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# Demand of Spare Parts and Criticality Analysis Using Fuzzy AHP Approach

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## ABSTRACT

*Industrial and Production problems are acknowledged incredible interest from the operations. Most of the industrial and production firms are maintain spare parts inventory and they expect plant managers at reducing costs while maintaining the performance of spare parts demand and its acceptations at reducing cost. In the past spare parts selection problem conventional slight attention and investigation in this area did not have much impact. The selection of best alternatives among the different alternatives of spare parts are a very difficult task. This research work aims to describe the traditional approach that is the fuzzy analytic hierarchy process (FAHP), which is also known as a multi-criterion decision-making process (MCDM). For the priority-wise ranking and selection of the best alternative, we proceed with this research work in automobile spare parts manufacturer in Jabalpur. FAHP method used to find out weight coefficient of criteria and spare parts selections, a sample of six possible alternatives has been considered. The originality of this work lies in the combined approach of FAHP. This study contributes by providing an actual preference for an inclusive set of selection criteria and calculating the best alternative from existing spare parts.*

***Keywords:—*** *Fuzzy Analytic Hierarchy Process; Criticality; Spare part; Fuzzy Set; multi-criteria decision-making; selection problem.*

## I. INTRODUCTION

Nowadays, manufacturers usually inspire for a philosophy of arranged undesirability. The awareness of such a philosophy is to approach their products to be rapid-existent and make products hard to repair, so that customers are inspired to purchase supplementary. However, this philosophy offers to wasting more environmental resources and energy, in addition rising global warming. Under this situation, spare parts inventory management is attracting extra attention from authorities and academia. Spare parts are stock items used in management activities to hold equipment or products in working situations. Spare parts inventory management is serious because the cost of spare parts accounts for a significant segment of the products' life-cycle cost: the value of spare parts yearly consumed by a variety of equipment, the utilization of spare parts is associated to the product practice, damage, and maintenance. [3]

## II. SPARE PARTS FEATURES

Spare substantial has unusual features that differentiate it from all the other material used in a industrious or service system. The principal feature inhabits in the consumption outline. The demand of spare parts is in the major part of the circumstances intermittent (an intermitted demand is a demand which takes place with irregular time interval and concerns reduced and above all, variable quantities). Alternative individual characteristic of maintenance spare parts is the specificity of the employment. Usually, spare parts aren't type of the "general purpose" and so they have to be working only for the use and the purpose for that they have been understood, which is investigated when the replacement of an equipment is decided: the set of spare parts that are not re-usable on other system (generally, the major part) becomes directly outdated. In the best of the suggestion the set might be retailed contextually with the system.

### *Characterizations of Intermitted Spare Parts Demands*

A few more specified categorizations standard of spare parts demand. The figure 1 present the four categories of the spare parts demand (patterns) as they are defined by the present literature:

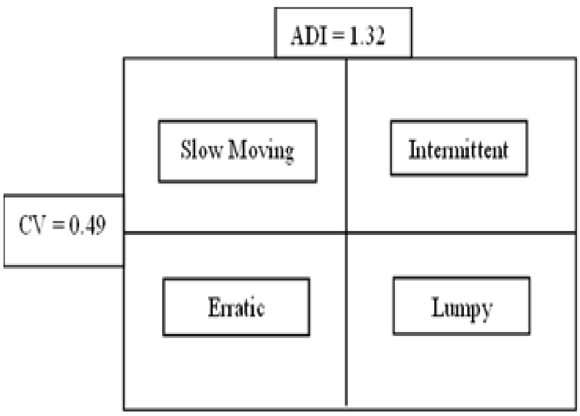


*Figure 1: Four categories of the spare parts demand*

***Four typologies can be recognized:***

***Slow Moving*** — This element has a performance which is similar to that of the outdated articles, at low rotation of a dynamic system.

***Strictly intermittent*** — They are categorized by very irregular demand (consequently a lot of a period with no demand) with a not emphasized changeability in the quantity of the single demand.

***Erratic*** — The essential quality is the excessive changeability of the demanded quantity, but the demand is almost constant as allocation in the time.

***Lumpy*** — It is the very difficult to control classification, because it is considered by a lot of intervals with zero- demand and excessive variability in the quantity.

### *Principle of Fuzzy APH*

The procedures for AHP such as eigenvector method and geometric mean cannot directly be used to derive the weights/priorities from a fuzzy comparison matrix. Various techniques for structure a fuzzy AHP model have been proposed. They fluctuate in terms of important features, strengths and weakness. The expansion of a fuzzy AHP model overall shadows the process to advance an AHP model the white and the light grey boxes show the common steps between AHP and fuzzy AHP but special methods are applied in the steps of light grey boxes. The dark grey box is the phase in fuzzy AHP but not in AHP. We demonstrate the process with spare parts selection using a special type of fuzzy set, triangular fuzzy number. Kubler et al. (2016)

## II. LITERATURE REVIEW

Shuai, Zhang et al. (2021) In this research work author described the Spare Parts

Inventory Management Problem Unlike final products whose inventory is provided as a source for delivery to customers, spare parts are kept to keep products in operating conditions. The demand pattern of spare parts is quite different from that of final products. Furthermore, spare parts have large obsolescence risks when the supported products quit the market. Due to these differences, the optimal policies for final products are usually sub-optimal for spare parts inventories in addition, the repairable spare parts inventory problem is more complicated than that of non-repairable spare parts, because repair operations and resources need to be taken into consideration.

Haya, R. Hasan et al. (2020): In this paper, author propose a blockchain based smart contract to trace and track the spare parts ownership details from the original equipment manufacturer to the supplier and end-users. In proposed solution, he integrated decentralized storage services (IPFS) to store the details of the spare parts and quotations of the suppliers and provided detailed discussions on implementation, testing, and validation aspects. However, today's spare part inventory systems fall short of providing reliable tracing and tracking of spare parts ownership which poses serious threats to their authenticity. Also, current approaches and systems leveraged for spare part inventory management are vulnerable to the single point of failures His proposed solution is generic enough and can be adopted for permissioned or permissionless blockchain platforms depending on the use case. We presented cost analysis to demonstrate the practicality to use and adopt our proposed solution by users and organizations involved in the trading, management, and traceability of spare parts.

***Analyzing the Empirical Findings from a Contingency Perspective***

Contingency theory provides a viewpoint for analyzing the gap emerging from the case studies. The contingency perspective argues that differences in technological and environmental dimensions result in differences in structure, strategies and decision processes. Therefore, managerial effectiveness can be achieved in more than one way (against a ‘‘one size fits all’’ view), but each way is not equally effective under all conditions certain organizational actions are more appropriate than others, depending on contextual factors The contingency perspective has recently gained attention in the operations management domain as a natural evolution of the best practice paradigm and it looks at identifying under which contextual conditions the adoption of operations management practices is effective. Olhager, Jet al. (2012).

## III. Objective of the Research

The main objective of this study is to be a critical analysis of spare parts. AHP approach used a pairwise comparison matrix and proper judgment to the decision-maker but a few drawbacks and failures occur during following this process. So that some advanced variants of AHP will use is called fuzzy analytical process (FAHP) are used to find out comparative weight attributes due to changes in physical activity. The fuzzy AHP approach provides a more accurate result of the decision-making process. Generally, the fuzzy approach initiates the decision-maker to determinant preference with crisp values and shows more clarity compared with the AHP method. It is a more significant approach for the selection of the best spare parts. Our main aim is to analyse the best alternatives among the global market demand and proper judgment between attributes and alternatives.

## IV. Research Methodology

Proposing an efficient demand. forecast. In fact, demand forecasts are one of the key problems in logistics, since many factors are involved and responsible for obtaining good forecast results. For that, we start from the developed idea in which you propose to try. Different forecast models to preserve the best to measure performance. From the proposed forecast system, we choose to develop an analytical hierarchical. Process (AHP), which allows you to have a good decision making involving structuring Criteria in a Saaty hierarchy gives a good description of AHP processes. Ones the demand is calculated efficiently, the project has a good basis for starting the evaluation. of the inventory management system.

There is three basic level for the evaluation system MCDM. In the first level, we make a proper hierarchical structure and give the priorities of spare parts characteristics. In the second level pairwise comparison matrix, fuzzy judgment and prepare weight vector. In the third level select the best alternatives by the ranking of alternatives from the judgment matrix and weight vector.

### *Overview of Fuzzy AHP- Method*

In this research work for performance and evaluation of ranking best alternatives of spare parts demand fuzzy AHP approach has been proposed. The basic steps for the proposed method are presented with a schematic diagram and find out the best alternatives among the attributes.

### *Identification of Selection Criteria*

These variants include Replenishment, Suppliers, Economic, Failures, Equipment, and Operations Similarly, there are various criteria that purchasers considered while selecting suitable vehicle, which includes- Price, Criticality of the equipment, Maintenance policy, Availability of technical information, Proximity, Ordering policy Substitutability/uniqueness, etc. Therefore, it is difficult for the purchaser to measure the performance of alternative variants/models and choose the most suitable spare parts for their intended use. In the present study, the central motivation for supporting the decision-making process is the selection and analyse best spare parts available in the Indian automotive market. We concentrated on selecting the most suitable spare parts for a purchaser, given the various criteria or purchaser preferences while choosing spare parts.

### *Analytic Hierarchy Process (AHP)*

Analytic hierarchy process (AHP) is a multi -criteria decision making (MCDM) tool useful for selection and arrangement of criteria, sub- criteria, and alternatives based on pair-wise comparisons. There are two significant advantages of using the AHP method over other MCDM methods. Firstly, this method deals with both determinate and indeterminate attributes, and secondly, with consistency check, it allows decision-makers to validate their judgments. Under many conditions, it is challenging to solve real-life decision problems due to insufficient data. To minimise this constraint. The use of AHP method is used to find out the relative importance of certain criteria for the variety of spare parts. The hierarchy structure of goal, criteria, and alternatives is as shown in figure 2.

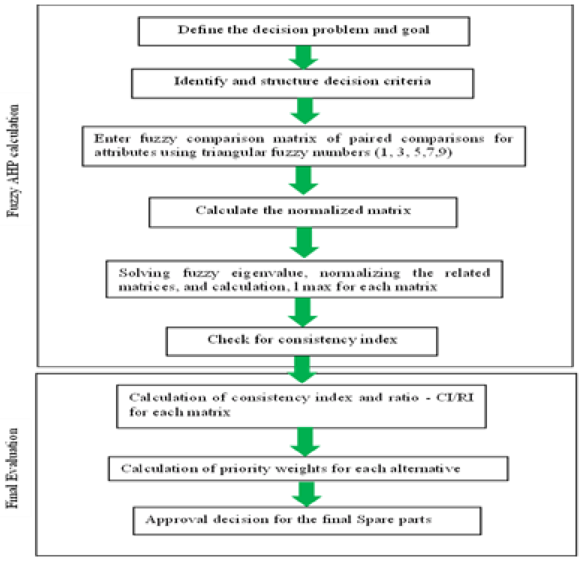


*Figure 2: Fuzzy AHP approach for spare parts selection problem*

Various steps involved in AHP are as shown below.

***Step 1:*** Determination of the decision-making problem.

***Step 2:*** Constructing the pair-wise comparison matrix.

***Step 3:*** Calculation of normalized matrix.

***Step 4:*** Determine the weight coefficient of criteria.

***Step 5:*** Calculation of the consistency ratio.

**Table 1: Attribute Frame Work of Spare Parts**

| Factor | Attributes | Sub attributes |
|---|---|---|
| Maintenance | Failures | • Frequency/rate<br>• Predictability |
| | Equipment | • Life cycle stage<br>• Criticality of the equipment<br>• Reparability |
| | Operations | • Frequency of use<br>• Maintenance policy<br>• Responsiveness<br>• Availability of technical information |
| | Replenishment | • Lead time<br>• Ordering policy |
| Logistics | Suppliers | • Substitutability/uniqueness<br>• Proximity<br>• Responsiveness |
| | Economic | • Stock out implications<br>• Stocking strategy<br>• Price |

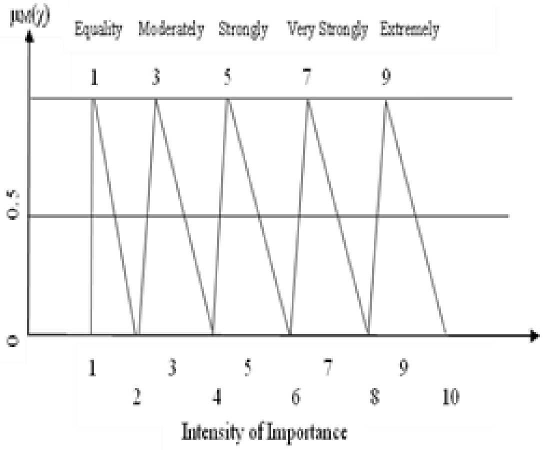


*Figure 5: Attributes or Alternatives Values of Fuzzy Membership Function*

In this method, each of these judgments is assigned a number on a scale ranging from 1 to 9, as shown in Table 1. The consistency ratio (CR) is a pointer of the consistency of decisions made in AHP. The consistency ratio (CR) is calculated using the following formula,

$$CR = \frac{\text{Consistency Index (CI)}}{\text{Random Index (RI)}}$$

Where, consistency index (CI) for each matrix of order n is calculated by using the following formula,

$$CI = \frac{\lambda\ max}{n-1}$$

Where ë max is the maximum eigenvalue and n denotes the number of criteria. Random index (RI) for matrices of order (N)

The acceptable range of consistency ratio (CR) must be kept below 0.1 for all larger matrices, n ≥5. If the value of CR is equal to or less than this value, it implies that the assessment of the matrix is acceptable or indicates an adequate level of consistency in the comparative stops represented in this matrix.

**Table 2 : Fundamental Scale for Pair-Wise Comparison**

| Intensity of importance | Definition | Explanation | Membership functions |
|---|---|---|---|
| 1 | Equal Importance | Two factors contribute equally to the objective | (1,1,1) |
| 3 | Somewhat more important | Experience and judgment slightly favor one over the other | (2,3,4) |
| 5 | Much more important | Experience and judgment strongly favor one over the other | (4,5,6) |
| 7 | Very much more important | Experience and judgment very strongly favor one over the other. Its importance is demonstrated in practice. | (6,7,8) |
| 9 | Absolutely more important | The evidence favoring one over the other is of the highest possible validity. | (9,9,9) |
| 2,4,6,8 | Intermediate value | When compromise is needed. | (1,2,3)(3,4,5)(5,6,7)(7,8,9) |

The purpose of Fuzzy AHP methodology is to identify knowledge and judgment from expert's therefore conventional AHP approach could not reflect human awareness and thoughts. Using membership functioning to highlight the contribution or impact of each alternative, with all fuzzy judgment vectors the judgment matrix will be obtained and for the decision-maker opinion and relative importance of each criteria weight vector W is used. The popularity of human beings and his demand FAHP method is often criticized and it is associated with the AHP technique.

$$X_{ij} = \begin{bmatrix} W_{11} & W_{21} & W_{1n} \\ W_{12} & W_{22} & W_{21} \\ W_{1n} & W_{2n} & W_{nn} \end{bmatrix} \begin{matrix} A1 \\ A2 \\ \vdots \\ A_n \end{matrix}$$

Using Expert opinion and awareness Satty' scale represented subject to direct pairwise comparison matrix to be obtained (Table 2). Matrix A shows the positive matrix. after that eigenvalue and eigenvector are calculated. From matrix A to evaluate eigenvector and taking parameter as fuzzy member. As well as, since aij= 1/aji, if i is not equal to j, **A** is a reciprocal matrix.

$$A_{ij} = \left\{ \prod_{J=1}^{n} a_{ij} \right\}^{\frac{1}{n}}$$

we have....

$$A = (a_{11} * a_{12} * a_{13} \dots\dots\dots\dots a_{1n})^{1/n}$$

$$A_n = (a_{n1} * a_{n2} * a_{n3} \dots\dots\dots A_{nn})^{1/n}$$

Eigenvector A is compound by the n triangular numbers defined as:

$$A = (A_1, A_2, \dots\dots\dots\dots A_n)^{1/n}$$

where Ai is a triangular number defined as ($A_l$ Am, Au). As the traditional AHP methodology, eigenvector is to be normalized according to the next relation:

Now, some Randomly Generated Consistency Index (R.I.) values are given in Table 3

**Table 3: Randomly Generated Consistency Index for different size of matrix.**

| n | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| R.I. | 0 | 0 | 0.58 | 0.9 | 1.12 | 1.24 | 1.32 | 1.41 | 1.45 | 1.49 |

(Source: Saaty, 2008),

The Consistency ratio will be acceptable depending upon the matrix size, it is taking 0.05 when the matrix is used by 3 × 3 matrix, it is 0.08 when we used 4 × 4 matrix and taking 0.1 when the matrix is used 5 × 5 or more. When consistency ratio is obtained with this given criteria matrix is acceptable and consider the good level comparative judgment and some discrepancy may occur when the value of CR is more than the given condition. So that some assessment or evaluation is to be needed and revaluated for a particular area. An acceptable CR value give facilitates decision-maker judgment for determining the significances criteria.

***CASE STUDY***

In this chapter, we introduce the company profile of Porwal Auto Components Ltd. (PACL) in the manufacture of a diversity of Cast Iron steel and steel alloy casting components. PACL includes many sectors like automobile spare parts, agriculture parts, and tractor equipment, machine tools manufacturer. The company's sales association is in many cities all over the country. PACL attentive on manufacturing Drum Break (FG-30), Rear Wheel Hub (SG -500/7), Front Wheel flange (SG-500//7), etc. Porwal Auto components Ltd. was established in the year of 1992 and joint venture with Eicher Motors and Valvo groups. PACL has registered and established for moving evolution as a reliable supplier for excellence assurance of spare parts demand for the customer. The quality management system of PACL is ISO 9001:2008 and ISO/TS 16949:2009, Health and safety ISO 14001: 2004 certified by TUV NORD and also manufacturing for Indian railway.

These six attributes are characterized here by the six following symbols: XT1, XT2, XT3, XT4, XT5 and XT6 respectively. Once the decision makers performed the pair wise judgments for the established of attributes X matrix is obtained. This comparison matrix is made by Using the Saaty scale but now with triangular numbers.

To find the relative importance or significances of the six attributes eigenvector, eigenvalue and the RC index are to be computed. Thus, the eigenvector (with triangular values) is as follows:

**Table 4 : Fuzzified Pairwise Comparison Matrix**

| Sr.no | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1 | (1,1,1) | (2,3,4) | (2,3,4) | (4,5,6) | (9,9,9) | (2,3,4) |
| 2 | (1/4, 1/3, 1/2) | (1,1,1) | (1,2,3) | (2,3,4) | (3,4,5) | (1,2,3) |
| 3 | (1/4, 1/3, 1/2) | (1,2,3) | (1,1,1) | (2,3,4) | (3,4,5) | (1,2,3) |
| 4 | (1/6, 1/5, 1/4) | (1/4, 1/3, 1/2) | (1/4, 1/3, 1/2) | (1,1,1) | (1,2,3) | (1,2,3) |
| 5 | (1/9, 1/9, 1/9) | (1/5, 1/4,1/3) | (1/5, 1/4,1/3) | (1/3, 1/2, 1/1) | (1,1,1) | (1/3, 1/2, 1/1) |
| 6 | (1/4, 1/3, 1/2) | (1/3, 1/2, 1/1) | (1/3, 1/2, 1/1) | (1/3, 1/2, 1/1) | (1,2,3) | (1,1,1) |

Now, find inverse fuzzy number using formula

$$(l_1, m_1, u_1)^{-1} = (1/u_1, 1/m_1, 1/l_1)$$

For adding two fuzzified pairwise comparison matrix

$$A1 \ \Theta \ A2 = (l_1, m_1, u_1) \ \Theta \ ((l_2, m_2, u_2) = (l_1 + l_2, m_1 + m_2, u_1 + u_2)$$

**Table 5 : Fuzzified Pairwise Comparison Matrix with Geometric Mean**

| Sr.no | 1 | 2 | 3 | 4 | 5 | 6 | Fuzzy geometric mean value ri |
|---|---|---|---|---|---|---|---|
| 1 | (1,1,1) | (2,3,4) | (2,3,4) | (4,5,6) | (9,9,9) | (2,3,4) | (2.56, 3.26, 3.88) |
| 2 | (1/4, 1/3, 1/2) | (1,1,1) | (1,2,3) | (2,3,4) | (3,4,5) | (1,2,3) | (1.06, 1.58, 2.11) |
| 3 | (1/4, 1/3, 1/2) | (1,2,3) | (1,1,1) | (2,3,4) | (3,4,5) | (1,2,3) | (1.06, 1.58,2.11) |
| 4 | (1/6, 1/5, 1/4) | (1/4, 1/3, 1/2) | (1/4, 1/3, 1/2) | (1,1,1) | (1,2,3) | (1,2,3) | (0.46, 0.66, 0.90) |
| 5 | (1/9, 1/9, 1/9) | (1/5, 1/4,1/3) | (1/5, 1/4,1/3) | (1/3, 1/2, 1/1) | (1,1,1) | (1/3, 1/2, 1/1) | (0.28, 0.34, 0.48) |
| 6 | (1/4, 1/3, 1/2) | (1/3, 1/2, 1/1) | (1/3, 1/2, 1/1) | (1/3, 1/2, 1/1) | (1,2,3) | (1,1,1) | (0.45, 0.66, 1.06) |
| Total Sum | | | | | | | (5.87,8.08, 10.54) |

**Table 6 : Fuzzy Weight Calculations**

| Sr.no | Fuzzy geometric mean value ri | Fuzzy weight wi |
|---|---|---|
| 1 | (2.56, 3.26, 3.88) | 0.121, 0.212, 0.330 |
| 2 | (1.06, 1.58, 2.11) | 0.050, 0.097, 0.179 |
| 3 | (1.06, 1.58,2.11) | 0.050,0.097,0.179 |
| 4 | (0.46, 0.66, 0.90) | 0.021, 0.040, 0.076 |
| 5 | (0.28, 0.34, 0.48) | 0.013, 0.021,0.040 |
| 6 | (0.45, 0.66, 1.06) | 0.021, 0.040, 0.090 |

**Table 7: Calculation of Normalizing Weight**

| Sr.no | Fuzzy weight wi | weight, wi | Normalize weight |
|---|---|---|---|
| 1 | 0.121, 0.212, 0.330 | 0.221 | 0.397482014 |
| 2 | 0.050, 0.097, 0.179 | 0.108 | 0.194244604 |
| 3 | 0.050,0.097,0.179 | 0.108 | 0.194244604 |
| 4 | 0.021, 0.040, 0.076 | 0.045 | 0.080935252 |
| 5 | 0.013, 0.021,0.040 | 0.024 | 0.043165468 |
| 6 | 0.021, 0.040, 0.090 | 0.05 | 0.089928058 |
| | SUM | 0.556 | 1 |

**Table 8: Fuzzy Pairwise Comparisons for The Alternative Spare Parts**

| XT 1 | | | | XT 2 | | | |
|---|---|---|---|---|---|---|---|
| | Spare Part A | Spare Part B | Spare Part C | | Spare Part A | Spare Part B | Spare Part C |
| Spare Part A | (1,1,1) | (2,3,4) | (6,7,8) | Spare Part A | (1,1,1) | (1/3, 1/2, 1) | (1/4, 1/3, 1/2) |
| Spare Part B | (1/4,1/3,1/2) | (1,1,1) | (2,3,4) | Spare Part B | ((1,2,3) | (1,1,1) | (1/3, 1/2, 1/1) |
| Spare Part C | (1/8,1/7,1/6) | (1/4,1/3,1/2) | (1,1,1) | Spare Part C | (2,3,4) | (1,2,3) | (1,1,1) |
| **XT 3** | | | | **XT 4** | | | |
| | Spare Part A | Spare Part B | Spare Part C | | Spare Part A | Spare Part B | Spare Part C |
| Spare Part A | (1,1,1) | (3,4,5) | (7,8,9) | Spare Part A | (1,1,1) | (3,4,5) | (1,2,3) |
| Spare Part B | (1/5, 1/4, 1/3) | (1,1,1) | (3,4,5) | Spare Part B | (1/5, 1/4, 1/3) | (1,1,1) | (1/4, 1/3, 1/2) |
| Spare Part C | (1/9, 1/8, 1/7) | (1/5, 1/4, 1/3) | (1,1,1) | Spare Part C | (1/3, 1/2, 1/1) | (2,3,4) | (1,1,1) |
| **XT 5** | | | | **XT 6** | | | |
| | Spare Part A | Spare Part B | Spare Part C | | Spare Part A | Spare Part B | Spare Part C |
| Spare Part A | (1,1,1) | (1/5, 1/4, 1/3) | (1/9, 1/9, 1/9) | Spare Part A | (1,1,1) | (7,8,9) | (3,4,5) |
| Spare Part B | (3,4,5) | (1,1,1) | (1/5, 1/4, 1/3) | Spare Part B | (1/9, 1/8, 1/7) | (1,1,1) | (1/6, 1/5, 1/4) |
| Spare Part C | (9,9,9) | (3,4,5) | (1,1,1) | Spare Part C | (1/5, 1/4, 1/3) | (4,5,6) | (1,1,1) |

**Table 9: Fuzzy Pairwise Comparisons for The Alternative Spare Parts**

| XT 1 | | | | XT 2 | | | |
|---|---|---|---|---|---|---|---|
| | Spare Part A | Spare Part B | Spare Part C | | Spare Part A | Spare Part B | Spare Part C |
| Spare Part A | (1,1,1) | (2,3,4) | (6,7,8) | Spare Part A | (1,1,1) | (0.33, 0.5, 1) | (0.25, 0.33, 0.5) |
| Spare Part B | (0.25,0.33,0.5) | (1,1,1) | (2,3,4) | Spare Part B | ((1,2,3) | (1,1,1) | (0.33, 0.5, 1) |
| Spare Part C | (0.12,0.14,0.16) | (0.25,0.33,0.5) | (1,1,1) | Spare Part C | (2,3,4) | (1,2,3) | (1,1,1) |
| **XT 3** | | | | **XT 4** | | | |
| | Spare Part A | Spare Part B | Spare Part C | | Spare Part A | Spare Part B | Spare Part C |
| Spare Part A | (1,1,1) | (3,4,5) | (7,8,9) | Spare Part A | (1,1,1) | (3,4,5) | (1,2,3) |
| Spare Part B | (0.2, 0.25, 0.33) | (1,1,1) | (3,4,5) | Spare Part B | (0.2, 0.25, 0.33) | (1,1,1) | (0.25, 0.33, 0.5) |
| Spare Part C | (0.11, 0.12, 0.14) | (0.2, 0.25, 0.33) | (1,1,1) | Spare Part C | (0.33, 0.5, 1) | (2,3,4) | (1,1,1) |
| **XT 5** | | | | **XT 6** | | | |
| | Spare Part A | Spare Part B | Spare Part C | | Spare Part A | Spare Part B | Spare Part C |
| Spare Part A | (1,1,1) | (0.2, 0.25, 0.33) | (0.11, 0.11, 0.11) | Spare Part A | (1,1,1) | (7,8,9) | (3,4,5) |
| Spare Part B | (3,4,5) | (1,1,1) | (0.2, 0.25, 0.33) | Spare Part B | (0.11, 0.12, 0.14) | (1,1,1) | (0.16, 0.2, 0.25) |
| Spare Part C | (9,9,9) | (3,4,5) | (1,1,1) | Spare Part C | (0.2, 0.25, 0.33) | (4,5,6) | (1,1,1) |

Now, we can find the scores of the spare part with respect to six attributes, shown in **Table 1**. The local weights all spare parts for each attribute are obtain by multiplying their relatives' weight by the weight of the attributes.

**Table 10: On the Basis of Six Attributes Calculation of Eigenvectors of Spare Parts**

| | |
|---|---|
| $V_{XT1}$ | ((0.06, 0.22, 1.05) (0.10, 0.46, 1.79) (0.08, 0.32, 1.37)) |
| $V_{XT2}$ | ((0.09, .033, 0.82) (0.11, 0.33, 0.99) (0.13, 0.33, 1.19)) |
| $V_{XT3}$ | ((0.08, 0.17, 0.40) (0.11, 0.25, 0.55) (0.29,0.58, 1.14)) |
| $V_{XT4}$ | ((0.15, 0.29, 0.58) (0.08, 0.16, 0.33) (0.26, 0.55, 1.11)) |
| $V_{XT5}$ | (0.26, 0.55, 1.11)) (0.26, 0.55, 1.11)) (0.08, 0.27, 1.23)) |
| $V_{XT6}$ | ((0.13, 0.38, 0.95) (0.10, 0.34, 0.88) (0.12, 0.28, 0.97)) |

The overall classification can be obtained by multiplying (triangular product) the weight matrix Table 11 by the transposed eigenvector of the attributes.

**Table 11: According Six Attributes Local Weight of Spare Parts**

| | XT1 | XT2 | XT3 | XT4 | XT5 | XT6 |
|---|---|---|---|---|---|---|
| Sp. Part 1 | (0.06, 0.22, 1.05) | (0.09, 0.33, 0.82) | (0.08, 0.17, 0.40) | (0.15, 0.29, 0.58) | (0.26, 0.55,1.11) | (0.13, 0.38, 0.95) |
| Sp. Part 2 | (0.10, 0.46, 1.79) | (0.11, 0.33, 0.99) | (0.11, 0.25, 0.55) | (0.08, 0.16, 0.33) | (0.26, 0.55,1.11) | (0.10, 0.34, 0.88) |
| Sp. Part 3 | (0.08, 0.32,1.37) | (0.13, 0.33,1.19)) | (0.29,0.58, 1.14)) | (0.26, 0.55,1.11) | (0.08, 0.27,1.23) | (0.12, 0.28,0.97) |

**Table 12: Overall Classification Vector**

| | |
|---|---|
| Sp. Part 1 | (0.01 . 0.25, 5.20) |
| Sp. Part 2 | (0.01, 0.27, 6.38) |
| Sp. Part 3 | (0.03, 0.48, 9.39) |

The priority scores for the spare parts are obtained and they are ranked based on their magnitude.

SparePart 3 consider by the users as the most critical item.

## VI. CONCLUSION

In this research work, we used fuzzy -AHP approach for identifying demand for spare parts and judgment of proper decision making in the automobile industry, from the adoption of fuzzy AHP analysis proper characterize and demand of spare parts in a competitive market with the help of different attributes and alternatives. This proposed methodology can apply real value analysis and acceptably function from the customer point of view. In fuzzy methodology members of the fuzzy set have more independence to make a decision and proper judgment of spare parts and this fuzzy methodology was useful rather than the conventional AHP approach so that a basic feasible solution will be obtained. This work analyses the application of quality function for spare parts analysis and tried to reduce uncertainty from customer satisfaction. The result shows that proper judgment and decision should be an important role for selection parameter of spare parts and also demand can more increase according to organizational behaviour and maintaining a quality product for proper judgment.

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