Vendor Evaluation and Selection an Electrical Industry

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Abstract

In today's competitive environment, effective supplier selection process is very important for the success of manufacturing industries. Supplier selection represents one of the most important functions to be performed by the purchasing departments. Supplier selection is a multi-criteria problem including many factors (criteria).Aim of this paper to find out the best supplier from bench of suppliers from the manufacturing industry by using AHP and ELECTRE method.

Keywords: Supplier selection, multi criteria decision making, analytical hierarchy process (AHP), The Eliminiation and Choice Translating Reality (ELECTRE)

I. INTRODUCTION

Supplier selection and evolution are decisions of strategic importance to manufacturing industries. The selecting supplier process mainly involves evaluation of different alternative suppliers based on different criteria. Supplier selection process affected by various quantitative and qualitative criteria. Improper supplier or vendor selection leads to raw material rejections, production decreases etc.

II. NEED FOR VENDOR SELECTION

The current vendor selection method used in the industry is very old. Currently company considering vendor selection criteria are cost, quality and delivery. Considering only three criteria is not for proper vendor evaluation. The improper vendor evaluation and selection process lead to production loss and raw material rejection. Therefore company needs an appropriate vendor evaluation and selection procedure.

III. LITERATURE SUMMARY

Kurian John, Vinod Yeldho Baby, Georgekutty S.Mangalathu 2013[1] explains that one of the main goals of vendor evaluation process to finding the best vendors and finding the performance of vendors. According to H.K. Sim Mohamed. K. Omar , W.C. Chee, N. T. Gan1 2010[2], says that expert opinion is very important in the vendor selection process. Considering more expert opinion which is help to finding the best result. Six major selection criteria were considered in this research, quality and delivery nowadays are used as a qualifier factors. Once a supplier is qualified, then most of the companies will used cost and service as a selection factors. Moreover, companies use factors such as relationship with supplier and suppliers' management and organization status as additional factors for the selection process. Sanjay Kumar, Neeraj Parashar, Dr. Abid Haleem 2009[3] explains the use of Analytical Hierarchy Process in vendor selection process.in vendor selection process considering both qualitative and quantitative criteria helps to achieving best result. A well-researched methodology has been adopted for the synthesis of priorities and the measurement of consistencies.

Smrutiranjan Mohanty ,Balaji.M. Dabade 2015 [4] explains the supplier selection analysis model considering Analytic Hierarchy Process (AHP). AHP model can significantly reduce the time and effort in decision making. According to Y.N.Liu 2010[5], explain that different selection criteria used in manufacturing companies, ranking of different criteria are identified.it explain to finding weightages of criteria. Chun-Ling Chuang 2003[6] explains the advantages of using AHP and fuzzy set ranking in MCDM. This method to converts the qualitative factors of suppliers transferred into the quantitative measure. Pema wangchen Bhutia 2012 [7] explains the advantages of using AHP and TOPSIS. It is easy to compute and easily understood, because the methods are directly giving a definite value by experts. N.Harikannan,Vijay jayakumar 2014 [8] explain that different decision making method explained, importance of methods to be explained. H.Tezcan UYSAL 2014 [9] explains that the advantages of using ELECTRE method. Paper gives the idea about the ELECTRE method working in real world problems. Jihong Pang 2011[10] explain that AHP based ELECTRE method of reliability design scheme decision for computer numerical control (CNC) machine

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IV. PROBLEM IDENTIFICATION AND PROBLEM STATEMENT

The case study is done at alternator manufacturing industry. The companies currently use old and inefficient vendor selection process. This vendor selection process mainly considering only three criteria of vendor selection, and company not consider other important criteria. Current vendor selection method followed by the company is not sufficient in today business world.
The main problems identified in the company are:

1) Problems due to raw materials rejection
2) Improper supply of raw materials from suppliers.

– Problem Statement - "Rejection of raw materials due to improper vendor evaluation & selection"

V. PROBLEM DEFINITION

The major problem faced by the company is the high rejection of raw material and improper supply because company currently using Improper vendor selection process. The data which helps to prove this problem is expressed in the table below:

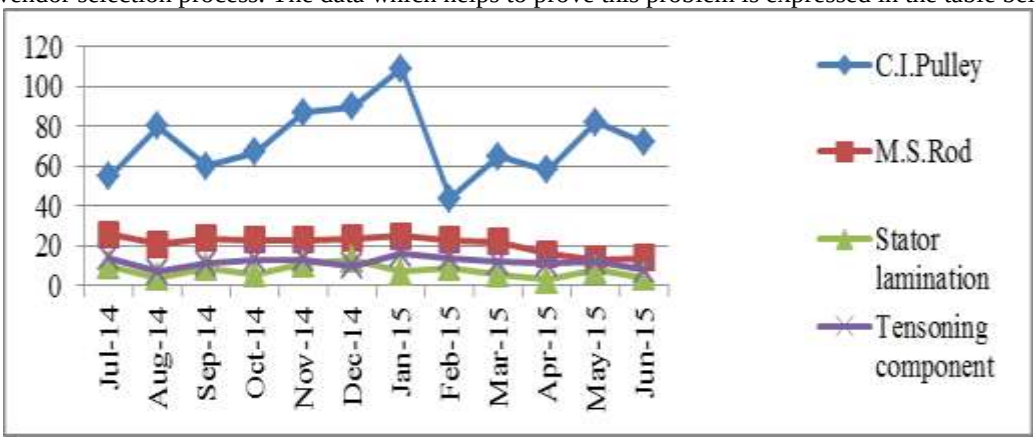

Fig. 1: Rejection of important raw materials

The figure shows the rejection of important raw materials for the alternator. From the figure, it is clear that raw material rejection in this electrical industry is high. And clear that cast iron pulley have high rate of rejection.

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

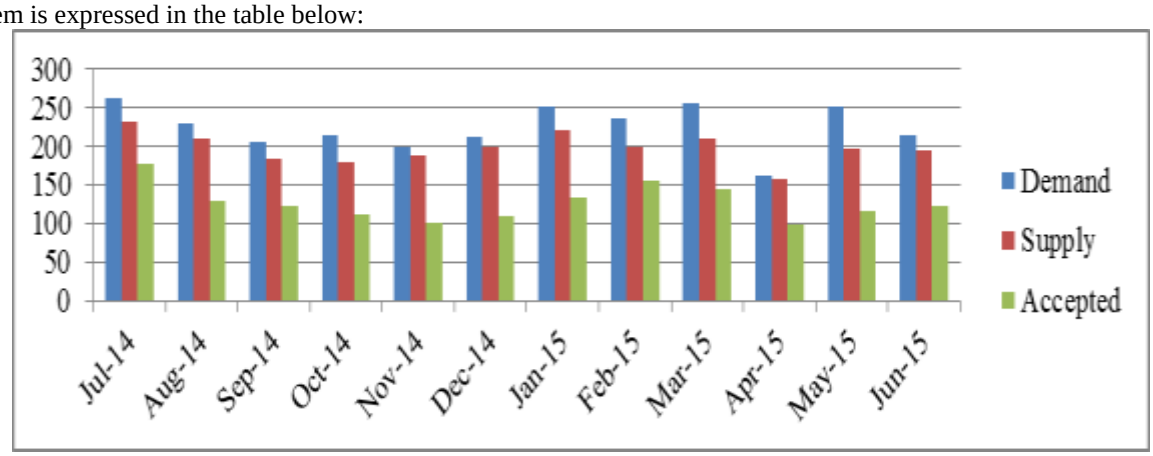

Fig. 2: No. of cast iron pulley was accepted in 2014-2015

The above data shows that number of cast iron pulley accepted in 2014-2015 it is clear that accepting quantity of cast iron pulley is very low and improper supply of raw material from the vendors.

VI. PROCEDURE

A. Stage 1

Firstly selecting important criteria of vendor selection in the industry are found out. Expert opinion is taking the selection of selection criteria. Data is collected with the help of questionnaire. Data's required for AHP is collected from three experts. Then

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analytical hierarchy process used to find the importance of criteria and pairwise comparisons of vendors with respect to criteria are found out.

The below table shows geometric mean of importance of criteria and pairwise comparison of vendors with respect to criteria:

Table - 1
Geometric mean of criteria

Criteria	*Expert 1 (W)*	*Expert 2 (W)*	*Expert 3 (W)*	*GM (W)*
Price	*0.230*	*0.218*	*0.23*	*0.22*
Quality	*0.401*	*0.367*	*0.372*	*0. 38*
Delivery	*0.145*	*0.179*	*0.15*	*0.16*
Warranties & claim policies	*0.085*	*0.0978*	*0.106*	*0.09*
Production facilities & capacity	*0.066*	*0.0673*	*0.064*	*0.06*
Performance history	*0.041*	*0.0417*	*0.037*	*0.04*
Technical capability	*0.032*	*0.028*	*0.030*	*0.03*

Table - 2
Pairwise comparison of vendors with respect to criteria

	Price	*Quality*	*Delivery*	*Warranties & claim policies*	*Production facilities & capacity*	*Performance history*	*Technical capability*
A	*0.362*	*0.399*	*0.093*	*0.360*	*0.0599*	*0.354*	*0.320*
B	*0.220*	*0.1825*	*0.169*	*0.240*	*0.270*	*0.228*	*0.269*
C	*0.158*	*0.148*	*0.205*	*0.127*	*0.253*	*0.171*	*0.175*
D	*0.111*	*0.119*	*0.135*	*0.132*	*0.204*	*0.115*	*0.100*
E	*0.0745*	*0.0923*	*0.079*	*0.075*	*0.129*	*0.073*	*0.0629*
F	*0.0669*	*0.0562*	*0.0805*	*0.054*	*0.0725*	*0.0545*	*0.057*

B. Stage 2

In this step above results apply ELECTRE 1 method to find the vendor ranking.
The various steps of ELECTRE method explained as follows

1) Normalized Matrix

For finding normalized matrix the following equation is used

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}, \quad i = 1, 2, \ldots, n \quad j = 1, 2, \ldots, m$$

Table - 3
Normalized matrix

0.760	*0.814*	*0.280*	*0.753*	*0.132*	*0.742*	*0.678*
0.462	*0.372*	*0.510*	*0.502*	*0.598*	*0.477*	*0.571*
0.331	*0.302*	*0.617*	*0.265*	*0.560*	*0.358*	*0.371*
0.233	*0.242*	*0.406*	*0.276*	*0.452*	*0.240*	*0.212*
0.156	*0.188*	*0.238*	*0.156*	*0.286*	*0.152*	*0.133*
0.140	*0.114*	*0.242*	*0.114*	*0.160*	*0.114*	*0.120*

2) Weighted Normalized Matrix

The weighted matrix's ratings are calculated as multiplied the rates with the relevant weights.

Table - 4
Weighted Normalized matrix

0.171	*0.310*	*0.035*	*0.072*	*0.0069*	*0.0296*	*0.0206*
0.104	*0.140*	*0.121*	*0.048*	*0.0462*	*0.0185*	*0.0175*
0.075	*0.114*	*0.070*	*0.025*	*0.0354*	*0.0141*	*0.0112*
0.054	*0.093*	*0.048*	*0.026*	*0.023*	*0.0095*	*0.0065*
0.036	*0.071*	*0.027*	*0.015*	*0.0144*	*0.0061*	*0.0041*
0.031	*0.043*	*0.027*	*0.0107*	*0.0099*	*0.0044*	*0.0037*

3) Concordance and Discordance Sets

For each pair of alternatives Ap and Aq the set of attributes is divided into two different subsets. The concordance set, which is composed of all attributes for which alternative Ap is preferred to alternative Aq can be written as

$$C(p,q)=\{j, V_{pj} \geq V_{qj}\}$$

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Where Vpj is weighted rating of alternative Ap with respect to the jth attribute, The complement of C (p,q), which is called the discordance set

$$D(p,q)=\{j, Vpj < Vqj\}$$

4) Outranking Relationships

The method defines that Ap outranks Aq when Cpq ≥ Average(C) and Dpq ≤Average (D).

Table - 5
Outranking Relationships

	C>average =0.5066			D<average =0.5282		
C(A,B)	0.7782	OK	D(A,B)	0.506	OK	A→B
C(A,C)	0.7782	OK	D(A,C)	0.176	OK	A→C
C(A,D)	0.7782	OK	D(A,D)	0.0768	OK	A→D
C(A,E)	0.9382	OK	D(A,E)	0.0315	OK	A→E
C(A,F)	0.9382	OK	D(A,F)	0.0109	OK	A→F
C(B,A)	0.2275	NOK	D(B,A)	1	NOK	
C(B,C)	0.8457	OK	D(B,C)	0	OK	B→C
C(B,D)	1	OK	D(B,D)	0	OK	B→D
C(B,E)	1	OK	D(B,E)	0	OK	B→E
C(B,F)	1	OK	D(B,F)	0	OK	B→F
C(C,A)	0.2275	NOK	D(C,A)	1	NOK	
C(C,B)	0.160	NOK	D(C,B)	1	NOK	
C(C,D)	0.9076	OK	D(C,D)	0	OK	C→D
C(C,E)	1	OK	D(C,E)	0	OK	C→E
C(C,F)	1	OK	D(C,F)	0	OK	C→F
C(D,A)	0.2275	NOK	D(D,A)	1	NOK	
C(D,B)	0	NOK	D(D,B)	1	NOK	
C(D,C)	0.0981	NOK	D(D,C)	1	NOK	
C(D,E)	1	OK	D(D,E)	0	OK	D→E
C(D,F)	1	OK	D(D,F)	0	OK	D→F
C(E,A)	0.0675	NOK	D(E,A)	1	NOK	
C(E,B)	0	NOK	D(E,B)	1	NOK	
C(E,C)	0	NOK	D(E,C)	1	NOK	
C(E,D)	0	NOK	D(E,D)	1	NOK	
C(E,F)	1	OK	D(E,F)	0.001	OK	E→F
C(F,A)	0.0675	NOK	D(F,A)	1	NOK	
C(F,B)	0	NOK	D(F,B)	1	NOK	
C(F,C)	0	NOK	D(F,C)	1	NOK	
C(F,D)	0	NOK	D(F,D)	1	NOK	
C(F,E)	0.160	NOK	D(F,E)	1	NOK	

VII. RESULT

AHP method applied to find out weightages of criteria and vendors with respect to criteria, the results from AHP method applied in ELECTRE method to find outranking relationships .This outranking relationship gives the ranking orders of vendors. In this case study the outranking relationship shows vendor A is best.

VIII. CONCLUSION

Improper vendor evaluation and selection leads to raw material rejection, improper supply raw materials from the vendors. Implementation of AHP-ELECTRE method will result to selecting best vendors and decreasing the raw material rate.

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