Improving The Supplier Selection Methodology in a Tool Manufacturing Unit

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Abstract

Supplier selection, which includes multi criteria and multiple conflicting objectives, can be defined as the process of finding the right suppliers with the right quality at the right price, at the right time, and in the right quantities. In this paper, a two-stage model for Supplier quality evaluation for a Tool Manufacturing unit is proposed. Improper evaluation of supplier selection affects delivery, quality and cost of products, and a new MCDM method of combined SWARA and TOPSIS for supplier rating is proposed which facilitates selection of best supplier from a bunch of suppliers. SWARA is used to find out the criteria weight individually & TOPSIS is used to decide the best supplier from existing one.

Keywords: SWARA (Stepwise Weight Assessment Ratio Analysis), TOPSIS (Technique of Order Preferences to Similarity to Ideal Solution), MCDM (Multi Criteria Decision Making)

I. INTRODUCTION

The importance of Supplier selection process has been increased recently, since the cost of raw materials and component parts constitute the main cost of a product and most of the firms have to spend huge amount of money on purchasing of raw materials. Supplier selection is a multi-criteria decision making problem. The purchasing department of the company consider four criteria's like Time, Quality, Cost and Technology for their supplier selection problem

II. NEED FOR USING SWARA AND TOPSIS

SWARA: There are several factors to be deals with while making decision on the Suppliers. SWARA is used to determine the weight of each main criteria and sub criteria's individually.

Considering the literature, we find

- Its perceptive is different from other methods like AHP, ANN, ELECTRE etc.
- It give Importance for experts opinions and survey's based on their implicit knowledge and experience
- It helps to find weight of criteria and sub criteria's individually.

A. TOPSIS

For Solving Multiple Criteria Decision Making (MCDM) problems. Technique for Order Performance by Similarity to Ideal Solution (TOPSIS), provides the basis for developing supplier selection models. In this two artificial alternatives are hypothesized, positive ideal alternative and Negative ideal alternatives. Selects the alternative that is the closest to the ideal solution & farthest from negative ideal alternative

III. PROBLEM IDENTIFICATION AND PROBLEM STATEMENT

The work is done in a Tool manufacturing unit. Company faces some problems due to frequent raw material rejection due to improper supplier selection methodology currently used by the unit, and improper supply of materials. Out of the raw materials carbide material is found out highest rejection rate during the study. Due to improper supplier methodology, supply of raw material is lowered during the past three years. In addition to that, improper supplier rating and review system is existing within the company. Raw material is accepted only based on the availability and cost at the time of ordering. Supplier performance review is not done within periods, mean while most of the raw material is being rejected at monthly. Unavailability of requested

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raw materials from few suppliers is another problem. Hence rise in the overall cost of Production due to improper supplier evaluation and review technique seems to be a major problem faced by the company.

The problem statement is 'Continuous rejection of raw materials due to improper supplier evaluation and selection.'

IV. PROBLEM DEFINITION

The major problem faced by the company is the rejection of important raw materials currently used by the unit during the year 2015.

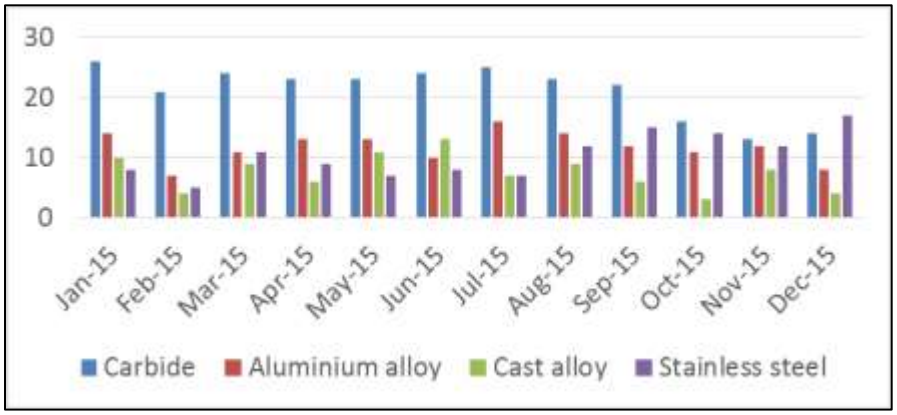

Fig. 1: Rejection of important Raw materials in kg

The table shows the rate of rejection of important raw materials. The wastage and quantity after rejection is produced in kg is shown. Out of the raw materials, carbide material is find out highest rate of rejection in the year 2015.

Another problem faced by the company is improper supply of raw material from the suppliers. Data of 2015 which helps to prove this problem is expressed in the table below.

Fig. 2: Total weight of carbide material was accepted in 2015 in Kg

The above data shows that number of carbide material is accepted in the year 2015, it is clear that accepting quantity of carbide material is very low and improper supply of raw material from the vendors

V. SUPPLIER RATING METHODOLOGY

A. Stage 1 Supplier rating is done in a Ranking Scale Method

Excellent	*Very good*	*Good*	*Poor*	*Very poor*	*Worst*
10	*8*	*6*	*4*	*2*	*0*

Conducting an Expert Questionnaire evaluation based on above ranking method. Expert use above ranking score given to main criteria's and sub criteria's of current problem structure of the unit like Time, Quality, Cost, and Technology and finding the average of these criteria.

B. Stage 2 SWARA Method is used to find the Criteria Weights

Steps of SWARA method for finding the criteria weights:

- Step 1. Sort the evaluation criteria in descending order, based on their expected significances.

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- Step 2. Starting from the second criterion, make the respondent express the relative importance of the criterion j in relation to the previous (j-1) criterion, and do this for each particular criterion. This ratio is called the Comparative importance of average value, s_j.
- Step 3. Determine the coefficient k_j as follows:

$$K_i = \begin{cases} 1 & j = 1 \\ S_i + 1 & j > 1 \end{cases}$$

- Step 4: Determine the recalculated weight Wj as follows

$$W_i = \begin{cases} 1 & j = 1 \\ K_i - 1 / K_i & j > 1 \end{cases}$$

- Step 5: Determine the relative weights of the evaluation criteria as follows

$$Q_j = W_j / \sum W_j$$

Calculation results by applying SWARA method

Table – 1
Calculation results obtained by SWARA method

Main Criteria	*Comparative Importance of Average Value (S_j)*	*Coefficient $K_j = S_j + 1$*	*Recalculated Weight $W_j = (X_j - 1) / K_j$*	*Weight $Q_j = W_j / \sum W_j$*
X_1 (Time)	*.88*	*1.88*	*.5319*	*.2672*
X_{1-2} (Transportation time)	-	*1*	*1*	*.4775*
X_{1-1} (Distribution time)	*0.76*	*1.76*	*0.5681*	*0.2712*
X_{1-4} (Delivery time)	*0.72*	*1.72*	*0.3302*	*0.1576*
X_{1-3} (On time response to request)	*0.68*	*1.68*	*0.1966*	*0.0938*
X_2 (Quality)	-	*1*	*1*	*0.5025*
X_{2-1} (Product quality)	-	*1*	*1*	*0.4975*
X_{2-2} (Product reliability)	*0.84*	*1.84*	*0.5434*	*0.2722*
X_{2-4} (Quality certification)	*0.80*	*1.80*	*0.3018*	*0.1512*
X_{2-3} (Failure rate)	*0.76*	*1.76*	*0.1715*	*0.0859*
X_3 (Cost)	*0.84*	*1.84*	*.2890*	*0.1447*
X_{3-1} (Transportation Cost)	-	*1*	*1*	*0.4878*
X_{3-2} (Product price)	*0.80*	*1.80*	*0.5555*	*0.2708*
X_{3-3} (Custom duty)	*0 .76*	*1.76*	*0.3156*	*0.1539*
X_4 (Technology)	*0.64*	*1.64*	*.1762*	*.1762*
x_{4-1} (Technical features)	-	*1*	*1*	*.6153*
x_{4-2} (Compliance with international standards)	*0.6*	*1.6*	*0.625*	*.3846*

C. ***Stage 3 Once the weights of all criteria are obtained we can use TOPSIS, which is a simple and useful technique to rank the number of suppliers needed to be considered.***

Steps in TOPSIS are:

- Calculate the Decision matrix.
- Normalize the Decision matrix.
- Calculate the weighted normalized decision matrix.

Table - 2
Weighted Normalized Matrix

Final result of criteria weight	*0.2672*	*0.5025*	*0.1447*	*.1762*
Criteria / Supplier	*Time*	*Quality*	*Cost*	*Technology*
A	*.0710*	*.1629*	*.0632*	*.0397*
B	*.1057*	*.1629*	*.0507*	*.0362*
C	*.0422*	*.2597*	*.0287*	*.0068*
D	*.0820*	*.0436*	*.0306*	*.0159*
E	*.0721*	*.1104*	*.0465*	*.0103*

- Find the Positive Ideal Solution and Negative Ideal Solution.

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- Determine the Euclidean distance of each alternatives from the ideal and negative-ideal solution
- Calculate the relative closeness of the i^{th} alternative to ideal solution using the following equation:

$$RC_i = \frac{d_i^-}{d_i^* + d_i^-} \qquad i= 1, 2, 3\ldots., n$$

- Based on the closeness of i^{th} , the ranks of vendors are determined.

Table - 3
Result

*d**	*d⁻*	*Ci*	*Rank*
.8605	*.4141*	*.3250*	*1*
.7030	*.1387*	*.1647*	*5*
.7614	*.1860*	*.1963*	*4*
.5235	*.0824*	*.2560*	*3*
.7454	*.0810*	*.2851*	*2*

VI. RESULT

The combined SWARA and TOPSIS method is very well suited to find the suitable supplier from multiple alternatives. SWARA method is used to find criteria weight individually and TOPSIS is used to rank best supplier from existing one. Supplier A is find out the best after the Topsis computation.

VII. CONCLUSION

Current supplier selection model used in the unit is not sufficient for Today's business process.as result of continuous rejection of raw materials and improper supply. Hence by overcome this situation by using SWARA-TOPSIS method used to rank the supplier from available alternative suppliers and obtain the best supplier.

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