



VENDOR SELECTION USING ANALYTICAL HIERARCHY PROCESS IN SUPPLY CHAIN MANAGEMENT

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ABSTRACT

A supply chain is a network of four -departments, which is involved in various activities like product procurement to distribution of final product. The purchasing has gained importance in supply chain management due to the factors like globalization and technological changes. In this paper the supplier selection for the leading glass product manufacturing industry is taken. Here, a versatile technique namely “Analytical Hierarchy Process” has been used to select the best vendor. When any vendor for a particular item make changes for the parameters like price, quality and performance improvement to deliver better quality product to customer, the whole hierarchy process for arriving at developing ranking of vendors is to be performed again for finding out the best vendor. So, a suitable standard programming logic was developed to meet current requirement. The package can be executed seven number of times with changing input parameters values thus serving the purpose.

KEY WORDS: Supply chain management, AHP, Programming Logic

INTRODUCTION

Traditionally organizations have been divided in operative functions such as Marketing, planning, production, purchasing, finance, etc. Supply chain is a strategy that integrates these functions creating a general plan for the organization, which Satisfies the service policy, maintaining the lowest possible cost level due to the incredible competition environment that they are exposed to retailers. There has been an evolution in the role and structure of the purchasing function through the nineties. The purchasing function has gained great importance in the supply chain

management due to factors such as globalization, increased value added in supply, and accelerated technological change. Purchasing involves buying the raw materials, supplies, and components for the organization. The activities associated with it include selecting and qualifying suppliers, rating supplier performance, negotiating contracts, comparing price, quality and service, sourcing goods and service, timing purchases, selling terms of sale, evaluating the value received, predicting price, service, and sometimes demand changes, specifying the form in which goods are to

be received, etc. In general, this research intends to provide empirical evidence of the criteria and the procedures for the supplier selection process used in different corporate environments. Also, it plans to evaluate if these processes follow rigorous regulations as the ISO 9000 standards. Finally, identify the suitability of the Analytical Hierarchical Process (AHP) to assist in decision making to resolve the supplier selection problem. The major objective of this paper is to evaluate the best vendor in a corporate environment using AHP (Analytical Hierarchy Process) and to develop software. Using oracle database which will accept the input values as input parameters such as price, performance, quality, delivery and returns the output values through output parameter, overall development priority ranking of different vendors and the maximum overall development ranking value can be picked, which will enable us to identify the most effective vendor.

Literature Review

According to Simchi - Levi et.al, (2000) Supply Chain Management can be defined as "Supply Chain Management is a set of approaches utilized to efficiently integrate suppliers, manufactures, warehouses and stores, so that merchandise is produced and distributed at the right time, to the right location, in order to minimize system

wide costs whole satisfying customer level requirements."

Johnson (1995) has quoted that Supply Chain Management is the process of strategically managing the movement and storage of materials, parts, and finished goods inventory from suppliers through the firm and to the customer.

Shapiro (2001) has defined Supply Chain Management as "Concept about integrated business planning that have been espoused by logistics experts, strategists and operation research practitioners an far back as 1950s"

Beamon (1999) defines Supply Chain as "An integrated process when in a number of business entities (i.e. Suppliers, Manufacturer Distributors and Retailers) work together in an effort to acquire raw materials, convert these raw materials into specified final products and then deliver these final products to retailers."

Supplier Selection Process

Experts agree that no best way exists to evaluate and select suppliers, and thus organizations use a variety of approaches. The overall objective of the supplier evaluation process is to reduce risk and maximize overall value to the purchaser. An organization must select suppliers it can do business with over an extended period of time.

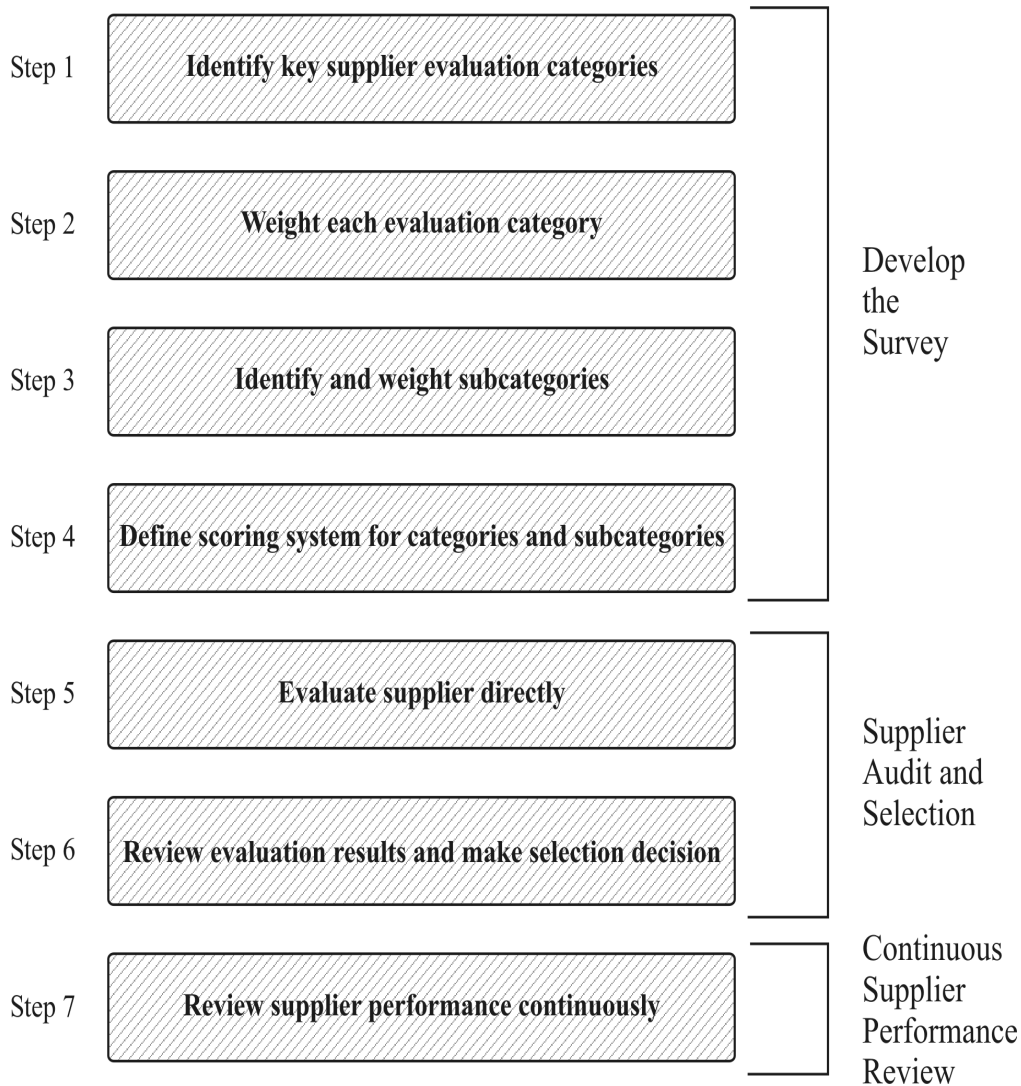


Figure: Initial Supplier Evaluation and Selection Audit Development.

Step 1: Identify key supplier evaluation categories

One of the first steps when developing a supplier survey is for the purchaser to decide which performance categories to include. The primary criteria are cost/price, quality and delivery, which are generally the most obvious and most critical areas that affect the buyer. For many items, these three performance areas

would be enough, however for critical items needing an in-depth analysis of the supplier's capabilities, a more detailed supplier evaluation study is required.

Step 2: Weight each evaluation category

The performance categories usually receive a weight that reflects the relative importance of the category. The total of each weight must equal 1.0. An important characteristic of an effective evaluation is

flexibility. One way that management achieves this flexibility is by assigning different weights or adding or deleting performance categories as required.

Step 3: Identify and weight subcategories

This process requires identifying any performance subcategories, if they exist, within each broader performance category. The sum of the subcategory weight must equal the total weight of the performance category.

Step4: Define scoring system for categories and subcategories

A clearly defined scoring system takes criteria that may be highly subjective and develops a quantitative scale for measurement. Scoring metrics are effective if different individuals interpret and score the same performance categories under review.

Step 5: Evaluate supplier directly

A purchaser can compare objectively the scores of different suppliers competing for the same purchase contract or select one supplier over another based on the evaluation score. It is also possible, based on the evaluation that a supplier does not qualify at this time for further purchase consideration. Purchasers should have minimum acceptable performance requirements that suppliers must satisfy

before they can become part of the supply base.

Step6: Review evaluation results and make selection decision

The primary output from this step is a recommendation about whether to accept a supplier for a business. A purchaser may evaluate several suppliers who might be competing for a purchaser contract. The purpose of the evaluation is to qualify potential suppliers for current or expected future purchase contracts.

Step7: Review supplier performance continuously

When a purchaser decides to select a supplier, the supplier must then perform according to the purchaser's requirements. The emphasis shifts from the initial evaluation and selection of suppliers to evidence of continuous improvement by suppliers.

THE NEED FOR THE ANALYTICAL HIERARCHY PROCESS

One of the key skills required of an engineer is the ability to produce systems that satisfy user's requirements, by the correct selection, configuration, integration, operation and control of proprietary building blocks. These component parts can be physical entities such as computer and manufacturing

machinery and the hard system components. However, they can also be non physical entities such as software, algorithms, control strategies and methods- the ‘soft’ systems components, if the wrong components are elected then the user requirements will not be satisfied. If sub-optimal. Components are selected then the system solution will be sub-optimal. Clearly, selection is a critical element of the engineering process. Therefore, it is essential that it is systematic, formalized and accountable, so that it is amenable to detailed analysis for the purpose of verification and optimization. To satisfy these requirements we have to use the Analytical Hierarchy Process.

What is AHP?

Table: Standard Preference

Preference Level	Numerical Value
Equally preferred	1
Equally to moderately preferred	2
Moderately preferred	3
Moderately to strongly preferred	4
Strongly preferred	5
Strongly to very strongly preferred	6
Very strongly preferred	7
Very strongly to extremely preferred	8
Extremely preferred	9

According to operations management 4th edition by Russell and Taylor it is a quantitative method for ranking decision alternatives and select the one among given multiple criterion. AHP is process for developing numerical score to rank each decision alternative based on how well each alternative meets the decision maker's criteria.

Data Collection and Analysis

ABC Company Data

Grinding Wheels

	Vendor A	Vendor B
Price	4,382	4065
Performance	28 shifts	25 shifts
Quality	Good	Good
Delivery	Good	Good

Bearings

Suppliers

1. Vendor A
2. Vendor B
3. Vendor C
4. Vendor D

	Vendor A	Vendor B	Vendor C	Vendor D
Price	1786	1850	1374	2500
Quality	average	Standard	Below average	Above average
Performance	5 months	6 months	4 months	7 months
Delivery	Good	Good	Good	Good

Grinding Powders

Suppliers

1. Vendor A
2. Vendor B

	Vendor A	Vendor B
Price	62	57
Performance	Good	Good
Delivery	Good	Very Good

Lubricants

Suppliers

1. Vendor A
2. Vendor B
3. Vendor C

	Vendor A	Vendor B	Vendor C
Price	62.5	75	70
Delivery	below average	above average	average

Data Analysis

Data Analysis of Grinding Wheels

Priority Vectors for price:

- Vendor A 0.333
- Vendor B 0.666

Priority Vector for performance:

- Vendor A 0.666
- Vendor B 0.333

Pair wise comparison Matrix for the two criteria:

Criteria	Price	Performance
Price	1	2
Performance	1/2	1

Priority Vector for criteria:

- Price 2/3
- Performance 1/3

Evaluation of overall priority ranking for grinding wheel

	Price	Performance	Criteria	
Vendor A	0.333	0.666 x	Price	2/3
Vendor B	0.666	0.333	Performance	1/3

Overall Vendor A Priority= 4/9

Overall Vendor B Priority= 5/9

Since overall vendor priority value of B is more, vendor B is the best

Data Analysis of Bearings

Price	Vendor A	Vendor B	Vendor C	Vendor D
Vendor A	0.175	0.243	0.16	0.25
Vendor B	0.08	0.121	0.128	0.25
Vendor C	0.701	0.609	0.641	0.45
Vendor D	0.035	0.024	0.071	0.02

Priority Vectors for price:

- Vendor A 0.207
- Vendor B 0.144
- Vendor C 0.600
- Vendor D 0.037

Quality	Vendor A	Vendor B	Vendor C	Vendor D
Vendor A	0.153	0.16	0.2	0.13
Vendor B	0.461	0.48	0.4	0.522
Vendor C	0.076	0.12	0.1	0.08
Vendor D	0.3	0.24	0.3	0.26

Priority Vectors for quality:

Vendor A	0.1607
Vendor B	0.465
Vendor C	0.094
Vendor D	0.275

Performance	Vendor A	Vendor B	Vendor C	Vendor D
Vendor A	0.107	0.07	0.166	0.120
Vendor B	0.321	0.222	0.333	0.201
Vendor C	0.035	0.037	0.0555	0.076
Vendor D	0.535	0.666	0.44	0.604

Priority vectors for performance:

Vendor A	0.115
Vendor B	0.269
Vendor C	0.051
Vendor D	0.565

Criteria	Price	Performance	Quality
Price	0.285	0.333	0.273
Performance	0.142	0.166	0.18
Quality	0.571	0.5	0.18

Priority vectors for criteria:

Price	0.297
Performance	0.162
Quality	0.539

Developing an overall Priority

Price	Performance	Quality	Criteria	
0.207	0.115	0.166	Price	Vendor A
0.144	0.269	0.465	Performance	Vendor B
0.6	0.051	0.094	Quality	Vendor C
0.037	0.565	0.602		Vendor D

Overall Vendor A Priority =0.168

Overall Vendor B Priority =0.36

Overall Vendor C Priority =0.237

Overall Vendor D Priority =0.335

Since Overall Value of Vendor B is More, So Vendor B is The Best

Data Analysis of Grinding Powders

Price	Vendor A	Vendor B
Vendor A	1/3	1/3
Vendor B	2/3	2/3

Priority Vector for Price:

Vendor A	0.333
Vendor B	0.666

Other pair wise comparisons:

Delivery	Vendor A	Vendor B
Vendor A	1	2
Vendor B	1/2	1

Priority vector for delivery:

Vendor A	0.666
Vendor B	0.333

Pair wise comparison Matrix for the two criteria:

Criteria	Price	Delivery
Price	1	1/2
Delivery	2	1

Priority Vector for Criteria:

Price	1/3
Delivery	2/3

Developing an overall priority ranking:

	Price	Delivery	Criteria
Vendor A	0.333	0.666 x	1/3 Price
Vendor B	0.666	0.333	2/3 Delivery

Overall Vendor A Priority = 5/9

Overall Vendor B Priority= 4/9

Since overall Vendor A Priority is more,
So Vendor A is the Best.

Data Analysis of Lubricants

Other Pair Wise Comparisons:

Priority vector for Delivery:

Vendor A	0.54
Vendor B	0.163
Vendor C	0.297

Delivery	Vendor A	Vendor B	Vendor C
Vendor A	1	3	1/2
Vendor B	1/3	1	2
Vendor C	2	1/2	1
	3.33	4.5	3.5

Priority vector for Delivery:

Vendor A	0.37
Vendor B	0.3
Vendor C	0.33

Pair wise Comparison for Criteria:

Criteria	Price	Delivery
Price	1	2
Delivery	1/2	1
	1.5	3

Synthesizing Judgments:

Criteria	Price	Delivery
Price	2/3	2/3
Delivery	1/3	1/3

Priority vector for criteria: Criteria

Price	2/3
Delivery	1/3

Developing an overall priority ranking:

	Price	Delivery	Criteria
Vendor A	0.54	0.37 x	2/3 Price
Vendor B	0.163	0.3	1/3 Delivery
Vendor C	0.297	0.33	

Overall Vendor A Priority = .426

Overall Vendor B Priority= .26

Overall Vendor C Priority= .314

Since overall Vendor A Priority is more,
So Vendor A is the Best.

So, by using AHP the following decisions
were made

- (1) Vendor B is selected for grinding wheel
- (2) Vendor B is selected for bearing
- (3) Vendor A is selected for grinding powder
- (4) Vendor A is selected for lubricants

CONCLUSION

Quantitative Analysis

The following were obtained after analyzing the data:

- For grinding wheels Vendor B is the best Vendor between the two vendors.
- For Bearings Vendor B is the best vendor among the four vendors.
- For Lubricants Vendor A is the best vendor among the three vendors.

Qualitative Analysis

Implementation of AHP:

- AHP Avoids the arbitrary assignment of weights for the

factors considered by the decision maker which results in more accurate evaluation of the vendor.

- The concept of relative pair wise comparison which has been used between any two alternatives and two factors made this vendor rating technique as the best one in the current corporate environment.
- In order to execute several number of times with changing input parameters, a software program for calculating vendor rating is developed using oracle as backend.
- Using data definition, we need to create tables which will store the information about vendors, their supplying items including price, performance, quality, delivery schedule.
- The software accepts input values as price, performance, quality delivery and returns the out values through output parameters overall development priority ranking of different vendors and maximum overall development ranking value can be picked, which will enable us to identify the most effective vendor.

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