), the Fuzzy logic approach measures for supplier performance evaluation. This approach can help Decision Making (DM) to find out the appropriate ordering from each supplier.

The Analytic Hierarchy Process (AHP) is a structured technique for helping people deal with complex decisions. Rather than prescribing a "correct" decision, the AHP helps people to determine one. Based on mathematics and human psychology, it was developed by Thomas L. Saaty in the 1970s and has been extensively studied and refined

since then. The AHP provides a comprehensive and rational framework for structuring a problem, for representing and quantifying its elements, for relating those elements to overall goals, and for evaluating alternative solutions. It is used throughout the world in a wide variety of decision situations, in fields such as government, business, industry, healthcare and education (Saaty, 1980). To solve our problem by AHP, first we decompose our decision problem into a hierarchy of more easily comprehended sub-problems, each of which can be analyzed independently. The elements of the hierarchy can relate to any aspect of the decision problem—tangible or intangible, carefully measured or roughly estimated, well- or poorly-understood—anything at all that applies to the decision at hand.

Once the hierarchy is built, the decision makers systematically evaluate its various elements, comparing them to one another in pairs. In making the comparisons, the decision makers can use concrete data about the elements, or they can use their judgments about the elements' relative meaning and importance. It is the essence of the AHP that human judgments, and not just the underlying information, can be used in performing the evaluations.

The AHP converts these evaluations to numerical values that can be processed and compared over the entire range of the problem. A numerical weight or priority is derived for each element of the hierarchy, allowing diverse and often incommensurable elements to be compared to one another in a rational and consistent way. This capability distinguishes the AHP from other decision making techniques. In the final step of the process, numerical priorities are derived for each of the decision alternatives. Since these numbers represent the alternatives' relative ability to achieve the decision goal, they allow a straightforward consideration of the various courses of action (Saaty, 1980).

The use of the AHP approach offers a number of benefits. One important advantage is its simplicity (Liu and Hai, 2005). AHP can also accommodate uncertainties and subjective information, and allows the application of experience, insight, and intuition in a logical manner. It is observed that AHP is being predominantly used in the area of selection and evaluation (Maggie and Tummala, 2001).

3. Uses and Application of AHP

As a method of measuring intangible factors, the AHP has many areas of application. Among them are:

- Conflict Resolution
- Environmental Applications
- General Resource Allocation & Optimization
- Group Decision Making
- Human Resources
- Marketing Decisions
- Medical Decision Making
- Military Applications

While it can be used by individuals working on straightforward decisions, Analytic Hierarchy Process is most useful where teams of people are working on complex problems, especially those with high stakes, involving human perceptions and judgments, whose resolutions have long-term repercussions. It has unique advantages where important elements of the decision are difficult to quantify or compare, or where communication among team members is impeded by their different specializations, terminologies, or perspectives.

The applications of AHP to complex decision situations have numbered in the thousands, and have produced extensive results in problems involving planning, resource allocation, priority setting, and selection among alternatives. Many such applications are never reported to the world at large, because they take place at high levels of large organizations where security and privacy considerations prohibit their disclosure. But some uses of AHP are discussed in the literature. Recently these have included:

- Deciding how best to reduce the impact of global climate change
- Quantifying the overall quality of software systems (Microsoft corporation)
- Selecting university faculty (Bloomsburg University of Pennsylvania)
- Deciding where to locate offshore manufacturing plants (University of Cambridge)
- Assessing risk in operating cross-country petroleum pipelines
- Deciding how best to manage watersheds (U.S. Department of Agriculture).

AHP is sometimes used in designing highly specific procedures for particular situations, such as the rating of buildings by historic significance. It was recently applied to a project that uses footage to assess the condition of highways in. first used it to determine the optimum scope of the project, then to justify its budget to lawmakers.

AHP is widely used in countries around the world. At a recent international conference on AHP, over 90 papers were presented from 19 countries, including the U.S., Germany, Japan, Chile, Malaysia and Nepal. Topics covered ranged from Establishing Payment Standards for Surgical Specialists, to Strategic technology Road mapping, to Infrastructure Reconstruction in Devastated Countries. AHP was introduced in China in 1982, and its use in that country has expanded greatly since then—its methods are highly compatible with the traditional Chinese decision making framework, and it has been used for many decisions in the fields of economics, energy, management, environment, traffic, agriculture, industry and the military.

Though using AHP requires no specialized academic training, the subject is widely taught at the university level—one AHP software provider lists over a hundred colleges and universities among its clients. AHP is considered an important subject in many institutions of higher learning, including schools of engineering and graduate schools of business. AHP is also an important subject in the quality field, and is taught in many

specialized courses including Six Sigma, Lean Six Sigma, and QFD.

In China, nearly a hundred schools offer courses in AHP, and many doctoral students choose AHP as the subject of their research and dissertations. Over 900 papers have been published on the subject in that country, and there is at least one Chinese scholarly journal devoted exclusively to AHP.

AHP is a popular method for assessing multiple criteria and deriving priorities for decision making purposes. Major companies (e.g., Ford, General Electric), public Accounting firms (e.g., KPMG, PricewaterhouseCoopers) and government agencies (e.g. United States Treasury Department, United States State Department) already utilize AHP for various purposes. Additionally, for instance, researchers have applied AHP to a number of complex problems such as analytical review, internal control evaluation, and Assessment of management fraud “red flags”.

The number and diversity of AHP applications continues to grow because AHP is simple to employ, and yet is based upon the well-established and theoretically sound techniques of (1) structuring problems into hierarchies, (2) reducing complex judgments into a series of pair wise relative comparisons, (3) using redundant judgments to assess participant consistency (Smith et al., 2003).

4. Conclusion

When an organization is dealing with selecting the best supplier to deliver a good or service, the decision can often be very complex. Supplier selection problems are multi-criteria problems which have many qualitative and quantitative concerns. This research has presented the AHP as a decision analysis tool in supplier selection problems.

On the basis of literature review it may be concluded on a large number of researches have been devoted to the development of different kind of methodologies to cope with the Supplier Selection Problem (SSP). Moreover, AHP and its derived approaches turn out to be the most popular one. The suitability of AHP to the SSP can be explained by its ability to Handle both tangible and intangible attributes, Structure problems through hierarchies that allow gaining insights into the decision making process, Monitor the consistency of decision maker’s judgments and to Provide a synthetic score for each supplier.

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