

Supplier Selection Antecedents in Furniture Manufacturing Industry Using Analytic Hierarchy Process

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Abstract

Selecting the right supplier are critical to help reduces purchasing costs, improves competitiveness in market and enhances end user satisfaction. Therefore, the objective of this study is to determine the ideal criteria of supplier for furniture manufacturing industry using Analytical Hierarchy Process (AHP) model. This quantitative study method is carried out by distributing questionnaires to 49 respondents in SMEs furniture manufacturing industries and the data analyzed using Expert Choice Software to rank the supplier selection criteria. The result shows that the ideal criteria for supplier selection are ranked by quality, delivery, service and cost. Other SMEs furniture manufacturing possibly referred this outcome when sort out a decision making for ideal supplier selection.

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1. Introduction

Over the years, Malaysia Furniture industry has experienced dynamic transformation from a traditional process to a technological operation. Malaysia Furniture industry is targeting to be among the world's top five furniture exporters in 2022[1] was the 10th largest exporter of furniture in the world through exporting over RM9.14bil worth of furniture to more than 160 countries [2]. The type of furniture exported are for kitchen, bedroom, office, upholstered wooden frame and garden or outdoor [3].

Ratnasingam [4] indicate that, large proportions of the furniture manufacturers are located in western region of Peninsular Malaysia. Since this study will focus on furniture manufacturing company in Batu Pahat that stated as third largest furniture manufacturing industry in Johor, there are 49 SMEs Furniture manufacturing company registered under Johore State Investment Centre (JSIC) in Batu Pahat, Johor[5].

Manufacturing industry requires high level of agility and flexibility of the suppliers; hence the right selection of supplier becomes more complicated [6] for instance, to determine the best suppliers and to assure long term

Feasibility of an organization, accurate decision making strategies is essential for purchasing raw materials [7]. Moreover, different company may have different organizational and cultural background which may also affect the supplier selection process [8]. Since supplier selection critical in industries where wooden work is intensively used, poor decision made may experience dramatic results in terms of quality, flexibility and productivity [9]. Even though adoption of ISO certification (ISO 9000 quality management) among wooden furniture suppliers able to improve their overall performance, the application is limited [10]. These can be improved with a correct guideline and sufficient dimensions of supplier's criteria in supplier selection process to determine a suitable supplier and in order to build more effective relationship with suppliers [11]. Thus, effective supplier evaluation and purchasing processes are critical success factors for an organization[12].

Supplier selection process previously has been based solely on price criterion, which resulted in companies engaging many short term agreements with suppliers with the lowest price quotation [13]. These impacted on the every task of operational decisions to strategic decision

and its process of supplier selection is usually devised with multiple criteria decision problem [14]. Furthermore, selecting the right supplier significantly reduces purchasing costs, improves competitiveness in the market and enhances end user satisfaction [15]. Therefore, this study identified the ideal criteria of supplier selection in SMEs Furniture manufacturing industry. Since AHP is popular for problem of evaluating and selecting suppliers [6]; [8]; [9]; [11]; [15]; [16]; [17]; [18]; [19]. Thus, this study aims using AHP model to rank the ideal criteria of furniture manufacturing industry.

The remainder of this paper is organized as follows. In Section 2, supplier selections' antecedents from previous study, overviewed. In Section 3, AHP applied to considering several evaluation criteria. The results and discussions are presented in Section 4.

2. Material and Methods

In Malaysia, furniture manufacturers can be categorized into four groups [18]; industries that operating conventionally in the furniture village (micro), industries that recognized and functioning outside the furniture village (small), local owned manufacturing companies (medium) and joint venture or foreign owned (large). Small and medium scale industries can be classified as micro with sales turnover less than RM 300,000 or number of employee is less than 5. Small scale industries generate revenue in between RM 300,000 to 15 million or numbers of full time employees between five to 75 people. Meanwhile, medium and large manufacturing company is a medium industry with sales turnover between 15 million to 50 million or number of employees about 75 to 200 staff. Lastly, a large manufacturing company has revenue more than 50 million or more than 200 employees. Table 1 shows the characteristics of the each group.

Table 1: Industrial Classification of Malaysian Furniture Manufacturers [20]

Industrial Classification	Sales turnover (RM)	Number of full time employees
Micro	< 300,000	< 5
Small	> 300,000 ≤ 15 million	5 ≤ 75
Medium	> 15 million ≤ 50 million	75 ≤ 200
Large	> 50 million	> 200

Furniture manufacturing in Malaysia regardless different classification, implement one of these manufacturing strategies identified as Original Equipment

Manufacturer (OEM), Original Design Manufacturer (ODM) and Original Brand Manufacturer (OBM). The descriptions for each strategy show in table 2. OEM strategy or namely contract-manufacturing has implemented widely in Malaysian and contribute almost 77% of the total production volume [4]. However, the key player in the furniture industry moving forward to ODM [21] and with latest technology advancement has enables industry players to swiftly diversify from being merely (ODM) player to become an (OBM) player [22].

The previous study done by researchers have listed out some general supplier selection criteria that always preferred by the industry which are cost ([8]; [11]; [16]; [17]; [18]; [19]; [22]);, service ([8]; [11]; [16]; [17]; [19]; [22]), quality ([8]; [11]; [16]; [17]; [18]; [19]; [22]), delivery ([8]; [11]; [16]; [17]; [18]; [19];)

Table 2: Malaysia Furniture Manufacturing Strategies [4]

Manufacturing Strategies	Descriptions
Original Equipment Manufacturer (OEM)	Manufactures products or components under contract for another company or retailer, under the purchasing company's brand name.
Original Design Manufacturer (ODM)	A company which designs and manufactures a product which is specified and eventually branded by another firm for sale. Such companies allow the brand firm to produce (either as a supplement or solely) without having a manufacturing outfit.
Original Brand Manufacturer (OBM)	Typically a company that sells an entire product made by a second company, as its own branded product.

Generally the cheapest one will be preferred in every industry in order to earn at higher profit and although a low price never define a best product, the cost criteria is always identify as important criteria which associate in process of procurement in an organization [24]. Supplier's service performance such as ease of communication, technical support, capability, warranty and claim policy and responsiveness usually evaluated subjectively [25]. Meanwhile, a good quality product with satisfy meets the minimum standards and the requirements of the customer [8]. Last but not least, the compliance of supplier to make delivery schedule is important criteria to measure supplier. The delivery's criteria comprise supplier's on-time delivery, good packing, order fulfillment lead time, reliable delivery method and delivery location.

This quantitative research approach is carried out by distributing questionnaires to 49 respondents of SMEs furniture manufacturing industries in BatuPahat, Johor, Malaysia that has authority to select the supplier. This is due to furniture manufacturers are highly concentrated in Johor [4] and BatuPahat has stated as third largest furniture manufacturing industry in Johor [5]. The data analyzed using AHP Expert Choice Software to rank the supplier selection criteria. There are three phases of AHP, which are *decomposition*, *comparative judgement* and *priority synthesis* [26].

Phase 1: *Decomposition* phase.

The problem is decomposed into a hierarchy of goal and criteria as shown in figure 1.

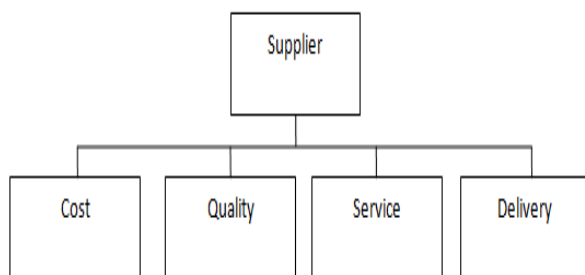


Figure 1: AHP model

Phase 2: The next phase is *comparative judgement* at each level based on the customer's preference from the numerical ratings of pair wise comparison. The AHP questionnaire was designed using a scale of 1 to 9: 1 = equal importance; 3 – moderately more important; 5 - strongly more important; 7 - very strongly more important; 9 -extremely more important; 2, 4, 6, 8 - intermediate values, as suggested by Saaty[27]. Respondents were given a number of tables regarding the criteria of supplier selection in furniture manufacturing industry. Respondents were then given the numerical scale against which to rank their preferences on criteria influencing the selection of furniture manufacturing supplier that offer them the most value-added.

The data from the questionnaires were then transformed into comparative judgements and subjected to pair wise comparison to be analysed. The pair wise comparisons of various criteria generated are organized into a square matrix.

Let $C = \{C_j | j = 1, 2, \dots, n\}$ be the set of criteria. Equation (1) is the pairwise comparison shown by a square and reciprocal matrix.

$$A = a_{ij} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \quad (1)$$

Phase 3: *Priority synthesis* calculated a composite weight for each criterion and sub-criterion based on the preferences obtained from the previous phase. The technique in weight determination used is known as the eigenvalues method. The principal eigenvalue and the corresponding normalized right eigenvector of the comparing matrix give the relative importance of the

various criteria being compared. The elements of the normalized eigenvector are termed weights with respect to the criteria or sub-criteria and ratings with respect to the alternatives. Equation (2) showed formula of each matrix that needs to be normalized. The priority rankings for all criteria are presented to form the overall results of the study.

$$A_w = \lambda_{max} \cdot W \quad (2)$$

Saaty[27] demonstrated that $\lambda_{max} = n$ is a necessary and sufficient condition to check the consistency of judgements. Inconsistency may arise when λ_{max} deviates from n due to varying responses in the pairwise comparisons. Therefore, the matrix A should be tested for consistency by using the equation of (3) and (4).

$$CI = \frac{(\lambda_{max} - n)}{(n-1)} \quad (3)$$

$$CR = \frac{CI}{RI} \quad (4)$$

CI is the consistency index while RI is a random index generated for a random matrix of order n [27]. The CR value must less than 0.1 in order to accept the judgments. CR that larger than 0.10 indicates that judgments are too close to comfort the randomness and required to omit or recollect the data.

3. Result and Discussion

The questionnaires were collected from 49 SMEs furniture manufacturing Industry in BatuPahat that distributed by e-mail, and by hand. However, only 45 questionnaires returned and all the respondents met the consistency ratio with less than 0.1, shows that trustworthy and acceptable for further analysis. The majority job position of the respondents are from purchasing department, which consists of 21 respondents (58.2%), 14 respondents (38.9%) in the middle management and only 1 respondent (2.8%) is managing director. Distribution of respondents' gender is 77.8 per cent male and 22.2 per cent female.

Even though there are four groups of SMEs furniture manufacturing classified by [18], only two types established at BatuPahat which are small and medium enterprise. Table 5 shows comparison the average weight for Small Enterprise, Medium Enterprise and both between criteria that influencing the selection of furniture manufacturing supplier. Results revealed that quality is the highest ranking, followed by delivery, service and cost. This shows that quality is the main criterion that manufacturer considered when selecting supplier.

Table 5: Comparison the average weight between all main criteria

Ranking	Criteria	Small Enterprise	Medium Enterprise	SME
1	Quality	0.412	0.407	0.409
2	Delivery	0.237	0.234	0.235
3	Service	0.203	0.214	0.212

4	Cost	0.148	0.144	0.145
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Results show obviously that quality is the most priority criteria among all. This finding is similar with [22],[11], [8], [23] and [24] who indicated that quality criteria is the most importance criteria that considered when selecting their supplier. Next, delivery criteria were ranked as second placeto show that, time delivery is important in production line and may affect scheduled. Authors of [16],[17],[11],[8],[23] and[24] also obtained the same result. However, service and cost were ranked third and fourth place. According to the perspectives of SMEs enterprises, service and cost were the last two considerations among all criteria which they would not much emphasized. This is hence due to reasons the reduction on cost or discount may not give much effect on production where they could earn more if the production department produced satisfied result with well end product.

4. Conclusion

This study provided useful information and reference of selecting ideal supplier for furniture manufacturing company. The objective of this study is to determine the ideal criteria of supplier for furniture manufacturing industry using Analytical Hierarchy Process (AHP) model. Collected questionnaires of 45 furniture manufacturers at BatuPah at, Johor, Malaysia analyzed by using Expert Choice Software. The ideal supplier criteria ranked by quality, service, cost and delivery. It shows that, quality of the material is priority in furniture industry, meanwhile delivery of material is substantial to ensure production is operation as per scheduled. Moreover, services given by the supplier is less contributed to be an ideal selection and although cost of raw materials is critical to determine the cost of total product, cost criteria ranked in fourth place. This is could be due to the economical raw material price. The study cannot be generalized to the entire SMEs furniture manufacturing in Malaysia since a survey was conducted among furniture manufacturer in BatuPahat, Johor areas only. Future study should be conducted in a representative sample of the SMEs furniture manufacturing in Malaysia for a better understanding of ideal supplier selection criteria.

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