

# Supplier Selection In Automotive Industry Based On Analytical Hierarchy Process

Muhammad Dawood Idrees, Kashan Ahmed, UroosaAli, Arsalan Ansari, Abdul Sami

**Abstract:** The main objective of this study is to optimize the way of supplier selection for any kind of automobile industry of Pakistan. This study is conducted through a decision support system using analytical Hierarchy Process (AHP), which is basically a multi criteria decision making technique more over it carries out a sensitive analysis to evaluate the flexibility of supplier selection decision. This research begins with identification of the criteria (service, price, delivery and price), it ranks the criteria depending on expert's opinion and experts must be of managerial level they might be engineers, supervisors or head of the department. This technique finally evaluates the flexibility of the decision by performing sensitive analysis using software of expert's choice. Once the sensitivity analysis is successfully performed then it provides the confidence to decision maker regarding consistency of flexibility throughout the process. Moreover it also suggests the impact of changing in criteria over supplier ranking.

**Index Terms:** Multicriteria Decision Making, Supplier Selection, Automotive Industry

## 1 INTRODUCTION

Supplier selection is an important criteria in supply chain management [1]. Selection of suppliers in a right manner also supports the production, quality and services of the competitive quality product [2]. It is basically a multi criteria decision making problem which is a critical task for success of the organization and as well as the complete performance of supply chain cycle [1]. Supplier selection can be categories into two scenarios. In the first case, only one supplier can satisfy all the demands of the buyer (service, price, delivery, etc.) it may also called as single sourcing in which management have to select the best supplier for every purchased item, on the other hand the in the second case, no one supplier can satisfy all the buyer's demand more than one supplier must be selected for this purpose this is also known as multi sourcing [3]. The present study mainly focus on the developing a decision support program for selecting the supplier using AHP based on case study of Pakistan's automotive sector. Automotive industry is one of the important industry for the economy of country and it plays an important role in because it is key customer of steel, iron, petrochemicals, tires, glasses etc. It consumes large volume of employment with its suppliers and marketing distribution [4]. The top stable automotive industries of Pakistan that has annual production of One-hundred thousand to One-hundred seventy thousand automobiles including (Toyota, Hino Pak Suzuki Honda etc.) the contribution of automotive sector in 2012 to GDP was 2.8% which is going to be increase in next coming years up to 5.6%. In manufacturing sector the auto sector of Pakistan contributes 16% it is predicted that it will increase up to 25% for coming 7 years [1].

In any Organization selection of supplier plays a significant role because the cost of final product depends on the cost of raw material [5]. It is essential for purchasing department of an automotive industry to do supplier selection activity because it seems that it has significant cost cutting opportunity in the supply chain [6]. Studies have shown that there number of methods for selecting the supplier but experts believe that there is no sufficient practical efficient method for selecting supplier [7]. There may be certain integrated techniques for selecting the suppliers like DEA, fuzzy combination method, and AHP [8]. Selection of the suppliers rely on different factors technical collaborations, financial measures, price of the product, delivery of the product and quality of the product these can also be named as the criteria for selecting the supplier [1]. Dickson inspect the supplier criteria importance and awarded 23 supplier attributes that a manager can consider, there were 3 most valuable criteria for supplier selection discovered from 23 attributes and those were cost of the product, Quality of the product and delivery performance [9]. The supplier selection can be done through using AHP technique, in which each criteria is identified through their weight (effect) and these main criteria will determine through surveys and with the opinion of the experts. The main reason for conducting surveys is to list the critical success factor which will provide help to develop the AHP model [1]. Analytical hierarchy process is a multi-criteria decision making technique developed by Saaty [11], which help in making complex decisions it, basically breaks down the down the problem into levels or hierarchy as shown in figure 1. Analytical hierarchy process can help to generate the decision in an organized way if following steps are taken:

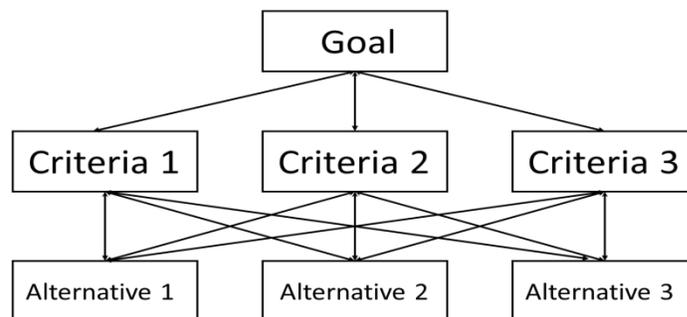


Figure 1. AHP Model (from Dweiri, Kumar, Khan, & Jain, 2016 [10])

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Develop the hierarchy as shown in Figure 1 which must define the goals first and the different criteria or objective of broad perspective and then it ends with the lowest level which shows the different alternatives. A pairwise comparison is developed, and the priorities obtained from comparison are used to weight the priorities at immediately below level. Repeat it for every element, then for each element in the below level and global priorities will be achieved through adding the weighted value for each element and repeat the process until final priorities achieved from most bottom level. For making the comparison a scale is needed which show how much important it is and how less important it is over another element [12].

**2 METHODOLOGY**

In order to prioritize the suppliers of Automotive in Pakistan with the help of AHP, strategy is developed which Show in figure 2. To attain the most suitable supplier is the main desire of the firm who fulfill there all demanded specifications. To follow up this point, Applying Analytical hierarchy process (AHP) for supplier selection, the strategy enroll beneath.

**2.1 Main Criteria**

AHP is the multi criteria programming technique for decision making and prioritization in a complex environment. So, Price, Quality, Delivery time and service as main criteria, got by analyzing the necessities of the firm through literature review. Main criteria and sub criteria are shown in Figure 3.

**2.2 3.2 Development of Questionnaire**

Next step is to develop a questionnaire for survey, i.e. for the reason to find the favorable parameters of the firm while selection. The composed structure of the questionnaire rely on pair wise comparison method, in comparison takes place between two parameters and responder rank between them, i.e. if one become more favorable than eliminatory the other option become less favorable. Saaty scale [11]. is employed for the collection of data and expressing ratings between different criteria. The example of scale is shown below:

Price 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 Quality

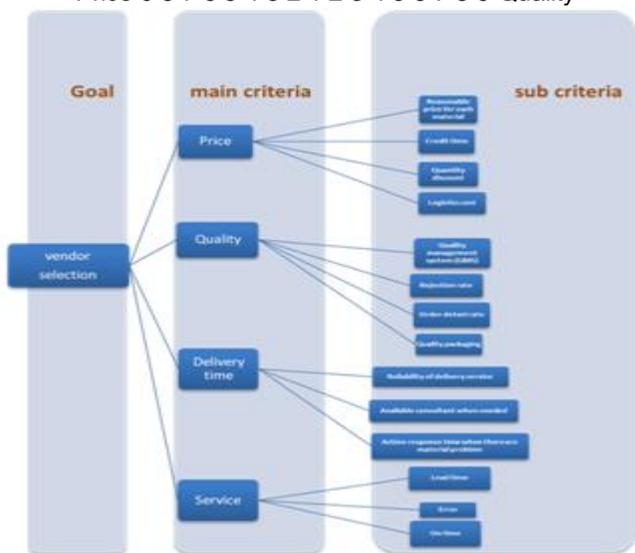


Figure 2. Strategy of AHP

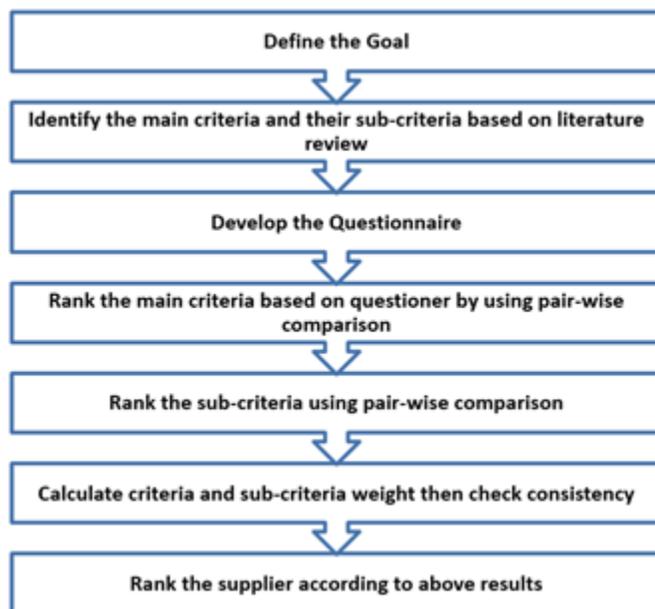


Figure 3: The Main Criteria and Sub Criteria of AHP goal

**2.3 Data Collection**

In data collection stage, a survey was performed in different automotive industry in Karachi, Pakistan at such as, HINO PAK Motors, Pak Suzuki Motor Company, Atlas Honda, Daewoo Pak Motor (Pvt.) Limited, Isuzu Ghandhara Industry, etc. Data collected via Email from some them and rest of them by personal meeting with industry representatives and 165 filled survey questionnaire collected out of 200.

**2.4 Data Analysis**

All the mathematical analysis done on Microsoft Excel version 2019 and then in SPSS version 26. At this stage, calculation of the criteria weightage and consistency performed. Then, all the collected data placed in a matrix, the matrix was solved in it. Its rows and columns depends upon the number of criteria i.e. 4\*4. The diagonal element are always 1.

After getting all the survey results, now below steps were followed:

1. Measure suppliers in the market against the main criteria.
2. By using above step, make a comparison of the relative importance of the supplier against the criteria and calculates its priority.
3. Use the above results with the results of pairwise comparison method and then calculate the priority or the weightage of the supplier for the purpose of hierarchy.

**3 RESULTS**

After collection of data from different automotive industries from Pakistan, this data is analyzed using MS Excel and SPSS. At this step first matrix is formed as shown in table 1.

Table 1. Formation of Matrix

Criteria	Price	Quality	Delivery time	Service
Price	1	1.039047401	0.731614527	0.603638734
Quality	0.96242	1	0.324852517	0.296457921

Delivery time	1.36684	3.07832	1	0.420606346
Service	1.65662	3.37316	2.37752	1

$$CR = 0.053290431/0.9 = 0.05921$$

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At the second step, priority vectors are formed, as shown in table 2.

**Table 2. Priority Vectors**

Criteria	Price	Quality	Delivery time	Service
Price	0.2005664	0.12237725 1	0.16500150 3	0.26011029 2
Quality	0.1930291 14	0.11777831 4	0.07326420 1	0.12774487 8
Delivery time	0.2741421 78	0.36255933 9	0.22553065 4	0.18124092
Service	0.3322623 09	0.39728509 7	0.53620364 2	0.43090391 1
Sum	1	1	1	1

After priority vectors the normalized principal Eigen vector can be obtained by averaging across the rows as shown in table 3.

**Table 3. Principle Eigen Vector**

Criteria	weightage	Priority Vector in Percentage %
Price	0.187013861	18.70138612
Quality	0.127954127	12.79541266
Delivery time	0.260868273	26.08682726
Service	0.42416374	42.41637396
Sum	1	100

Based upon the priority vector, it is found that service is the most important criteria, i.e., 42%, after that delivery time, i.e., 26%, price, i.e., 19%, and quality, i.e., 13% important criteria for automotive industry. These results are obtained based upon the priority matrix and these are the priority criteria for automotive industry. For the authentication and verification of AHP, it is important to check the Consistent Ration (CR) for these calculations. The CR is calculated as follows:

$$CR = \frac{C.I}{RI} \quad (2)$$

Where, CI=Consistency Index

$$C.I = \frac{\lambda_{max} - n}{n - 1} \quad (3)$$

The Principal Eigen Value ( $\lambda_{max}$ ) is calculated as shown in table 4, using standard procedures:

**Table 4. Principal Eigen Value**

Criteria	Price	Quality	Delivery time	Service	Sum
Principal Eigen ( $\lambda_{max}$ )	0.9324	1.0863	1.15668	0.98435	4.159871

$$C.I = \frac{4.1598 - 4}{3} = 0.05329043 \quad (4)$$

For the above values, RI = 09 is obtained and the consistency ratio (CR) is calculated:

The value of CR is 0.1 so judgments of this study are accurate and acceptable.

## 4 CONCLUSION

The field of study targeted in this research provides managers of the automotive industry of Pakistan to deal with various factors while selecting the suppliers for their industry. This methodology boosts the confidence of the managers in making decisions for selecting various vendors. This approach also provides help in prioritizing the criteria (service, delivery, quality and price). Managers can utilize this approach by making a hierarchal structure as purposed in the methodology and rank the suppliers according to the criteria or factors. This study targets most of the crucial problems faced by managers of the organization in making complex decision for selecting best vendors, it makes easier for the managers by making it into a hierarchy form and divides all the complex problems. It provides managers insight pros and cons of various factors in selecting the suppliers. This study contributes in 3 different formats, firstly AHP applied to an automotive industry and selection of suppliers through this technique and secondly it performs sensitivity analysis to evaluate the robustness of the process and lastly it is simple and appropriate technique for the managers because it is easy to understand and cost effective.

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