AN ANALYTIC HIERARCHY PROCESS APPROACH FOR SUPPLIER SELECTION: A CASE STUDY

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Abstract: Supplier selection is a complex problem involving qualitative and quantitative multi-criteria. A trade-off between these tangible and intangible factors is essential in selecting the best supplier. In this study, an AHP-based supplier selection model applied to improve and assist decision making to resolve the supplier selection problem in choosing the optimal supplier combination. There are four criteria in determining an optimal supplier, which are price, quality, logistic, and service. Information is obtained from the interview, interpreted into simple form and analysed using Microsoft Excel. These data calculated using Pairwise comparison. It is considered to be adequately consistent if the corresponding consistency ratio (CR) is less than 0.1 (<10%) A value of less than 0.1 is good, but the threshold of 0.1 is the rule of thumb. Among three suppliers, supplier C has the highest performance of overall attributes, followed by supplier B and supplier A. Supplier C perform best on two criteria logistic and service, supplier B perform best towards price and supplier A perform best on price.

Keywords: Analytic Hierarchy Process (AHP), Supplier Selection.

1. Introduction

In today’s competitive environment, an effective supplier selection is very important to the success of any manufacturing organization to create and increase competitive advantages (Liu and Hai, 2005). One of the strategies preferred is a strategy of few dedicated suppliers that have a long-run communication (Chandra and Kumar, 2000). Advantages for having few relative suppliers can create value to the buyer and be able to produce both lower transaction and production costs (Koh et al., 2007).

Choosing the right supply chain and synchronizing through collaborative design are critical factors to achieve supply chain effectiveness and efficiency (Anderson, D. L. and Lee, 2000). Often, selecting the suitable supplier is always hard for buyers. Suppliers have varied strengths and weaknesses, which require careful assessment by the purchasers before ranking, can be given to them. Usually the considerable aspect of the purchasing function is supplier selection criteria. Vendor selection process could be simple if and only if one criterion was used in the decision making process. However in many situations, purchasers have to into consideration of a range of criteria in making their decisions. If few criteria are used then it is necessary to determine how far for each criterion influences the decision making process, whether if all are to be equally weighted or by chances the influence varies accordingly to the type of criteria (Yahya & Kingsman, 1999). Seamlessly, the lack of metrics or inappropriate metrics for evaluating performances may hinder further improvement of supply chain performance.

A short interview with the company revealed that, the company is often troubled with which supplier to select. There are a lot of decision to reconsider upon receiving a project from customer, different suppliers has different value to the company. Careful assessment had to be given to make sure both party comes to a win-win situation. Any wrong choices will influence the decision making, misleading the company to bad reputation and financial damage. Thus this research is to identify potential supplier for various outsourced components to meet its supplier selection criteria based on AHP.

This paper is organized as follows. Material and Methods provides some definition and background of supplier development and selection, AHP and methodology. Data analysis details the pairwise comparison result. While the conclusion section, concludes the paper.
2. Material and Methods

This study has used the data collected from a manufacturing factory specialized in factory automation facilities, conveyor systems, lifting equipment, automatic warehousing, and automatic sorting systems. Currently the company has been exporting to Singapore, Indonesia, Thailand, Vietnam and Philippines. There are a lot of products produced from the company. The study focused on sensor product only.

In the operations management, major in supply chain management literatures, the majority of studies focus on the purchasing of manufactured goods or raw materials (Ellram et al., 2004). Generally, one important stage in the decision making process for organizational purchasing is to determine the decision criteria against which of the potential service providers to be assessed.

2.1 Supplier Development

Studies of academic literature shows in this area of concern have a way long history in North America. Doctoral dissertation concerning this domain has published as early as back 1965 (Leenders, 1965). Soon after Leenders (1966) article reports on the supplier development activities in Canada industrial firm, years later when the business environment starting to pay more attention on quality management issues, supplier development appears as a prominent method.

Krause, et al. (1998) described it into a collective of ten-step approach from identification of critical commodities for development to the systematic and continuous improvement. Direct supplier development involves activities such as on-site consultation, education and training programs, temporary personnel transfer, inviting the supplier’s personnel, including the provision of equipment or capital (Krause, 1997; Krause et al., 2000; Monczka et al., 1993). Despite, direct supplier development still posit problems concerning the potential for opportunistic behavior on behalf of the supplier. Thus, the firm must defend its investment-specific supplier by establishing long-term relationships.

2.2 Supplier Selection

For the last few decades, supplier performance measurement has been an important research area for researchers as well as practitioners (Giannakis, 2007; Ryu et al., 2009). In the current business nature, suppliers are playing an important role in improving the competitiveness and efficiency of supply chains (Park et al., 2010).

Formerly, buyers used to evaluate the performance of suppliers (Slobodow et al., 2008). But things were different, now the evaluation of supplier alone is not sufficient enough to improve the performance and to build a long-term relationship (Cousins et al., 2008). Essig and Amann (2009) have mentioned that without measuring supplier selection, it is very difficult to maintain successful buyer-suppliers relationships.

Supplier’s performance rating is a key criterion in the selection process. Once a pool of potential source is accepted in, requests for quotations are sent out, negotiations conducted, and specific suppliers are selected. For the present, contractor’s trend is to reduce the supplier base and mean time the percentage of purchased materials becomes vast (Benton and McHenry, 2010).

2.3 Analytic hierarchy process: a tool for multi-criteria decision analysis

Dickson (1966) was one of the original studies in the supplier selection area. Majority of the studies initially applies results of Dickson’s study as guidance, foundation and recommended various techniques for ranking of these attributes include : Categorical method, Linear weighted average method, Cost-ratio method, Vendor profile analysis, Vendor rating with AHP, Dimensional analysis, Data envelopment analysis (DEA), Cluster analysis, Artificial intelligence-based models, Taguchi loss function method and Hybrid methods. A part of that, Multiple Criteria Decision Making (MCDM) involves finding the best opinion out of all feasible alternatives in the presence of multiple, usually complex, decision criteria. Priority- based, outranking, distance-based, and mixed methods are usually the primary approaches
One of the most widely used MCDM approaches is the AHP and it has been successfully applied to many practical problems (Saaty, 2003). It also provides a well-founded and comprehensible solution which makes decisions credible especially in teams or groups decision making in supplier selection (Politis, et.al 2010).

Essentially, AHP allows decision makers to measure the consistency in each judgment. Instead of requiring perfect consistency in judgment, AHP provides an acceptance tolerance level for the degree of inconsistency. This is especially suitable for complicated decision issues in which the large number of information (technical, social, environmental) aspects must be taken into consideration. It ascertains that the decision maker is reliable in rating the relative importance of the criteria.

AHP is used to determine the relative priorities weights to be assigned to different criteria and alternatives that characterize a decision (Lin and Yang, 1996). This method divides a complicated system under study into a constructive hierarchical system of elements. To proceed with this method, first it is necessary for the researcher to identify the qualitative and quantitative criteria of the company mainly focused on. With the available criterion next, the respondent weights each criterion using a rating scale “Not important (1 to 3)”, “Some-what important (4 to 5)”, “Important (6 to 7)” and “Very important (8 to 9)” and priority weights of the criteria were determined using pairwise comparisons. Last, the optimal supplier will be selected after a stage of evaluation.

Although AHP has been used in many applications of the public and private sectors, Hartwich (1999) noted several limitations. One, AHP was criticized for not providing sufficient guidance about structuring the problem to be solved, forming the levels of the hierarchy for criteria and alternatives, and aggregating group opinions when team members are geographically dispersed or are subject to time constraints. Team members may carry out rating items individually or as a group. As the levels of hierarchy increase, so does the difficulty and time it takes to synthesize weights.

### 2.4 AHP model for Supplier Selection

Various factors have been used as criteria for supplier selection including price, delivery performance, reputation in the industry, size of capacity, geographical location, quality, environmental compliance, lead-time, packaging, transportation storage, and product development. The details of the assessment criteria based on previous study are provided in Table 1.

<table>
<thead>
<tr>
<th>Author</th>
<th>Price</th>
<th>Quality</th>
<th>Delivery</th>
<th>Performance</th>
<th>Capacity</th>
<th>Service</th>
<th>Reliability</th>
<th>Time</th>
<th>Relationship</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dickson (1966)</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welber, Current and Benton (1991)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zhang, Lei, Cao, Ng (2003)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tullous and Munson (1991)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bross and Zhao (2004)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Pullman (1998)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Meanwhile, the criteria that company applied for supplier selection is price, quality, logistic and service. Although the criteria selected is limited, it is important to purchasers have to take into account of a range of criteria in making their decisions (Farzad et al., 2008). If limited criteria used, it is necessary...
to determine how far for each criterion influences the decision making process, whether if all are to be equally weighted or by chances the influence varies accordingly to the type of criteria (Yahya & Kingsman, 1999).

Figure 1 : AHP model

Figure 1 shows AHP model for this study that consists of there levels. At the top level is the goal of the model followed by criteria at level two, while various suppliers at the level three is an alternatives. The goal of this study is to identify potential supplier for various outsourced components to meet its supplier selection criteria based. The four criteria selected are price, quality, logistic and service. At the alternatives level, there are three suppliers to be evaluated in order to select best supplier.

2.5 Methodology

Interviews are one of the main instruments in this research where conversation is triggered between two or more people to obtain information from the interview. After the interview is conducted, all data are then analyzed using Microsoft Excel. All the primary data collected through the interview are then interpreted into understandable, easy and simple form. These data will be calculated using Pairwise comparison. It is considered to be adequately consistent if the corresponding consistency ratio (CR) is less than 0.1 (<10%) (Saaty, 1980) A value of less than 0.1 is good, but the threshold of 0.1 is the rule of thumb.

3. Result and Discussion

A four-point rating scale was designed, and priority weights of the criteria were determined using pairwise comparisons. The AHP evaluation process was conducted after interviewing two department managers of purchasing and engineering. A program written in Microsoft Excel has been developed to aggregate evaluators’ judgments and calculates the weights as shown in table 2.
After obtaining the pair-wise judgments in table 2, the next step is the computation of a vector of priorities or weighting of elements in the matrix. In terms of matrix algebra, this consists of calculating the priority vector (eigenvector) of the matrix by adding the members of each column to find the total. In order to normalize each column to sum to 1.0 or 100%, divide elements of that column by the total of the column and sum them up.

<table>
<thead>
<tr>
<th>Table 2: Pairwise comparison matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Criterion</strong></td>
</tr>
<tr>
<td><strong>Price</strong></td>
</tr>
<tr>
<td><strong>Service</strong></td>
</tr>
<tr>
<td><strong>Quality</strong></td>
</tr>
<tr>
<td><strong>Logistic</strong></td>
</tr>
</tbody>
</table>

Finally, add the elements in each resulting row and divide this sum by the number of elements in the row to get the average. The results (priority vectors) are that the attributes have the following approximate priority weights: Price (0.097), Service (0.487), Quality (0.286), and Logistic (0.130) as shown in calculation 1.0.

<table>
<thead>
<tr>
<th>Table 3: Normalized matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Criterion</strong></td>
</tr>
<tr>
<td><strong>Price</strong></td>
</tr>
<tr>
<td><strong>Service</strong></td>
</tr>
<tr>
<td><strong>Quality</strong></td>
</tr>
<tr>
<td><strong>Logistic</strong></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>

The consistency ratio ($C_r$) is vital to test the level of acceptance. Using existing data in table 1 and priority vector calculation (1.0), the calculation of weighted sum for the four priority criterion is shown. Estimating the consistency ratio ($C_r$) as shown in calculation 1.1.

\[
P_{\text{Priority Vector}} = \frac{1}{4} \left[ \begin{array}{ccc}
0.1 + 0.174 + 0.055 + 0.059 \\
0.3 + 0.522 + 0.655 + 0.471 \\
0.4 + 0.174 + 0.218 + 0.353 \\
0.2 + 0.130 + 0.073 + 0.118
\end{array} \right] = \left( \begin{array}{c}
0.097 \\
0.487 \\
0.286 \\
0.130
\end{array} \right)
\]

The consistency ratio ($C_r$) is vital to test the level of acceptance. Using existing data in table 1 and priority vector calculation (1.0), the calculation of weighted sum for the four priority criterion is shown. Estimating the consistency ratio ($C_r$) as shown in calculation 1.1.

\[
\begin{bmatrix}
1 \\
3 \\
4 \\
2
\end{bmatrix}
\begin{bmatrix}
0.333 \\
1 \\
0.333 \\
0.25
\end{bmatrix} + \begin{bmatrix}
0.25 \\
3 \\
0.333 \\
0.333
\end{bmatrix} + \begin{bmatrix}
0.5 \\
4 \\
0.13 \\
1
\end{bmatrix} = \begin{bmatrix}
0.396 \\
2.156 \\
1.227 \\
0.541
\end{bmatrix}
\]
Lambda Max ($\gamma_{\text{max}}$) is the maximum eigenvalue of the matrix and it is needed in order to calculate Consistency Index (CI). To find Lambda Max ($\gamma_{\text{max}}$), first dividing all the elements of the weighted sum matrices by priority vector for each criteria.

\[
\begin{align*}
\frac{0.396}{0.097} &= 4.082 \\
\frac{2.156}{0.487} &= 4.427 \\
\frac{1.227}{0.286} &= 4.290 \\
\frac{0.541}{0.130} &= 4.162
\end{align*}
\]

Then compute the average of these values to obtain $\gamma_{\text{max}}$

\[
\gamma_{\text{max}} = \frac{(4.082+4.427+4.290+4.162)}{4}
\]

\[
= 4.240
\]

Due to the fact that pairwise comparisons are done in a subjective way, it is important that a consistency check is done. The calculation of the Consistency Index (CI) includes following calculation

\[
\text{CI} = \frac{\gamma_{\text{max}} - n}{n-1} = \frac{4.24-4}{3} = 0.08
\]

\[n = \text{numbers of criteria}\] (1.4)

<table>
<thead>
<tr>
<th>Size of matrix</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random consistency</td>
<td>0</td>
<td>0</td>
<td>0.58</td>
<td>0.9</td>
<td>1.12</td>
<td>1.24</td>
<td>1.32</td>
<td>1.41</td>
<td>1.45</td>
<td>1.49</td>
</tr>
</tbody>
</table>

Selecting an appropriate value of random consistency ratio (RI), for a matrix size (numbers of criteria) of four using Table 4, R1 =0.9. Therefore the consistency ratio $C_r$ is as follows

\[
C_r = \frac{\text{CI}}{\text{RI}} = \frac{0.08}{0.9} = 0.08898
\]

As the value of $C_r$ is less than 0.1, the judgment is acceptable.

Evaluating the alternative suppliers according to the used model to select the best supplier is the next step. The pairwise comparison matrix of each alternative can be obtained through multiplying the global weights by the local weights of each alternative. The calculations of the global weights in relative to cost (price) between the three suppliers in the company are shown in table 5.
Table 5: Pairwise comparison matrix of three suppliers with respect to price

<table>
<thead>
<tr>
<th>Price</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>0.333</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>0.25</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 6 shows the weighted sum of pairwise comparison matrix indicated in Table 5. For example the weighted sum of column one is 5 follow by 1.583 and 6.

<table>
<thead>
<tr>
<th>Price</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>0.333</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>0.25</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1.583</td>
<td>6</td>
</tr>
</tbody>
</table>

In order to normalize each column to 1.0 or 100%, divide elements of that column by the total of the column and sum it up. Table 7 shows the normalized judgments of supplier A, B, and C.

<table>
<thead>
<tr>
<th>Price</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.2</td>
<td>0.210</td>
<td>0.167</td>
</tr>
<tr>
<td>B</td>
<td>0.6</td>
<td>0.632</td>
<td>0.667</td>
</tr>
<tr>
<td>C</td>
<td>0.2</td>
<td>0.158</td>
<td>0.167</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

As shown before in evaluating the criterion, priority vector is necessary after normalization to calculate the weighting of elements in the matrix. Calculation is shown below:

Prioritization vector for the suppliers respect to price

\[
\text{Supplier A} = \frac{(0.2 + 0.210 + 0.167)}{3} = 0.192 \\
\text{Supplier B} = \frac{(0.6 + 0.632 + 0.667)}{3} = 0.633 \\
\text{Supplier C} = \frac{(0.2 + 0.158 + 0.167)}{3} = 0.175
\]

Estimating the consistency ratio (C_r)

\[
0.192 \begin{pmatrix} 1 \\ 3 \\ 1 \end{pmatrix} + 0.633 \begin{pmatrix} 0.333 \\ 1 \\ 0.25 \end{pmatrix} + 0.175 \begin{pmatrix} 1 \\ 4 \\ 1 \end{pmatrix} = \begin{pmatrix} 0.578 \\ 1.909 \\ 0.525 \end{pmatrix}
\]

Dividing the elements of the weighted sum matrices by their respective priority
Then compute the average of these values to obtain

\[
\gamma_{\text{max}} = \frac{(3.010 + 3.016 + 3)}{3} = 3.009
\]

(1.9)

\[
C_{I} = \frac{\gamma_{\text{max}} - n}{n-1} = \frac{3.009 - 3}{2} = 0.0045
\]

(1.10)

RI=0.58 for a matrix size of three, Consistency ratio (C\text{r}) as follow

\[
C_{r} = \frac{C_{I}}{R_{I}} = \frac{0.0045}{0.58} = 0.0078
\]

(1.11)

As the value of C\text{r} is less than 0.1, the judgments are therefore acceptable.

Table 8 illustrates the priority of four criterion with respect to supplier A, B, and C.

<table>
<thead>
<tr>
<th>Price</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>P.V</th>
<th>(\gamma_{\text{max}})</th>
<th>Cl</th>
<th>R\text{I}</th>
<th>C\text{r}</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>0.333</td>
<td>1</td>
<td>0.192</td>
<td>3.009</td>
<td>0.0045</td>
<td>0.58</td>
<td>0.0078</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>0.633</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>0.25</td>
<td>1</td>
<td>0.175</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>P.V</th>
<th>(\gamma_{\text{max}})</th>
<th>Cl</th>
<th>R\text{I}</th>
<th>C\text{r}</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>2</td>
<td>0.5</td>
<td>0.297</td>
<td>3.009</td>
<td>0.0045</td>
<td>0.58</td>
<td>0.0078</td>
</tr>
<tr>
<td>B</td>
<td>0.5</td>
<td>1</td>
<td>0.333</td>
<td>0.164</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>0.539</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 9: Developing an overall priority ranking

<table>
<thead>
<tr>
<th>Quality</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>P.V</th>
<th>$\gamma_{max}$</th>
<th>CI</th>
<th>RI</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>0.525</td>
<td>3.053</td>
<td>0.0265</td>
<td>0.58</td>
<td>0.0457</td>
</tr>
<tr>
<td>B</td>
<td>0.333</td>
<td>1</td>
<td>0.333</td>
<td>0.142</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0.5</td>
<td>3</td>
<td>1</td>
<td>0.334</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Logistic</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>P.V</th>
<th>$\gamma_{max}$</th>
<th>CI</th>
<th>RI</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>1</td>
<td>0.25</td>
<td>0.167</td>
<td></td>
<td>3</td>
<td>0</td>
<td>0.58</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>1</td>
<td>0.25</td>
<td>0.167</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>C</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>0.667</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 9: Developing an overall priority ranking

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Price</th>
<th>Service</th>
<th>Quality</th>
<th>Logistic</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.192</td>
<td>0.297</td>
<td>0.525</td>
<td>0.167</td>
<td>0.335123</td>
</tr>
<tr>
<td>B</td>
<td>0.633</td>
<td>0.164</td>
<td>0.141</td>
<td>0.167</td>
<td>0.203305</td>
</tr>
<tr>
<td>C</td>
<td>0.175</td>
<td>0.539</td>
<td>0.334</td>
<td>0.667</td>
<td>0.461702</td>
</tr>
</tbody>
</table>

Based on global priority, weights of each alternative can be evaluated and summarized. The summaries of overall attributes are shown in Table 9. According to the AHP tools developed in this study, supplier C’s score (0.461702) is greater, followed by supplier A (0.335123) and supplier B (0.203305).

Further analysis in Figure 2, shows details on each criteria performances. Supplier A perform best on price, supplier B perform best towards price and supplier C perform best on two criteria logistic and service. There is no suppliers that perform equally well on all four criteria.

![Figure 2: Performance of supplier with respect to criteria](image)
4. **Conclusion**

This study is to identify potential supplier for various outsourced components to meet its supplier selection criteria based on AHP. The criteria selected are; price, quality, logistic and service. There are three suppliers for the product Z. The finding shows none of the supplier perform equally well on all four criteria. Supplier A perform best on price, supplier B perform best towards price and supplier C perform best on two criteria logistic and service.

The main contribution of the work was the identification of the important criteria for the supplier selection process. Then a multi-criteria decision model for evaluating and selecting a supplier was developed. Once the criteria is identified, selection the right supplier will be much more convincing. This is because AHP makes smaller adjustment a decision maker may not consider. A small breakthrough may mislead the company to make wrong decision.

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**References**


