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Selection of merchant for Manufacturing industries through application of analytic hierarchy process

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ABSTRACT: *Selection of a genuine merchant is an important task for any Industry. In this paper the assessment and selection of a merchant is carried out through Analytic Hierarchy Process (AHP). AHP is a pairwise comparison technique which compare the attributes and assess the quality level by considering its different characteristics which govern the qualitative aspect of the system. The factors identified for selection of a merchant are: Qualit,y, Cost, Service, Financial capability, Technical & Production capability through an Intense Literature Survey. On the basis of these factors and co – factors a model tree has been developed. The present methodology is dynamic in nature and takes into consideration Quality factors along with their predefined weightages before arriving at a selection.*

Keywords: AHP, Merchant

INTRODUCTION:

The gravity of "merchant selection process" is evident from umpteen number of research on the issue. Different authors have identified and analyzed various factors and applied different techniques to discuss the issue and provide a solution to the Merchant selection. The work done by the different researchers was of immense help to the authors for selection of factors in the present paper. However the authors observed that the individual and interactive effect of factors has not been taken into account during the course of application of techniques. To predict or compare the merchant performance for a manufacturing Industry, it is necessary to analyze various factors and their effect. Therefore, a mathematical model is required to correlate the different factors, sub-factors to evaluate and compare the merchants for different applications. The present works undertakes the application of AHP in the merchant selection for a manufacturing industry. A company must focus on both their immediate customers and those next in the chain(1). So Creating a win-win situation is a basic requirement for each supplier and manufacturer. And creating triple wins produces expansion for the entire industry (2).

METHODOLOGY:

The Analytic Hierarchy Process (AHP) has been developed by T. Saaty (1977, 1980, 1988, 1995) and is one of the best known and most widely used MCA approaches. It allows users to assess the relative weight of multiple criteria or multiple options against given criteria in an intuitive manner. In case quantitative ratings are not available, policy makers or assessors can still recognize whether one criterion is more important than another. Therefore, pairwise comparisons are appealing to users. Satty established a consistent way of converting such pairwise comparisons (X is more important than Y) into a set of numbers representing therelative priority of each of the criteria.

The basic procedure to carry out the AHP consists of the following steps:

1. Structuring a decision problem and selection of criteria

The first step is to decompose a decision problem into its constituent parts. In its simplest form, this structure omprises a goal or focus at the topmost level, criteria (and subcriteria) at the intermediate levels, while the lowest level contains the options.

Arranging all the components in a hierarchy provides an overall view of the complex relationships and helps the decision maker to assess whether the elements in each level are of the same magnitude so that they can be compared accurately. An element in a given level does not have to function as a criterion for all the elements in the level below. Each level may represent a different cut at the problem so the hierarchy does not need to be complete (1).

When constructing hierarchies it is essential to consider the environment surrounding the problem and to identify the issues or attributes that contribute to the solution as well as to identify all participants associated with the problem.

2. Priority setting of the criteria by pairwise comparison (weighing)

For each pair of criteria, the decision maker is required to respond to a question such as "How important is criterion A relative to criterion B?" Rating the relative "priority"of the criteria is done by assigning a weight between 1 (equal importance) and 9 (extreme importance) to the more important criterion, whereas the reciprocal of this value is assigned to the other criterion in the pair. The weighings are then normalized and averaged in order to obtain an average weight for each criterion.

3. Pairwise comparison of options on each criterion (scoring)

For each pairing within each criterion the better option is awarded a score, again, on a scale between 1 (equally good) and 9 (absolutely better), whilst the other option in the pairing is assigned a rating equal to the reciprocal of this value. Each score records how well option "x" meets criterion "Y". Afterwards, the ratings are normalized and averaged. Comparisons of elements in pairs require that they are homogeneous or close with respect to the common attribute; otherwise significant errors may be introduced into the process of measurement (2).

4. Obtaining an overall relative score for each option

In a final step the option scores are combined with the criterion weights to produce an overall score for each option. The extent to which the options satisfy the criteria is weighed according to the relative importance of the criteria. This is done by simple weighted summation.

Finally, after judgements have been made on the impact of all the elements and priorities have been computed for the hierarchy as a whole, sometimes and with care, the less important elements can be dropped from further consideration because of their relatively small impact on the overall objective. The priorities can then be recomputed throughout, either with or without changing the judgements (Saaty, 1990).

APPLICATION OF AHP IN MERCHANT SELECTION

Critical Factors:

There are critical factors for implementation of AHP technique namely: Quality, Cost, Service, Financial capability, Technical & Production capability.

Table: 1 Factors & Co-factors affecting quality of manufacturing Industry

Factors	Quality	Cost	Service	Financial Capability	Technical & Production Capability
Co-factors	Low defect rate	Unit Cost	On time Delivery	Economic Performance	Manufacturing Capability
	Commitment to Quality	Operating Cost	Quick Responsiveness	Financial Stability	Design Capability
	Improved Process Capability	Maintenance Cost	Warranty		Capacity Utilization

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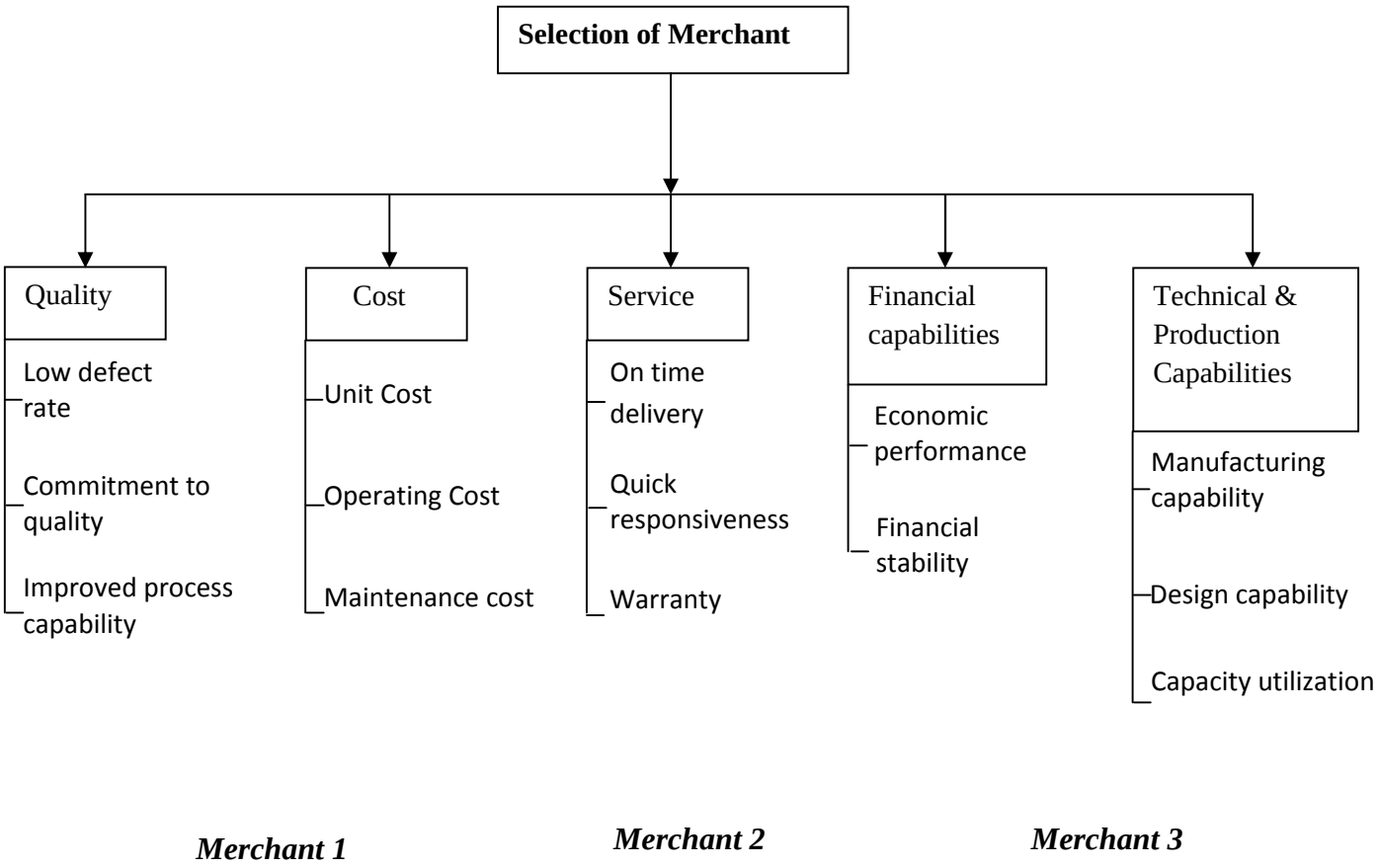

Fig. 1 Model Tree for comparing quality of Merchants

According to the critical factors the problem is converted into a model tree of hierarchical structure.

The model has four levels as shown in Fig.1
Level 1: Declares the goal of the problem
Level 2: Critical factors,
Level 3: Co-factors of the critical factors
Level 4: Result

Although it is difficult to analyze and quantify the intangibles, however for the purpose of application of methodology the data has been taken after a precise survey and discussions with Industry personals, academicians and complied in Table 1 and the local weights of each factor each shown by the chart (6).

Table: 2 Composite priority weights for performance evaluation

Factors	Local Weights	Criteria	Local Weights	Global Weights
Quality	0.423	Low defect rate (LDR)	0.606	0.256
		Commitment to Quality (CQ)	0.322	0.136
		Improved Process Capability (IPC)	0.072	0.0304
Cost	0.219	Unit Cost (UC)	0.507	0.111
		Operating Cost (OP)	0.201	0.044
		Maintenance Cost (MC)	0.292	0.064
Service	0.210	On – time Delivery (OTD)	0.355	0.075
		Quick Responsiveness (QR)	0.324	0.068
		Warranty (WT)	0.321	0.067
Financial Capability	0.064	Economic Performance (EP)	0.565	0.0362
		Financial Stability (FS)	0.435	0.0285
Technical & Production Capability	0.084	Manufacturing Capability (MC)	0.513	0.0432
		Design Capability (DC)	0.235	0.0197
		Capacity Utilization (CU)	0.252	0.0212
Total	1.000			1.000

Vol. 1 Issue III, October 2013
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Liberatore (3) suggested a five point rating scale of Outstanding (O), Good (G), and Average (A), Fair (F), Poor (P).This scale is adopted and priority weights of these scales can be determined using pairwise comparisons. Using pairwise comparison judgment matrix is generated. Liberatore found priority weights of outstanding, good, fair, average, and poor as 0.513, 0.261, 0.129, 0.063, and 0.034, respectively.

The rating and weights of all criteria are shown in Table 2. Multiplying the global priority weights and rating and subsequently adding the resulting values we can find the score of different Industries. Based on global priority weights of the three Industries shown in Table 2, Industry B scored the highest weight. Therefore Industry B stands high on basis of evaluation

.

Factors	Global Weight	INDUSTRY A		INDUSTRY B		INDUSTRY C	
		Rating	Score * GW	Rating	Score * GW	Rating	Score * GW
LDR	0.256	G	0.066816	G	0.066816	G	0.051156
CQ	0.136	F	0.008568	F	0.008568	G	0.035496
IPC	0.0304	P	0.001034	O	0.0155952	G	0.0079344
UC	0.111	F	0.014319	F	0.014319	F	0.001512
OP	0.044	A	0.002772	F	0.005676	G	0.011484
MC	0.064	A	0.004032	G	0.016704	A	0.004032
OTD	0.075	A	0.004725	A	0.004725	A	0.004725
QR	0.068	A	0.004284	A	0.004284	F	0.008772
WT	0.067	A	0.004221	F	0.004221	A	0.004221
EP	0.0362	P	0.0012308	A	0.0022806	P	0.0012308
FS	0.0285	P	0.000969	G	0.0074385	G	0.0074385
MC	0.0432	P	0.0014688	O	0.0221616	F	0.0055728
DC	0.0197	P	0.0006698	A	0.0012411	G	0.0051417
CU	0.0212	A	0.0013356	P	0.0007208	F	0.0027348
Total			**0.116445**		**0.174751**		**0.151451**

RESULT AND ANALYSIS

This paper proposed the use of AHP as powerful tools for evaluating the merchant in manufacturing Industry. The technique has been used by different authors in various fields for selection among alternatives. Application of this technique helps in analysis of various criteria and sub criteria leading to selection, comparison and ranking of Merchants.

This will further help in self appraisal and improvement. The Merchant A, B, and C scored 0.116445, 0.174751 and 0.151451 points respectively. The results illustrate that Merchant C has been capable in maintaining the quality better than other Merchants.

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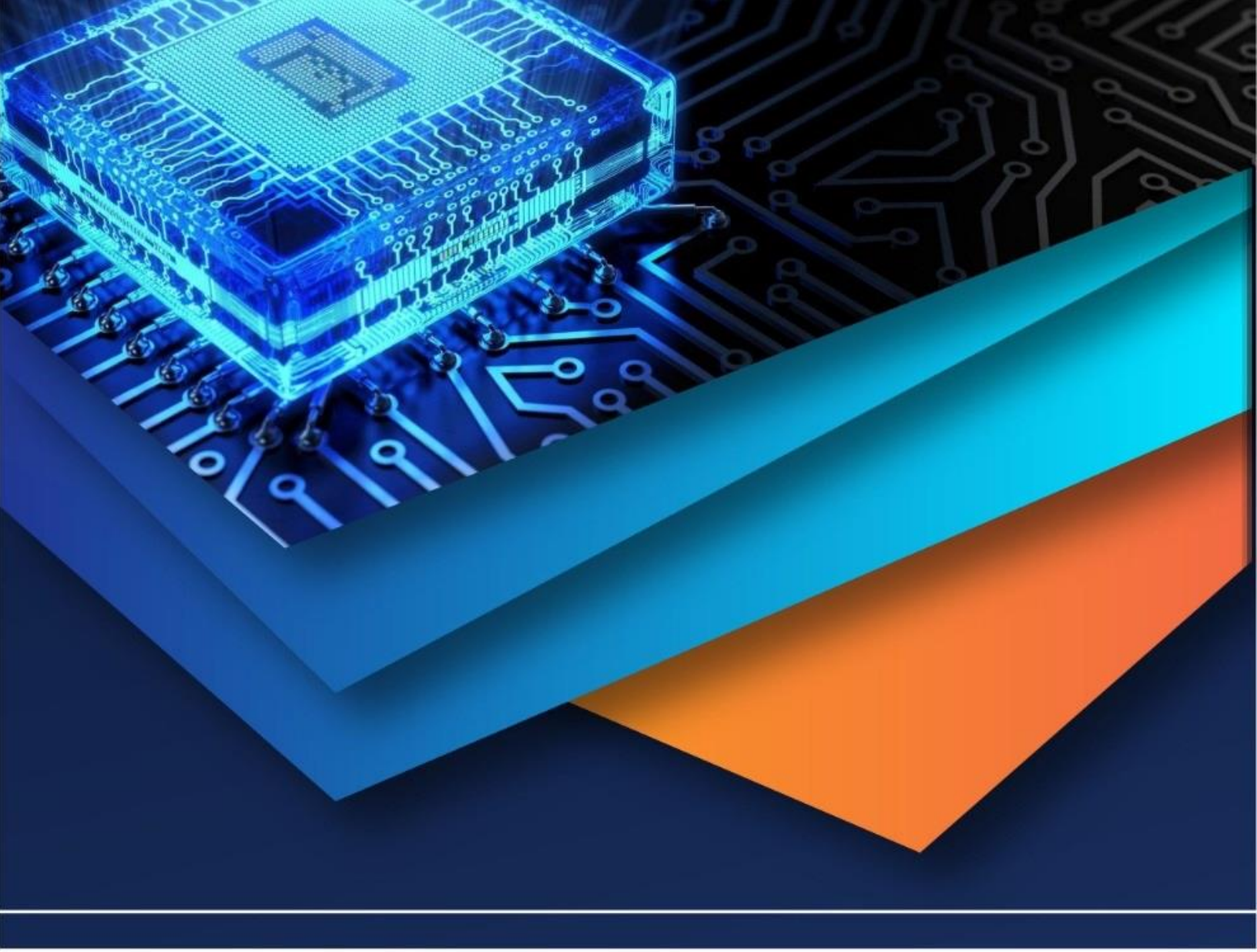

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