A VENDOR SELECTION PROBLEM: A Case Study

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ABSTRACT

This paper presents a vendor selection problem in Thai Manufacturing Company by using multi-attribute decision making (MADM) technique. Two vendors for casting parts are evaluated using Analytical Hierarchy Processes (AHP) techniques. Three main criteria to be considered are cost, process quality control and location. The sub-criteria can be obtained by interviewing corresponding persons of the company. Expert Choice software is used to solve the problem. The result points that the new vendor outranks the existing vendor.

1. INTRODUCTION

The direction of purchasing functions in the present business has changed radically from those in the past. Today, there is a trend to make long term cooperation between suppliers and customers. Customers tend to reduce the number of suppliers. The selection of suppliers is not merely based on price consideration, but comprehensive criteria are usually developed in order to gain shared benefits in the long term both for supplier and customer sides. The current trend is often referred as *supply chain management, just-in-time (JIT) purchasing, long-term partnership* and very much appreciated as new technique to develop competitive advantages in manufacturing industries.

One major aspect of the purchasing function is vendor selection. This function becomes a strategic decision since by making a right decision in selecting good and dependable vendors for long term, the company can gain benefits that can strengthen their competitive edge. It is not enough, of course, to select the best supplier or vendor based only on the cost consideration.

2. LITERATURE REVIEW

Many researchers have devoted to develop the method for selecting good vendor. Weber et al. [10] reviewed 74 papers related to the criteria and methods of vendor selection from 21 journals. They gave attention specifically to the criteria and methods used in the vender selection process. According to their review, the linear weighing models were by far the most utilized quantitative approach to vender selection. Narashima [5] used the analytical hierarchical process (AHP) to generate weights for the linear weighing models. Many other papers appeared in the area of vendor selection and the methods varied from integer programming [4] activity-based costing approach [6] and multi-criteria decision making [3], [5], [9] and [11]. Soukup [8] suggested that a vendor performance matrix need to be constructed in order to take into account all the relevant information available to the buying organization.

Using criteria developed by Dickson [2], classifications of vendor selection criteria presented by those papers were made. The five most frequently used factors among 23 factors are (1) net price; (2) delivery; (3) quality; (4) production facilities and capacity and (5) geographic location. It was also noted, as far as those methods were concerned, only a few researchers used quantitative methods such as mathematical programming models and statistical / probabilistic approaches.

3. CASE STUDY

Thai Manufacturing Co. Ltd. is a Thai-Japanese venture and produces compressors for air-conditioners. The company has been operating for four years under the promotion from the Board of Investment of Thailand. With continuous improvement of the quality and constant enhancement of technology, the company has significantly increased as the best supplier of air-conditioning compressor for local market.

There are three kinds of products The first is the small-sized products dedicated for in-room air conditioners. This kind of compressors is compact, light-weight and efficient in energy consumption. The medium-sized products have more capacity than the small ones and are usually applied for the larger size of air conditioners. The last classification is the large size designed for large air-conditioners with high efficiency and reliability.

With high competition in the compressor business, the company strives to constantly improving the competitive advantage. The effort is devoted not only to reducing the price and enhancing the quality of the products, but also to maintaining a firm link among all parties involved, especially the suppliers of raw materials and parts. Currently, there is one major supplier of the metal parts of the products. By employing one supplier, there is a risk associated with cost and availability.

There can be a possible trend that the supplier is not much concerned about quality and cost of his products and there is a risk of material availability in case that the supplier cannot function properly due to the possibility of unpredicted problems. With this idea in mind, the procurement manager and the technical manager work together to find another supplier of metal parts. The main objective is to find a new supplier who has high dependability and low cost. It is expected to lower the material cost because this material cost is around 30% of products' cost. Although the material cost is the main factor, the quality and the processes used to develop the raw material are also related to the cost of production. In addition, the reliability of the vendor supplying the raw material to the factory has to be considered (Dickson, [2]).

Based on the main objective of high dependability and low cost and Dickson's work [2], the following criteria for selection of the vendor are summarized as follows (1) Net Cost; (2) Location of the supplier factory which determines the promptness of the delivery and (3) Process and quality control at the supplier factory. Based on these criteria, only two candidates are selected from 14 potential suppliers. The first is the current supplier, company A, and the new one, company B.

4. RANKING CRITERIA

To rank the two suppliers, the procurement manager and the technical manager of the company utilize a multi-attribute criteria decision making procedure. Three selected main criteria are cost, process and quality control and location. The cost criterion can be easily determined since there is direct information of the cost of the products supplied by both suppliers. Location can be measured based on distance between each supplier to the company.

It is assumed that this distance is linearly correlated to the difficulty of transportation. Process and quality control is a technical criterion of the suppliers. This will give a very important insight into the technical capability of supplying high quality parts. Therefore, it is necessary to discuss with the technical manager the necessary information about process. The factory provides the necessary drawing and detailed working dimensions to the vendor and the vendor has to follow the given set of information to produce the raw material. Therefore, the technical manager provides the following factors as seven sub-criteria of process and quality control based on the historical data.

1. Control of drawings & working standards at the vendor;
2. Machine & tool maintenance;

3. Measuring instrument control;
4. Statistical process control;
5. Information and data control;

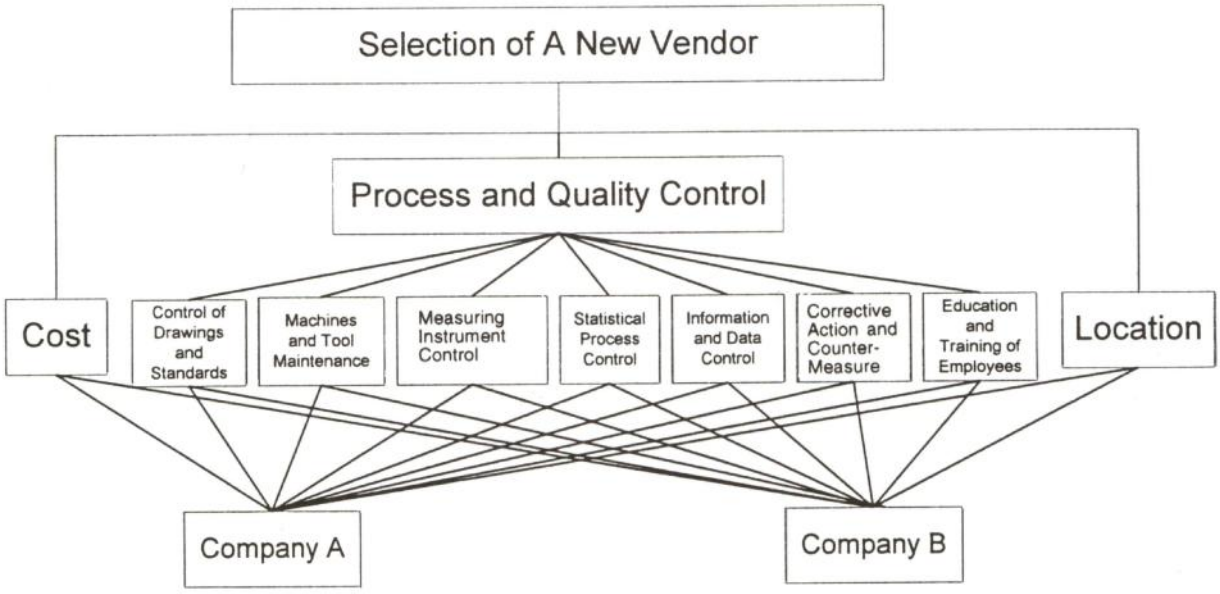

Figure 1 Hierarchical level of vendor selection for using AHP

6. Corrective action and counter-measure handling and
7. Education and training of employees

After finding the most possible criteria, the analysis can be conducted by constructing the Analytical Hierarchical Process (AHP) as shown in Figure 1. Two alternatives are company A and company B.

5. DETERMINATION OF WEIGHTS AND VENDOR RATING

AHP technique is used to determine the weight of each criteria and sub-criteria. Since there are two hierarchy of criteria, there are also two steps of weight calculation. The calculation is based on the pair-wise comparison for each criterion and an integer rating between 1 and 9 is chosen. The selected integer has the following meaning.

1 = Equal importance
3 = Moderate importance
5 = Essential or strong importance
7 = Demonstrated importance
9 = Extreme importance

2, 4, 6, 8 are intermediate values when compromise is needed.

The first step is to determine the weights of the main criteria, i.e cost, process and quality control and location. The plant manager and the technical manager discuss with each other and provide the following weights on the first level of criteria.

	Cost	Process & quality control	Location
Cost	1	3	5
Process & quality control		1	2
Location			1

The numbers in the upper diagonal represent the preference of the managers with respect to the importance of each criterion. From the table, "Cost" criterion is moderately more important than "Process & quality control" criterion and strongly more important than "location" criterion. The other values have similar interpretation. Although the weights can be easily calculated manually [10], EXPERT CHOICE software is applied to calculate the weights as well as to determine whether there is an intolerable inconsistency from the decision maker. The weight of cost criterion is 0.648; process & quality control criterion is 0.230; and location criterion is 0.122. The inconsistency ratio, which is 0.004, is less than the threshold value for 3 criteria. The illustration of the weights as the output of EXPERT CHOICE is shown in Table 2.

For the level 2 comparison, weights for sub-criteria are derived. In this model, there are seven sub-criteria that belong to process & quality control. The technical manager has set the weights based on the historical data of the vendor information and the followings are the weights specified for each sub-criterion calculated from the EXPERT CHOICE software.

1. Control of drawings and work standards 0.12
2. Machine and tool maintenance 0.08
3. Measuring instrument control 0.12
4. Statistical Process Control 0.20
5. Information and data control 0.20
6. Corrective action and counter-measure handling 0.20
7. Education and training of employees 0.08

After weights for all criteria have been obtained, a comparison between alternatives is made with respect to each criterion or sub-criterion. Since there are only two alternatives, the comparison is done via two by two matrix. In terms of cost, the data show that company B's cost is about 3% lower than that of company A. The company A's price is 160 Baht/unit and the price offered by company B is 155.2 Baht/unit. This cost is converted into normalized score without pair-wise comparison matrix. The calculation is as follows:

score of vendor i = (total cost - cost of vendor i) / total cost

where total cost = summation of all individual vendor costs.

In this case, total cost is (160 + 155.2) Baht or equal to 315.2 Baht. The score for company A is 0.492 and company B is 0.508. In terms of location, the data of the distance between the factory and the two vendors will automatically give the score, as it was done for the cost criterion. The distance between the factory and company A is 250 km and the distance between factory and company B is 400 km. For this attribute, the score can be calculated as follows:

Score of vendor i = (total distance - distance of the vendor i)/total distance

Total distance = (250+400) km or 650 km

Thus, the score of company A is 0.615 and the score of company B is 0.385.

The weights for process & quality control criterion of each alternative is done by interviewing the procurement manager regarding the potential knowledge. The data are shown in the following matrices.

1. Control of drawings and work standards:

	Company A	Company B
Company A	1	2
Company B		1

2. Machine and tool maintenances :

	Company A	Company B
Company A	1	
Company B	5	1

3. Measuring instrument control:

	Company A	Company B
Company A	1	
Company B	2	1

4. Statistical process control :

	Company A	Company B
Company A	1	
Company B	5	1

5. Information and data control:

	Company A	Company B
Company A	1	
Company B	3	1

6. Corrective action and counter-measure handling:

	Company A	Company B
Company A	1	
Company B	7	1

7. Education and training of employees:

	Company A	Company B
Company A	1	3
Company B		1

Computation of the scores for each criterion and subcriterion is done by EXPERT CHOICE and the result is presented in Table 2.

6. RESULTS AND DISCUSSION

The weights of the first level criteria indicate that cost dominates the other two criteria, location and process & quality control. This signifies the strong intention

of the company to enhance the competitive advantages in the market by reducing the cost and, consequently, the price of the product. After comparing the performance of the two vendors in terms of cost, their final score is not significantly different, where as company B achieves 0.329 and company A gets 0.319. It can be seen in the EXPERT CHOICE's output table that company B dominates company A in most of the sub criteria belong to process and quality control. The scores of both suppliers with respect to process and quality control are as follows:

Total score of company A = 0.008 + 0.011 + 0.006 + 0.018 + 0.009 + 0.003 + 0.014 = 0.069

Total score of company B = 0.038 + 0.034 + 0.040 + 0.009 + 0.018 + 0.015 + 0.005 = 0.159

This shows that company B is preferable to company A as far as the process and quality control is concerned. In terms of location, company A is preferred to company B since the latter is farther from the current factory. In terms of cost, company B is preferable to company A. When the final judgment is to be made, the overall scores are calculated as follows:

Total score of company A = 0.319 + 0.069 + 0.075 = 0.464

Total score of company B = 0.329 + 0.159 + 0.047 = 0.536

The two final scores are not so much different, although it is clear that the management should consider company B as the main supplier of the metal parts.

Table 2 Sorted details for Synthesis of Leaf Nodes with respect to GOAL DISTRIBUTIVE MODE

LEVEL 1		LEVEL 2		LEVEL 3	
COST	= 0.648			Company B	= 0.329
				Company A	= 0.319
PROCESS CONTROL	= 0.230	Statistical Process Control	= 0.046	Company B	= 0.038
				Company A	= 0.008
		Information and Data Control	= 0.064	Company B	= 0.034
				Company A	= 0.011
		Corrective Action and Counter-measure	= 0.046	Company B	= 0.040
				Company A	= 0.006
		Control of Drawings and Work Standards	= 0.028	Company B	= 0.009
				Company A	= 0.018
		Measuring Instrument Control	= 0.028	Company B	= 0.009
				Company A	= 0.018
		Machine and Tool Maintenance	= 0.018	Company B	= 0.015
				Company A	= 0.003
		Education and Training of Employees	= 0.018	Company B	= 0.005
				Company A	= 0.014
LOCATION	= 0.122	Company A			= 0.075
		Company B			= 0.047

APPENDIX

Notation Definition

COST	-	Cost
LOCATION	-	Location
Company B	-	Alternative 2 - Company B
PRO. CTRL	-	Process and Quality Control
Company A	-	Alternative 1 - Company A
L	-	Local priority : Priority relative to parent
G	-	Global priority: Priority relative to goal

Synthesis of Leaf Nodes with respect to GOAL

DISTRIBUTION MODE

OVERALL CONSISTENCY INDEX = 0.00