

## **SUPPLIER SELECTION CRITERIA IN A POWER UTILITY IN MALAYSIA: ENGINEERS' PERCEPTIONS**

**Sivadass Thiruchelvam<sup>1</sup>, John E. Tookey<sup>1</sup>, Don Amila Sajeewan Samarasinghe<sup>1</sup>,  
Quik Wee Hock<sup>1</sup> and Kamal Nasharuddin Mustapha<sup>2</sup>**

<sup>1</sup>Auckland University of Technology, New Zealand

<sup>2</sup>Universiti Tenaga Nasional, Malaysia

Email: [sivadass.thiruchelvam@aut.ac.nz](mailto:sivadass.thiruchelvam@aut.ac.nz)

### **ABSTRACT**

Supplier selection of electricity generating, transmitting and distributing systems is part of the problem-solving environment in a power utility because it is a long-term investment for the organisation. Therefore, the decision over supplier selection directly influences the operational and financial position of a power utility. In addition, the supplier selection of a power-related system is a complex multi-criteria decision problem. While some criteria may be common across different industries, there are some criteria unique to the power industry. This research aims to understand what constitutes the suitable supplier selection criteria for a power utility. This study reveals some interesting findings of how engineers perceive the importance of each criterion and suggests strongly that product quality, price and delivery are key determinants in the supplier evaluation process. The eighteen criteria considered for this study were mapped onto their respective cluster, namely: supplier's organisational system and technology, buyer-supplier relationship and economic value. The findings of this study should assist various groups of stakeholders (e.g., suppliers, buyers and end users) to gain a better understanding of social behaviour in making purchase decisions, particularly with regard to power utilities.

**Keywords:** Procurement; evaluating purchasing performance; supplier selection; case study; statistical analysis

### **INTRODUCTION**

Sourcing from the right suppliers ensures business growth and prosperity. In this current climate of economic uncertainty, evaluation with due diligence of suppliers in the electricity supply industry is becoming increasingly crucial to business-related success. There are three main components to the industry: generation, transmission and distribution, which involve purchasing goods and services required for set-up of new installations, as well as maintenance, repair and operations (MRO). The consequences of poor decision-making become increasingly severe as organisations become ever more dependent on their supplier's performance. In industrial companies, the purchasing share of total turnover is typically 40% to 80% (Karthik, 2006) and therefore, decisions about purchasing strategies and operations are primary determinants for reducing costs and increasing profits. Additionally, globalisation and advances in information technology provide more alternatives for supplier selection. Advanced computer models that permit more data input in decision-making, coupled with an increasing number of decision makers, result in the increased complexity of purchasing decisions (Erdem & Göçen, 2012). The advent of corporate governance places a greater emphasis on an

organisation's accountability by having transparent, internal "key measures" to protect its long-term success. One example of an internal key measure in a newly directed, long-term focused supply chain is a process called strategic sourcing (Cavinato, Flynn, & Kauffman, 2006). These advances necessitate a more 'systematic' and 'transparent' approach to supplier selection decision-making (De Boer, Labro, & Morlacchi, 2001).

The objective of decision-making is influenced by the selection criteria (Tan, Lee, & Goh, 2012). Supplier selection based solely on the criterion of price is no longer relevant in current supply chain management practices (Cebi & Bayraktar, 2003). The supplier selection literature has accepted price, delivery, support services, and product quality as the primary criteria for evaluating supplier performance (Sen, Basligil, Sen, & Barali 2008). However, Dickson (1966) contended that there are twenty-three preferred criteria inclusive of those previously mentioned. Bharadwaj (2004) highlights that the primary criteria vary by industry and that most of the relevant research has been conducted in the manufacturing sector. In addition, it is interesting to note that the ranking of the organisational set criteria might not always be in congruence with the view of purchasing executives. These two key points set the premise for this study in the context of the Malaysian electricity supply industry. Identification of suitable supplier selection criteria should be an important step towards enabling a transparent supplier selection process in a power utility. As part of the on-going study to capture the engineers' perceptions of suitable supplier selection criteria for developing a decision-making predictive model, the results of a questionnaire survey are presented. The findings of this study show that engineers primarily emphasise product quality as the key criterion followed in descending order by delivery, price, support service, safety awareness and performance history. Initially, this paper presents a review of the selection criteria and thereafter, an assessment of the methodological situation of the study is undertaken. Finally, conclusions are drawn based on the findings of the research.

## **THEORETICAL BASIS AND HYPOTHESIS DEVELOPMENT**

The theoretical basis for the construct of organisational buying can be derived from social exchange theory. The underlying premise of social exchange theory is that the reciprocal exchange made by two parties in terms of the benefits and costs (Taylor, Peplau, & Sears, 2002) is built upon trust, loyalty and mutual commitments (Cropanzano & Mitchell, 2005). Transferred to business exchange relationships, a buyer will be obligated to appraise the supplier appropriately upon meeting the criteria set for a particular purchase (Narasimhan, Nair, Griffith, Arlbjørn, & Bendoly, 2009). A supplier who is able to exceed the buyer's expectations in these pre-defined criteria is more likely to be retained for future transactions (Bharadwaj, 2004). The supplier selection literature has traditionally held that price, quality, delivery and service are the preferred criteria in selecting suppliers. However, criteria used for assessing alternative prospective suppliers have expanded beyond these four traditional conditions (Cheraghi, Dadashzadeh, & Subramaniam, 2004). Earlier research reported that price was the most important criteria but later studies found that quality had become most prominent (Wilson, 1994). Recent studies reaffirm that price is losing its dominance over supplier selection decisions (Cebi & Bayraktar, 2003; Sarkis & Talluri, 2002). Because the selection criteria deployed by buyers in evaluating their suppliers may vary by industry (Bharadwaj, 2004), it is vitally important for the decision-makers to understand the relative importance of the selection criteria. Some decision criteria are more important

in comparison with others. This study seeks to develop a ranking of the preferred selection criteria by engineers who are responsible for making decisions concerning suppliers in the procurement of strategic products. As such, this effort involves aggregating individual rankings to obtain a group ranking that is representative of coherent results. All eighteen relevant criteria will be represented by three constructs: organisational system and technology; buyer-supplier relationships; and economic value, as shown in Figure 1. These three factors might act independently or inter-dependently in facilitating the actual decision-making process; however, this will be beyond the scope of this study. Eighteen hypotheses proposed in light of the selection criteria, which may be specific to certain buying organisations rather than generalisable to all organisations, are presented below.

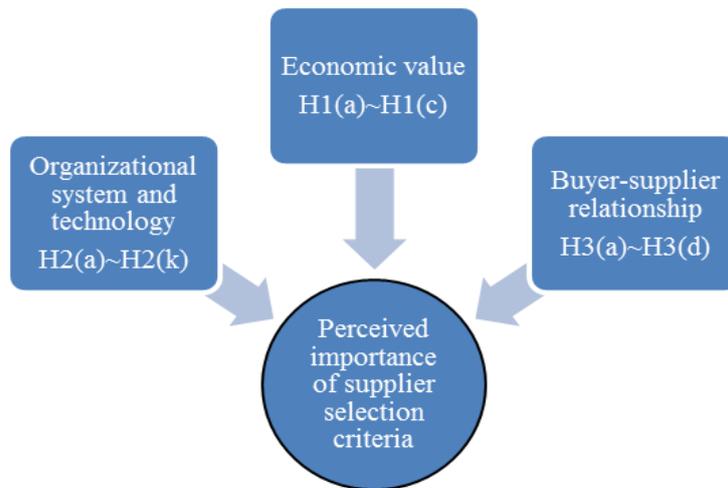


Figure 1. Hypothetical model of supplier selection criteria.

### Economic Value

Regardless of product type, buyers expect that their investment will benefit them for a long time. Therefore, product quality has gained a competitive importance (Garvin, 1984). The product performance secured from a supplier can affect the perception of the downstream customer about the buyer's end product (Devaraj, Matta, & Conlon, 2001). This implies that the supplier's product quality may influence the buyer's perception regarding the supplier's organisational performance. Different buying organisations perceive differently the importance of price as a preferred criterion (Kelly & Coaker, 1976). Moreover, it is not surprising to have the lowest bid rejected for various reasons. In fact, price is no longer considered as the core driving force of purchasing decision-making (Simpson, Siguaw, & White, 2002). On-time delivery with the exact quantity of products ordered is the cornerstone of an effective supply chain and is a key supplier selection criterion for buyers. Unreliable suppliers in terms of delivery lead-time may cause or exacerbate supply risks (Ernst, Kamrad, & Ord, 2007). Conversely, prompt delivery by suppliers has a great bearing in retaining the buyer's customer base (Bharadwaj, 2004). Thus, it is expected that:

- H1(a): Product quality perceived to be important by engineers
- H1(b): Price perceived not to be important by engineers
- H1(c): Delivery perceived to be important by engineers

## **Supplier Organisational System and Technology**

Success of a business entity is highly dependent upon management and organisational capabilities (Ellram, 1991). A well-managed supplier's firm in terms of human and organisational resources would develop its performance, which in turn will affect the buying organisation's success (Modi & Mabert, 2007). The supplier's financial performance can also influence the buying organisation's ability to meet customer needs (Cheraghi et al., 2004). Given that financial distress often surfaces slowly, the supplier's financial health needs to be monitored regularly. Suppliers with good financial health not only demonstrate cost reduction on their part but may also influence their buyer's market competitiveness in term of cost, lead-time, and quality (Chung & Kim, 2003). Flexibility is commonly perceived as the ability to change or react to environmental uncertainty (Sánchez & Pérez, 2005). In the supplier selection context, it may refer to the supplier's ability to accommodate changes in product development, mix, volume and delivery dates (Gosling, Purvis, & Naim, 2010). Subsequently, the supplier's flexibility represents a potential means to improve the buying organisation's efficiency and reduce downtime, which helps lower operational costs (Cannon & Homburg, 2001). A quality management system (QMS) applies to activities that affect the quality of products and services provided by the supplier. Suppliers adopting a QMS have greater potential to reduce product recall risks (Das, 2010). Employee training and development is a prerequisite for suppliers to reduce operational problems (Hartley and Jones, 1997). Employees that are better trained could potentially improve product quality (Forker, Ruch, & Hershauer, 1999). Thus, it is predicted that:

H2(a): Management and organisation is perceived to be important by engineers.

H2(b): Financial performance is perceived to be important by engineers.

H2(c): Flexibility is perceived to be important by engineers.

H2(d): Quality management system is perceived to be important by engineers.

H2(e): Employee training and development is perceived to be important by engineers.

Strategic sourcing requires suppliers to be able to make investment in order to acquire machines, processes and new technologies for their dedicated long-term buyers (Dowlatshahi, 2000). The underlying notion of a good production system is that suppliers are in the position to accommodate the uncertainties and variations in their buyers' business operations. Buyers embracing a just-in-time (JIT) philosophy prefer that their suppliers deliver products frequently, in small lots and at lower cost (Sarker & Parija, 1994). Depending on the type of relationship established with the buyers, suppliers may need to demonstrate certain innovative capabilities in order to gain a competitive advantage in today's turbulent business environment. Supplier product innovation capacities are measured in terms of R&D investment and technology acquisition (Petroni & Panciroli, 2002). A buyer could improve output when the supplier is willing to mobilise its innovation and product development capabilities (Schiele, Veldman, & Huttinger, L. (2011). Supplier innovativeness and supplier pricing: the role of preferred, 2011). The information and communication technology (ICT) improve the effectiveness of buyer-supplier relationships (Baglieri, Secchi, & Croom, 2007). The electronic matching between both parties increases the transparency of supply and demand information within the supply chain (Christiaanse & Kumar,

2000). Consequently, the supply chain lead-time can be reduced (Bertolini, Bottani, Rizzi, & Bevilacqua, 2007). Thus, it is hypothesised that:

H2(f): Production system is perceived to be important by engineers

H2(g): Product innovation is perceived to be important by engineers

H2(h): ICT is perceived to be important by engineers

The current dynamic nature of a supply chain is equally concerned about the safety awareness and environmental attributes of suppliers (Huang & Keskar, 2007), as this has the potential of reducing the buyer's environmental and occupational safety costs. Thus, the combination of turnover, safety awareness and environmental attributes leads to sustainable business practice (Gahan & Mohanty, 2011). With the increasing state of societal expectation, many organisations embrace the concept of corporate social responsibility (CSR) to ensure socially responsible business practices throughout the supply chain (Pedersen & Andersen, 2006). Even though it may be considered as an extra administrative burden, suppliers are expected to fulfil their societal obligations as corporate citizens by being profitable, law-abiding and ethical (Baden, Harwood & Woodward, 2009). Therefore, buyers concerned with CSR in the supply chain might have a stronger preference for socially responsible suppliers (Lee & Kim, 2009). Therefore, it is expected that:

H2(i): Safety awareness is perceived to be important by engineers

H2(j): Environmental attributes are perceived to be important by engineers

H2(k): CSR is perceived to be important by engineers

### **Buyer-Supplier Relationship**

The overall image of a product depends on the quality of service received after purchase (Devaraj et al., 2001). Support services, which refer to both maintenance and repair services, as well as business advisory services provided by the suppliers (Mathieu, 2001), can also influence the buying organisation's success (Gassenheimer & Ramsey, 1994). The value derived from support services will influence a buyer's decision to retain existing suppliers or switch to new ones (Liu, 2006). Although past experience with suppliers should not be considered as a barrier for engaging new ones, it serves as a useful criterion, which could eliminate underperformers (Spekman, 1988). Thus, the supplier selection decision-making time could be reduced. Buyer's knowledge of the supplier's performance history may influence the outcome of buyer-supplier relationships (Kotabe, Martin, & Domoto, 2003). As competitive pressure increases, customer focus, which is an element of total quality management (TQM) (Zhang, 2000), has the ability to bind suppliers and buyers together. It is about customising the firm to be a buyer-centric organisation (Chen & Popovich, 2003). The goal is to develop products and services to fit the buyer's needs. Increasing responsiveness to buyers' requirements has great potential for boosting the financial performance of the buying organisation (Groves & Valsamakis, 1998). Upon entering into a buying agreement, suppliers are usually obligated to provide training for the employees on the buyer's side. The buying organisation could benefit from customer training provided by the suppliers in terms of increased productivity and better product quality (Derouen & Kleiner, 1994). Thus, it is hypothesised that:

- H3(a): Support services are perceived to be important by engineers
- H3(b): Performance history is perceived to be important by engineers
- H3(c): Customer focus is perceived to be important by engineers
- H3(d): Customer training is perceived to be important by engineers

## METHODS AND MATERIALS

### Sample

The target population for this study consisted of engineers who had experience in the purchase of capital equipment. The respondents were drawn from a single power utility company, which is a significant player in the Malaysian electricity supply industry but for confidentiality purposes, will not be identified. The unit of analysis was capital equipment. To recruit participants, the research was advertised in the organisation's monthly online news bulletin. Respondents who were interested in participating in the research contacted the research team directly. Altogether, 500 copies of self-administered survey questionnaires were sent out by postal mail to the interested individual target respondents working in the generation, transmission and distribution arms of the power utility. From that, 248 engineers replied, representing a response rate of 49.6%. All 248 questionnaires were analysed. Table 1 provides a demographic profile of the respondents who participated in this study. The sample was dominated by respondents in generation and the majority of the respondents had already attained over six years of working experience within the industry. Approximately 80% of the respondents had at least some experience in supplier selection.

Table 1. Profile of survey respondents.

	n	%
Division:		
Generation	125	50.4
Transmission	88	35.5
Distribution	35	14.1
Working experience		
0-5 years	79	31.9
6-10 years	55	22.2
11-15 years	31	12.5
16-20 years	25	10.1
21-25 years	14	5.6
Above 25 years	44	17.7
Supplier selection experience		
Never	20	8.1
Rarely	53	21.4
Sometimes	88	35.5
Often	69	27.8
Very frequently	18	7.3

## Data Collection

The questionnaire was pre-tested using a selected sample of approximately 25 engineers in Malaysia with over fifteen years of purchasing experience. A collaborative participant pre-testing method (Cooper & Schindler, 2006) was used. Some items were then reworded to improve validity and clarity. Data for the main study were collected during September to November 2011 via a mail survey. Before conducting the surveys, the organisation's permission was obtained. Mail surveys have been used previously in studies on supplier selection. Two weeks after the initial mailing, a reminder was issued to the respondents to encourage them to complete the questionnaire. No incentives were offered to the respondents for completing the questionnaire.

## Measures

The measures of supplier selection are adapted from Roth, Schroeder, Huang & Kristal (2008) and 18 criteria used to select suppliers were identified. For each criterion, respondents were invited to indicate the degree of importance based on a five-point Likert rating scale (1 representing 'not at all important' and 5 representing 'extremely important'). In this study the overall Cronbach's alpha ( $\alpha$ ) value for the 18 individual criteria was found to be 0.931, reflecting that there is acceptable internal consistency in terms of the correlations amongst the 18 criteria and that the adopted measurement scale is reliable (Forza, 2009).

## Data Analysis

The sample size for this study warrants a one sample t-test to be carried out to examine whether the population considered a specific criterion to be important or otherwise (Antonius, 2003; Elliott & Woodward, 2007). The mean ranking for each criterion, including the associated standard deviation and standard error, is reported in Table 1. For each criterion, the null hypothesis was that the criterion was unimportant ( $H_0: \mu = \mu_0$ ) and the alternative hypothesis was that the attribute was important ( $H_a: \mu > \mu_0$ ); where  $\mu_0$  is the population mean, which was fixed at 3.5 (Ekanayake & Ofori, 2004). Based on the sample size, the authors set the risk level at 5% in making inferences for this study (Antonius, 2003; Sharpe, Veaux, & Velleman, 2010). Therefore, based on the five-point Likert rating scale, a criterion was deemed important if the mean was 3.5 or more. In the event of two or more criteria having the same mean, the one with the lowest standard deviation was given the higher ranking of importance (Sharpe et al., 2010).

## RESULTS AND DISCUSSION

The mean scores of each perceived criterion for all respondents were calculated and they were ranked in descending order according to the mean score values, as shown in Table 2. The chi-square value has been used to measure the agreement of different respondents on their rankings of supplier selection criteria as a whole, based on the mean scores. According to the degree of freedom ( $18-1 = 17$ ) and the allowable level of significance (5%) the critical chi-square value from table was found to be 27.587

(Heiman, 2000). For all respondents, the actual chi-square value of 75.347 was well above the critical value of chi-square 27.587. This result indicates the null hypothesis that respondents' sets of rankings are unrelated to each other and therefore, it has to be rejected. Consequently, there is adequate justification to conclude that there is a significant degree of agreement among all respondents on the rankings of the supplier selection criteria. This concordance test ensures that the data and opinions collected from the questionnaire survey are valid and consistent enough for further analysis.

Table 2. Perceived supplier selection criteria.

	Mean	Std. Deviation	Std. Error mean	Ranking
Product quality	4.57	0.645	0.041	1
Price	4.25	0.737	0.047	2
Delivery	4.25	0.795	0.050	3
Support services	4.17	0.730	0.046	4
Safety awareness	4.17	0.845	0.054	5
Performance history	4.06	0.827	0.053	6
Customer focus	4.02	0.782	0.050	7
Financial performance	3.99	0.856	0.054	8
Customer training	3.98	0.802	0.051	9
Environmental attributes	3.96	0.869	0.055	10
QMS	3.92	0.861	0.055	11
Employee training and development	3.87	0.883	0.056	12
Flexibility	3.82	0.764	0.049	13
Production system	3.77	0.833	0.053	14
Management and organization	3.77	0.858	0.054	15
Product innovation	3.72	0.848	0.054	16
ICT	3.69	0.846	0.054	17
CSR	3.39	0.996	0.063	18

The mean values for the criteria as rated by all respondents ranged from 3.39 to 4.57. Because seventeen mean values are above 3.5 with the exception of corporate social responsibility, it provides strong empirical support for the strong competitive significance of these seventeen criteria in the electricity supply industry. Therefore, sixteen hypotheses were supported and two were rejected. All respondents believed and ranked product quality (Mean = 4.57; SD = 0.645), price (Mean = 4.25; SD = 0.737) and delivery (Mean = 4.25; SD = 0.795) to be the top three criteria. The results of this survey further reinforces the research findings reported by Dempsey (1978), who found the same three variables to be the primary determinants of supplier selection in electricity utilities. However, it is interesting to note that product quality is perceived as being more important than price and delivery in the decision-making processes. The aftermath of a massive national blackout on the 29<sup>th</sup> September 1992 might have influenced engineers to place priority on product quality in their decision-making. In the electricity supply industry in particular, major investments need to be made in the purchase of more reliable equipment that can reduce supply interruptions to customers (Philipson and Willis, 2006). Poor product quality results in delays in operation, which in turn reduces the profit margin and worse still, results in the intangible costs of customer dissatisfaction (Sollish & Semanik, 2011). Woodside and Vyas (Narasimhan,

Talluri, & Mendez, 2001) stressed that it is common for buyers to accept bids up to 4% to 6 % above the lowest acceptable bid, in order to receive superior product performance. Whilst support service (Mean = 4.17; SD = 0.730) was ranked fourth, just behind delivery, the criterion customer focus (Mean = 4.02; SD = 0.782) was ranked seventh. In the electricity supply industry and for most other industries, buyers were significantly more sensitive to a supplier's support services, which mirrors the overall competence of a supplier (Dempsey, 1978; Donaldson, 1994). Power utilities depend on reliable support throughout their entire operations to enhance the value of purchased equipment and to reduce downtime. This observation lends support to the conclusion of Kannan and Tan (2003); that as product quality is influenced by delivery and support service, customer focus becomes an important criterion in meeting changes required by the buyer. This requires suppliers to become more transparent towards their buyer. Creation of unique individualised value through investments in the production process and the product provides a measure of the commitment of the supplier to the buyer (Chen and Paulraj, 2004; Millington, Eberhardt, & Wilkinson, 2006). More importantly, this closer collaboration between the two parties is built upon the supplier's performance history. The performance history (Mean = 4.06; SD = 0.827) was ranked sixth, suggesting that engineers tend to value current, well-performing suppliers. The sustainability of a power utility depends on the performance of its suppliers. The supplier's integrity helps the buyer to foster a superior reputation in the market (Chan, Kumar, Tiwari, Lau, & Choy, 2008).

The financial performance (Mean = 3.99; SD = 0.856) was ranked eighth, which indicates that engineers pay attention to the supplier's financial health. The crux of the matter is that having a sound financial position not only indicates the supplier's stability but also assures the continuous availability of quality products and services (Kahraman, Cebeci, & Ulukan, 2003). Power utilities have a wide range of equipment that necessitates training by the supplier, which is vital when facing a power outage. Restoration of power supply depends on adequate training of the operating personnel in order to perform the necessary installation, service or maintenance procedures. Thus, the importance of customer training (Mean = 3.98; SD = 0.802) was ranked ninth. Other criteria taken into consideration are closely associated with the supplier's organisational system (employee training and development (Mean = 3.87; SD = 0.883), production system (Mean = 3.77; SD = 0.833) and management and organisation (Mean = 3.77; SD = 0.858) and product innovation (Mean = 3.72; SD = 0.848). Table 2 indicates that some of the recently acknowledged new and emerging criteria are now also perceived to be important by engineers: safety awareness (Mean = 4.17; SD = 0.845), environmental attributes (Mean = 3.96; SD = 0.869), quality management system (QMS) (Mean = 3.92; SD = 0.861) and flexibility (Mean = 3.82; SD = 0.764). As a new entrant, safety awareness (Mean = 4.17; SD = 0.845) emerged significant with a ranking of fifth. The statutory requirements on safety operations and other occupational health and safety areas drive power utilities to adopt safety management practices. To support of this effort, it is crucial to include supplier's safety awareness as a risk assessment measure to reduce the likelihood of potential losses in production (Zsidisin, Panelli, & Upton, 2000). What is also quite clear is that a supplier's commendable performance in safety may reflect its excellence in other areas (Pun & Hui, 2002). Note however that while the ICT level of a supplier (Mean = 3.69; SD = 0.846) is generally believed to be a powerful mechanism in coordinating suppliers and their activities (Paulraj & Chen, 2007), in the Malaysian context, power utility engineers do not consider it as important as other criteria. Another point worth noting is that CSR (Mean = 3.39; SD = 0.996) was

not given a high priority, achieving a ranking of eighteenth. This is contrary to the findings in the literature (Björklund, 2010; Piercy & Lane, 2009). Engineers seemed to be unconcerned with this criterion during supplier selection decision making. This might be due to the concept of CSR, which includes obligations towards the natural environment and social dimensions. These dimensions are considered important from the perspective of a company (Björklund, 2010), more so than the considerations given by engineers and technical personnel. Generally, these findings suggest that engineers tend to focus more on criteria that contribute to the long-term success of their company. Although the procurement policy for the investigated power utility outlines only price, quality, delivery and support services as the standard supplier selection criteria, engineers believe that there are extra criteria beyond those stated, which would help the utility to obtain optimal suppliers. Thus, these criteria should define a new framework for the supplier selection decision-making process.

## **CONCLUSIONS**

The current competitive market, coupled with the deregulation of the power industry in Malaysia, demands that purchasing related costs be trimmed. This research reports the statistical results of a survey aimed at collecting perceptions of Malaysian engineers in the power industry. These perceptions concern critical supplier selection criteria that contribute to the supplier selection literature by finding suitable measures for supplier selection, specifically for the Malaysian power industry. A careful analysis of critical supplier selection criteria may help power utilities to improve their performance from the organisational perspective. The traditional supplier selection criteria, such as product quality, price and delivery still lead the list. However, many engineers believe that the list should be extended with a greater emphasis on building a good working relationship. Surprisingly, the concept of CSR is not considered as a priority for the Malaysian engineers in their supplier selection. The findings of this research show that supplier selection is most successful when it is capable of integrating three critical dimensions: supplier's organisational system and technology, buyer-supplier relationship and economic value. It is hoped that the framework provided in this paper will assist the power utilities in re-examining their procurement guidelines in order to understand the critical criteria and thus, maximise the probability of a successful supplier selection outcome, plan for the future and gain a competitive edge. Extending this research to include power utilities located outside Malaysia would enable testing of the generalisability of the results on a global basis. Another limitation of this research is that it is confined solely to engineers and there was no attempt to capture the perceptions of the suppliers. Despite these limitations, the findings from this study could serve as a guide to develop a standard supplier selection decision support model for power utilities.

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