

Selection of Best Supplier in Furniture Manufacturing Company by Using Analytic Hierarchy Process

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Abstract

The selection of supplier is one of the most critical decisions in the design and development of a successful production environment. In this study, a user friendly decision support system is proposed for supplier selection. This system guides the decision maker in selecting proper supplier via effective algorithms, such as the Analytic Hierarchy process (AHP) Cost analysis helps the user evaluate the results based on economical considerations. Selection of supplier is a time consuming process which needs extensive data exploitation. The process of supplier selection is a multi- criteria decision-making problem with conflicting and diverse objectives. In this work a systematic methodology is presented under the consideration of multiple factors and objectives that are witnessed to be crucial to the construction process. The model includes building an analytic hierarchy structure with a tree of hierarchical criteria and alternatives to ease the decision-making.

Keywords: Analytic Hierarchy Process (AHP); Multi criteria Decision Making (MCDM); Selection of Best Supplier

I. INTRODUCTION

Today's fierce market conditions force company's to make very careful decisions.

Any waste of resources such as money, time, workforce etc., due to wrong decisions directly increases company's costs, which in turn, is reflected to the customer.

The selection of supplier is very critical especially in industries where wooden work is intensively used. A poor decision would result in quality, flexibility, productivity, etc. problems which could have dramatic results. This study aims at developing a systematical, accurate, fast and practical decision-making process for supplier selection.

A decision is a choice made from two or more alternatives. In selection of supplier multi-criteria decision making process is very important. The table presents a model which links supplier alternatives to manufacturing strategy for supplier selection. In this study, the selection of proper supplier is very important by using the AHP method.

Cheng and Li claim that AHP is an effective tool for management decision making it can be defective if used improperly.

The study compares various suppliers naming Dongwa, Robin and Finsa. They are from various countries like Vietnam, Malaysia, and Europe etc.

If the supplier is not selected properly then material may not reach to the company on time and there will be production delay, orders of the customer will not fulfill on time. The material of one supplier may be costlier than that of other supplier, the quality of material of one supplier may be better than other supplier. So it will be difficult to select the supplier. But AHP is used to decide which supplier is the best

so that material should reach in time to the company and profit of the company will increase. Due to fulfillment of purchase orders on time customers will order more quantity. And thus profit of the company will be more.

II. LITERATURE REVIEW

Selecting the best supplier using Analytic hierarchy process is taken from Babak Daneshvar Rolyendegh (B.Erdebilli). The purchasing function of a firm directly affects its competitive ability. Purchasing managers need to periodically evaluate the performance of suppliers in order to retain those who meet their requirements. There are various criteria for supplier selection and evaluation. This report provides a guideline for establishing supplier selection criteria for purchasing activities. The AHP decision making process functions in terms of the multi-criteria analysis for cost credit terms technical parameters and shipping time.

A decision support system for supplier selection using an integrated AHP and linear programming SHGehodsypour, C. O. Brien.

In order to select the best suppliers it is necessary to make a trade off between tangible and intangible factors. Managers should decide about 2 problems which suppliers are the best and how much should be purchased from each selected supplier.

An integration of the AHP and linear programming is proposed to consider both tangible and intangible factors in choosing the best suppliers and placing the optimum order quantities among them such that the total value of purchasing becomes maximum. This model can be applied to supplier selection with and without capacity constraints.

Supplier selection using combined AHP and grey rational analysis. Authors ching-chow yang. Bai-sheng Chen. Journal of manufacturing technology. The purpose is to develop an evaluation model considering the qualitative and quantitative criteria for supplier selection in an outsourcing manufacturing organization.

The decision aiding software has been implemented in excel to automate the supplier selection process. This can widely apply the integrated model for the industry.

Supplier selection using Analytic hierarchy process methodology extended by D numbers.

Supplier selection is an important issue in supply chain management and essentially in a multi criteria decision making problem. Supplier selection highly depends on experts assessments. In the process of that it inevitably involves various types of uncertainty such as imprecision, fuzziness and incompleteness due to the inability of human beings subjective judgment. However the existing methods cannot adequately handle these types of uncertainties. Based on a new effective and feasible representation of uncertain information, called D numbers ,a D-AHP method is proposed for the supplier selection problem, which extends the classical AHP method within the proposed method, D numbers extended fuzzy preference relation has involved to represent the decision matrix of pair wise comparisons given by experts.

Supplier selection based on multi – criteria AHP method.

It describes a case-study of supplier selection based on multi-criteria AHP method. Using adequate mathematical method can bring us unprejudiced conclusion, even if the alternatives are very similar in given selection-criteria. The result is the best possible supplier company from the view point of chosen criteria and the price of the product. In many Industrial engineering applications the final decision is based on the evaluation of a number of alternatives in terms of a number of criteria. This problem may become a very difficult when the criteria is expressed in different units or the pertinent data is difficult to be quantified. The AHP is an effective approach in dealing with this kind of decision problems.

III. RESEARCH OBJECTIVES

The main objective of the study is

1. To select the best supplier amongst all suppliers. If there are n numbers of suppliers then it will be difficult for the company to take a decision as to which supplier is the best of all.
2. The purchasing function of a firm directly affects its competitive ability. Purchasing Managers need to periodically evaluate the performance of

suppliers in order to retain those who meet their requirements.

3. There are various criteria for supplier selection and evaluation. This report provides a guideline for establishing supplier selection criteria for purchasing activities.
4. The AHP decision making process functions in terms of the multi criteria analysis for cost, credit terms, technical parameters and shipping time.
5. People from different functions of the company such as purchasing, stores and quality control were involved in the selection process.

IV. IMPORTANCE AND NEED OF THE STUDY

A study of supplier selection is based on multi-criteria AHP method. It is demonstrated that using mathematical model can bring us conclusion, even if the alternatives are very similar in given selection criteria. The result is the best possible supplier company from the view point of chosen criteria and the price of the product.

Suppliers

Dongwa, Robin and Finsa. These suppliers are from various countries like Vietnam, Malaysia, and Europe etc.

Selection of supplier in a furniture making company.

1. First of all the objective is to be stated.
2. Then the next step is selection of supplier.
3. Then the criteria is defined

Various criteria are as follows.

1. Technical parameters,
2. Credit terms,
3. Shipping time

are decided and the alternatives are supplier names like

Alternatives

1. Dongwa
2. Robin
3. Finsa

The information is then arranged in a hierarchical tree.

1. Credit terms are 2 times as important as technical parameters.
2. Technical parameters are 3 times as important as shipping time.
3. Credit terms are 4 times as important as shipping time.

Using pair wise comparisons, the relative importance of one criterion over another can be expressed.

Pair wise comparisons

- | | |
|----------------|---------------------|
| 1. Equal | 2. Weak |
| 3. Moderate | 4. Moderate plus |
| 5. Strong | 6. Strong plus |
| 7. Very strong | 8. Very very strong |

9. Extreme

| | Technical parameters | Credit terms | Shipping time |
|----------------------|----------------------|--------------|---------------|
| Technical parameters | 1/1 | 1/2 | 3/1 |
| Credit terms | 2/1 | 1/1 | 4/1 |
| Shipping time | 1/3 | 1/4 | 1/1 |

We get a ranking of priorities from a pair wise matrix. And we get an eigenvector.

Eigenvector solution is the best approach.

- 1) Raise the pair wise matrix to powers that are successively squared each time.
- 2) The row sums are then calculated and normalized.
- 3) The computer is then instructed to stop when the difference between these sums in two consecutive calculations is smaller than a prescribed value.

Let's solve the matrix algebra.

Table no 2

| | Technical parameters | Credit terms | Shipping time |
|----------------------|----------------------|--------------|---------------|
| Technical parameters | 1/1 | 1/2 | 3/1 |
| Credit terms | 2/1 | 1/1 | 4/1 |
| Shipping time | 1/3 | 1/4 | 1/1 |

Converting the fractions to decimals.

| | | |
|--------|--------|--------|
| 1.0000 | 0.5000 | 3.0000 |
| 2.0000 | 1.0000 | 4.0000 |
| 0.3333 | 0.2500 | 1.0000 |

Step 1 Squaring the matrix This times

| | | |
|--------|--------|--------|
| 1.0000 | 0.5000 | 3.0000 |
| 2.0000 | 1.0000 | 4.0000 |
| 0.3333 | 0.2500 | 1.0000 |

This

| | | |
|--------|--------|--------|
| 1.0000 | 0.5000 | 3.0000 |
| 2.0000 | 1.0000 | 4.0000 |
| 0.3333 | 0.2500 | 1.0000 |

I.E. $(1.0000 \times 1.0000) + (0.5000 \times 2.0000) + (3.0000 \times 0.3333) = 3.0000$

Results in following-

| | | |
|--------|--------|---------|
| 3.0000 | 1.7500 | 8.0000 |
| 5.3332 | 3.0000 | 14.0000 |
| 1.1666 | 0.6667 | 3.0000 |

Step 2 Compute our first eigenvector (To four decimal places)

First we sum the rows.

$3.0000 + 1.7500 + 8.0000 = 12.7500$ 0.3194

$5.3332 + 3.0000 + 14.0000 = 22.3332$ 0.5595

$1.1666 + 0.6667 + 3.0000 = 4.8333$ 0.1211

We sum the row totals 39.9165 1.0000

Normalize by dividing the row sums by the row totals.

i.e. 12.7500 divided by $39.9165 = 0.3194$

The result is our eigenvector

0.3194 0.5595 0.1211

This process must be iterated until the eigenvector solution does not change from the previous iteration.

Step 1 We square this matrix

3.0000 1.7500 8.0000

5.3332 3.0000 14.0000

1.1666 0.6667 3.0000

With this result

27.6653 15.8330 72.4984

48.3311 27.6662 126.6642

10.5547 6.0414 27.6653

Compute the eigenvector (to 4 decimal places)

$27.6653 + 15.8330 + 72.4984 = 115.9967$ 0.3196

$48.3311 + 27.6662 + 126.6642 = 202.6615$ 0.5584

$10.5547 + 6.0414 + 27.6653 = 44.2614$ 0.1220

Totals 362.9196 1.0000

Compute the difference of the previous computed eigenvector

$0.3194 - 0.3196 = -0.0002$

$0.5595 - 0.5584 = 0.0011$

$0.1211 - 0.1220 = -0.0009$

One more iteration would show no difference to 4 decimal places.

| | Technical parameters | Credit terms | Shipping time |
|----------------------|----------------------|--------------|---------------|
| Technical parameters | 1/1 | 1/2 | 3/1 |
| Credit terms | 2/1 | 1/1 | 4/1 |
| Shipping time | 1/3 | 1/4 | 1/1 |

And the eigenvector gives us the ranking of our criteria.

Technical parameters 0.3196 second most important criteria

Credit terms 0.5584 the most important criteria

Shipping time 0.1220 least important criteria.

In terms of technical terms

| | Dongwa | Robin | Finsa |
|--------|--------|-------|-------|
| Dongwa | 1/1 | 1/4 | 4/1 |
| Robin | 4/1 | 1/1 | 4/1 |
| Finsa | 1/4 | 1/4 | 1/1 |

In terms of credit terms pair wise comparisons determines the preference of each alternative over another.

Credit terms

| | Dongwa | Robin | Finsa |
|--------|--------|-------|-------|
| Dongwa | 1/1 | 5/1 | 5/1 |
| Robin | 1/2 | 3/1 | 3/1 |
| Finsa | 1/5 | 1/3 | 1/1 |

Computing the eigenvector determines the relative ranking of alternatives under each criterion.

Ranking technical terms Ranking Credit terms

| | | | | | |
|----|--------|--------|----|--------|--------|
| 3. | Dongwa | 0.1160 | 1. | Dongwa | 0.3790 |
| 2. | Robin | 0.2470 | 2. | Robin | 0.2900 |
| 4. | Finsa | 0.0600 | 4. | Finsa | 0.0740 |

Shipping time

| | | |
|--------|----|----------------|
| Dongwa | 34 | 34/85 = 0.4000 |
| Robin | 27 | 27/85 = 0.3176 |
| Finsa | 24 | 24/85 = 0.2823 |
| Total | 85 | = 1.0000 |

Objective: select a supplier 1.00

Criteria

| Technical terms | credit terms | shipping time |
|-----------------|--------------|---------------|
| 0.3196 | 0.5584 | 0.1220 |

Alternatives

| | | | | | |
|--------|--------|--------|--------|--------|--------|
| Dongwa | 0.1160 | Dongwa | 0.3790 | Dongwa | 0.3010 |
| Robin | 0.2470 | Robin | 0.2900 | Robin | 0.2390 |
| Finsa | 0.0600 | Finsa | 0.0740 | Finsa | 0.2120 |

A little more matrix algebra gives us the solution.

| | Technical terms | Credit terms | Shipping time | Criteria ranking | |
|--------|-----------------|--------------|---------------|------------------|-----------------|
| Dongwa | 0.1160 | 0.3790 | 0.3010 | | Technical terms |
| Robin | 0.2470 | 0.2900 | 0.2390 * | 0.3196 | Credit terms |
| Finsa | 0.0600 | 0.0740 | 0.2120 | 0.5584 | Shipping time |

IF for Dongwa

$$(0.1160 * 0.3196) + (0.3790 * 0.5584) + (0.3010 * 0.1220) = 0.3060$$

| | |
|--------|--------|
| Dongwa | 0.3060 |
| Robin | 0.2720 |
| Finsa | 0.0940 |

And the winner is Dongwa

1. Dongwa 0.3060
2. Robin 0.2720
3. Finsa 0.0940

| | Cost | Normalized cost | Benefit cost ratio |
|-----------|--------------------------------|--------------------------|------------------------|
| 1. Dongwa | 258 dollar/cbm | 0.2529 | 0.3060/0.2529 = 1.2099 |
| 2. Robin | 257 dollar/cbm | 0.2519 | 0.2720/0.2519 = 1.0797 |
| 3. Finsa | 245 dollar/cbm Total = 1020 | 0.2401 Total = 1.0000 | 0.0940/0.2401 = 0.3915 |

Dongwa is the most important benefit to cost ratio.

V. RESULTS AND CONCLUSION

Best supplier is selected by using AHP.

There are 3 suppliers for supply of MDF boards. All the material is imported from countries naming Vietnam, Malaysia, and Europe etc.

M/s. Dongwa from Vietnam, M/s. Robin from Malaysia and M/s. Finsa from Europe are the major various suppliers.

Supplier selection is based on various criteria such as Technical terms, Credit terms, Shipping time, etc.

The main objective is selection of best supplier.

By applying AHP technique, the result suggests that M/s. Dongwa is the best supplier.

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