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**A Novel Development of a Strategic Sourcing  
Supplier Selection for Capital Equipment  
(S<sup>4</sup> – CapEq) Decision-Making Framework:  
A Case Study of a  
Government-Linked Company in Malaysia**

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**Sivadass Thiruchelvam**

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**Sivadass Thiruchelvam**

A thesis submitted to  
**Auckland University of Technology**  
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# ***List of Abbreviations***

AHP	Analytical Hierarchy Process
AI	Artificial Intelligence
AUTEC	Auckland University of Technology Ethical Committee
CBA	Cost-benefit analysis
CCGT	Combined Cycle Generating Technology
COS	Cost-of-Service
CSR	Corporate Social Responsibility
DCA	Discrete Choice Analysis
DEA	Data Envelopment Analysis
DMU	Decision-Making Unit
EC	Energy Commission
EDI	Electronic Data Interchange
EMS	Environmental Management Systems
ERP	Enterprise Resource Planning
ESI	Electricity Supply Industry
GLC	Government-Linked Company
GTP	Government Transformation Plan
ICT	Information and Communication Technology
IPP(s)	Independent Power Producer(s)
KBV	Knowledge Based View
KMO	Kaiser-Meyer-Olkin
MAUT	Multiple Attribute Utility Theory
MCDM	Multi-Criteria Decision Making
MRP	Materials Requirement Planning
NEB	National Electricity Board
OC	Open Cycle

PPA	Power Purchase Agreement
PPE	Personal Protection Equipment
RBV	Resource Based View
SCM	Supply Chain Management
SET	Social Exchange Theory
SESB	Sabah Electricity Private Limited
SESCO	Sarawak Electricity Supply Corporation
SPSS	Statistical Package for the Social Sciences
TCE	Transaction Cost Economics
TNB	Tenaga Nasional Berhad
TPM	Total Productive Maintenance
QMS	Quality Management Systems
UNITEN	Universiti Tenaga Nasional



# *List of Publications*

## **Journal Papers**

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1. Thiruchelvam, S., Tookey, J. E., Samarasinghe, D. A. S., Quik, W. H., & Mustapha, K. N. (2012). Supplier selection criteria in a power utility in Malaysia: engineers' perceptions. *Journal of Mechanical Engineering and Sciences*, 2, 148-161.
2. Thiruchelvam, S., & Tookey, J. E. (2012). Evolving trend of supplier selection criteria and methods. *International Journal of Automotive and Mechanical Engineering (IJAME)*, 5, 10-28.
3. Thiruchelvam, S., Tookey, J. E., & Mustapha, K. N. (2012). Sustainability of a national power utility: a way forward. *World Journal of Sciences*, Accepted for publication.

## Conference Papers

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1. Thiruchelvam, S., Tookey, J. E., Rotimi, J. O. B., Samarasinghe, D. A. S., Mustapha, K. N., & Kadirgama, K. (2012, 9-10 June). *A conceptual framework to evaluate suppliers for building infrastructure in the Malaysian electricity supply industry*. presented at the meeting of the UTM-IBIMA International Real Estate Conference 2012, Kuala Lumpur, Malaysia.
2. Thiruchelvam, S., Tookey, J. E., Samarasinghe, D. A. S., Mustapha, K. N., & Kadirgama, K. (2012, 4-5 June). *How power utility engineers can better select equipment suppliers?: the Malaysian case*. presented at the meeting of the Fourth Annual American Business Research Conference, New York. Retrieved from <http://www.wbiconpro.com/510-Sivadass.pdf>
3. Thiruchelvam, S., Tookey, J. E., & Mustapha, K. N. (2012, 4-5 June). *Sustainability of a national power utility: a way forward*. presented at the meeting of the Fourth Annual American Business Research Conference, New York. Retrieved from <http://www.wbiconpro.com/207-Sivadass.pdf>
4. Thiruchelvam, S., & Tookey, J. E. (2010). Review of supplier selection methods: Suitability for Malaysian electricity supply industry. In A. Wirabhuana, M. Abrori, & K. Amar (Chair), *UIN Sunan Kalijaga Yogyakarta*. Symposium conducted at the meeting of the International Conference on Industrial Engineering and Business Management (ICIEBM) 2010, Yogyakarta, Indonesia.

# ***Attestation of Authorship***

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Sivadass Thiruchelvam

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Sivadass Thiruchelvam

# ***Ethical Approval***

The ethics application for this research project was approved by the Auckland University of Technology Ethics Committee, AUTEK Reference number 11/111.

# ***Abstract***

Malaysian Electricity Supply Industry (ESI) is increasingly using strategic sourcing as a means to control costs and risks. Consequently, supplier selection has become a major strategic decision for buyers. Supplier selection is a multi-criteria decision-making problem which includes both qualitative and quantitative factors. A reliable supplier selection method should be able to handle this need in order to support modern procurement requirement of having a systematic and transparent decision-making approach. This mandate, as well as the need for an increasingly strategic focus of corporate supply chain management departments, provides the basis for the current research. This study examines the appropriate strategic sourcing supplier selection metrics for procurement of capital equipment in the ESI in Malaysia. It identifies metrics contributing to the successful procurement of capital equipment which is seen as one of the many management practices that contribute to corporate success.

A mixed methods approach comprising qualitative and quantitative survey was used. A case study of Tenaga Nasional Berhad (TNB), the key player in the Malaysian ESI formed the basis of the study with questionnaire survey and semi-structured interviews. The study intended to identify and define the metrics that key stakeholders at TNB believed should be used for supplier selection. From the mixed methods approach, the metrics and their underlying definitional dimensions for selecting suppliers for capital equipment products was formulated. The outcomes foresee the possible initiatives to bring procurement in TNB to a strategic level. Firstly, although TNB seems to be formally implemented a governing procurement policy and procedures, the status of organizational supplier selection judgment is generally average. There was an identified need for improving organizational supplier selection effectiveness through an urgent introduction of a standard set of supplier selection metrics and corresponding definitional dimensions. Secondly, results suggested executives in TNB view supplier selection metrics from two different perspectives: supplier competitiveness and supplier

attractiveness. Thirdly, the metrics ranked according to their importance level for strategic sourcing supplier selection in the ESI were product quality, delivery, price, support services, safety awareness, performance history and customer focus. Consequently, this study developed S<sup>4</sup> – CapEq decision-making framework for policy makers, practitioners, and researchers in the ESI which incorporates elements of rational decision-making and corporate governance. Finally, future developments for this framework were posited.



# Chapter 1

## Introduction

### 1.1 Background

Electricity is a vital input for any country's economic activities, particularly with countries like Malaysia, China and India, where the focus is on industrialisation and commercial growth (Besant-Jones, 1996; Williams & Dubash, 2004). National electrification works is all encompassing spanning residential, commercial and industrial needs. Every aspect of modern living such as transportation, communication, construction, and manufacturing is dependent on electricity for their effective functioning. Without electricity it would be impossible to achieve the industrial, technical, or cultural potential of the human race. Electricity has continued to play a significant role in the development process and the electricity supply industry and sectors utilizing power are considered as development blocks for the country's economic growth (Dahmén, 1988). However, the Electricity Supply Industry (ESI) is mostly famous for cost overruns, blackouts, physical network losses, service quality and environmental issues (Beard et al., 2010; Crawford, 1985; Joskow, 2008). As a result, the industry is one of the least popular investment sectors characterised by increased risks, complexity and controversy with unattractive business environment and uncertainty in the regulation of tariffs (Bacon & Besant-Jones, 2001). The distinctive and substantial set of challenges facing the ESI today will necessitate most utilities to re-think their business strategies.

Privatization of state-owned utilities which started in the 1980s forces the industry to be financially prudent (Smart, 2005). One of the methods that has been espoused as mandatory for electricity business sustainability has been the industry-wide adoption of

the principles of supply chain management (SCM). Using SCM principles has become a priority as the goal is to improve power sector efficiency, reduce electricity costs, and eventually maximize the social benefits of electricity production through the establishment of scientific and efficient mode of the electricity supply chain operation, and the coordination of the electricity supply chain enterprises (Fan & Cunbin, 2010). The electricity supply chain involves several entities including generators, transmitters, distributors and consumers. Regardless of magnitude, the electricity supply chain can be visualized as consisting of sourcing stages, production stages and distribution stages. It is important to highlight the fact that an electricity supply chain is not a set of isolated and individual entities, but the sum of all the entities involved in the production and distribution of electricity. Therefore, the success of electricity supply chain should be measured as a whole and not as the success of each separate member involved.

However, for the ESI to benefit from SCM, it is necessary to search for a competitive advantage by focussing attention on their entire supply chain. It has been argued by some researchers (e.g. Tummala et al., 2006) that improvements achieved in the area of SCM have an instant bearing on the overall costs of a firm and thus to corporate profits generation. Of the various activities involved in SCM, purchasing is one of the most strategic since it offers firms with opportunities to trim costs and subsequently, increase profits (Chen et al., 2004). Purchasing activities connect the firm to the upstream supply chain and permit a buying firm to acquire suitable inputs from external suppliers. Since a typical industrial firm spends 40-60% of earned revenue on purchased materials (Karthik, 2006), disruptions due to supply shortages could have a major influence on profitability. Supply chain problems originating with suppliers cause the buying firm's average shareholder return typically decreases by 11% (Hendricks & Singhal, 2008). Therefore, a firm's supplier sourcing strategy is a key driver for dictating an effective supply chain.

The cornerstone of the present-day value-added purchasing performance is strategic sourcing supplier selection. Many organizations have implemented strategic sourcing supplier selection to create a linkage between sourcing strategy and organizational strategy (Leenders et al., 2006). This shows that suppliers and supply base are acknowledged as contributing factors of an organization's success. More specifically, it

serves as an appropriate way for firms' to source any commodities, capital equipment or services that are considered critical in meeting their business objectives. The success or failure of sourcing strategy hinges on defining clear objectives for the selection of preferred suppliers (Saunders et al., 1997; Willcocks & Choi, 1995). Therefore, decision-making involved in strategic sourcing supplier selection should be made without ambiguity among key stakeholders in a purchasing firm (i.e. initiators, influencers, decision-makers, buyers and users). Carter et al. (2000) in a 10-year outlook study forecast that strategic sourcing supplier selection requires specific metrics (in particular supplier performance measures) which are detailed, precise and specialized for specific type of business. The study believes the level of complexity in managing supplier evaluation and assessment will probably escalate over the years. This mandate, as well as the need for a progressively strategic focus of electricity utilities, proffers the basis for this thesis.

In relation to sourcing, organizations' executive management will contend their purchasing personnel to work in congruence with company goals, usually expressed as supplier selection metrics. However, these metrics may not necessarily be endorsed or agreed upon by its employees who are directly involved in purchasing and procurement activities. Some scholars still believe that as the people directly involved in the buying process they should be given freedom to exercise their professional judgements on how a supplier should be selected (McDonald, 1996). Therefore, there is a prevalent disconnect between the employees' work reality and the management's mandated policy. The current study collects the relevant data and derives metrics that demonstrate strategic value within the strategic sourcing supplier selection context of the host organization.

## **1.2 The Malaysian Electricity Industry in the National Economy**

Like most other countries in the world, electricity is also a key component for Malaysia's economic growth. The need for electricity in Malaysia could be traced back to the early 19th century when it became necessary to operate electric pumps at tin mines (Tenaga Nasional Berhad, 2010). Since then, this need has continued to grow and

expand as Malaysia enters the 21st century. Today, the industry is a vital part of local life with a rapidly growing demand and consumption. Between 2004 to 2009, electricity consumption increased from 7.9% in 2004 to 12.6% in 2009, despite a slight fluctuation in economic growth for the same period (Central Bank Malaysia, 2008, 2009, 2010; Ministry of Finance Malaysia, 2009, 2010). According to Yoo and Lee (2010), increases in electricity consumption are correlated with economic growth although this might not necessarily imply a causal relationship. Economic growth results from the augmentation of capital input, labour input and productivity (National Research Council, 1988). Electricity can help simplify industrial production processes which in turn can enhance productivity (Enflo et al., 2009). Foreign Direct Investment (FDI) can also profoundly influenced electricity consumption especially in a country like Malaysia which has seen an influx in investments in manufacturing and high-end technological industries (Tang, 2009). Malaysia is unlikely to reduce this consumption because it aims to be an industrialised nation by the year 2020. To become an industrialised nation, Malaysia has to meet its forecasted electricity demand of 18,947 megawatts (MW) (Office of The Prime Minister Malaysia, 2009). This value is an increase of 35% from the 14,007 MW of actual consumption in 2008.

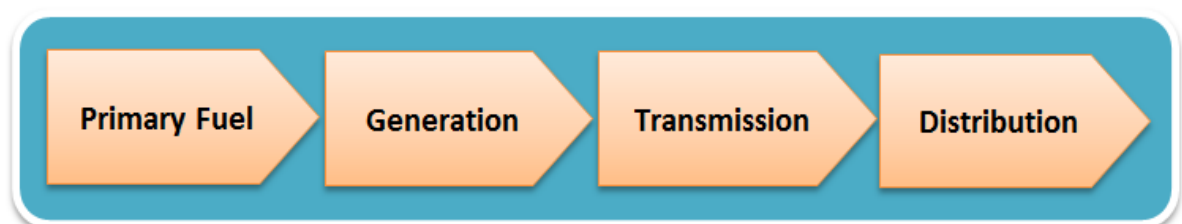
For the time being, electricity appears to be the only solution to achieving industrialised status for the country. In 2009, the Malaysian Ministerial Cabinet agreed to consider nuclear energy as one of the options for electricity generation post 2020 (World Nuclear Association, 2010). This suggestion however, resulted in much public dissent because of Malaysia's previous stand of not engaging in any nuclear activities. Although not implemented, the talks on nuclear energy as an alternative energy source is testimony of the government's acknowledgement of the importance of electricity and its willingness to take drastic steps if necessary to power the nation in the long run. With the rejection of nuclear energy as an alternative energy source, electricity remains crucial to Malaysia as a deciding factor for its economic growth. To supply enough electricity to drive growth meant that measures must be taken that can ensure a minimal or zero disruption to the power supply and this is influenced by reliable equipment and maintenance but the current status of both is still fraught with instabilities.

Electricity was propelled into the forefront of political and economic planning as a result of the May 13 bloodshed in 1969. This racial conflict exposed a fissure in

Malaysia's multi-racial society when it became apparent that the public was dissatisfied with the economic gap between the different ethnic groups in the country (Isa, 2009). After the incident, the Malaysian government embarked on a recovery plan to close the gap between urban and rural dwellers by promising full electrification to many rural districts (Economic Planning Unit, 1976). By 2008, it was reported that up to 94.3% homes in rural areas have been given electricity (Ministry of Finance Malaysia, 2010). Investments were made to further expand electricity transmission throughout the nation. Malaysia's goal was to become 100% electrified by 2013 (Haris et al., 2010a). These steps were important because they not only allow rural citizens to use modern household appliances but they were needed to support traditional cottage industries such as food processing, handicrafts, small goods manufacturing and so forth. The electricity supply chain has thus become an important element that can ensure the economic growth in rural areas that was needed to promote social equity in the country.

### 1.3 Electricity Industry Supply Chain

The generic supply chain for the electricity industry can be visualized as the process of converting a primary fuel source into a refined secondary energy carrier known as electricity and delivering it to the end user. Electricity cannot be stored and must be used as it is generated. Therefore a balance between supply and demand must be achieved, failing which may result in costly brownouts or even blackouts. The demand and supply of the Malaysian electricity supply chain are influenced by a number of political, economic and environmental factors. There are four key functional stages in the supply chain for electricity as shown in Figure 1.1: supply of a primary fuel source, generation, transmission, and distribution.



**Figure 1.1** Malaysian Electricity Supply Chain

The main activity in the primary stage is the extraction and refining of raw energy sources. Malaysia generates its electricity from four main types of fuel namely oil, gas, coal and renewable sources (Jalal & Bolger, 2009). Electricity generation in Malaysia is mostly fossil-based with a high dependence on natural gas and oil (Jafar et al., 2008). The generation fuel mix in 2008 comprises of 64.5% gas, 29.0% coal, 4.8% hydro, and 1.4% oil (Economic Planning Unit, 2010). The use of gas has increased rapidly and Petroleum Nasional (Petronas), a government owned corporate agency, is the main supplier of oil and natural gas in Malaysia. Electricity is also obtained from coal imported from Kalimantan (Indonesia) and Australia (Hickey, 2008).

The primary activity at the generation stage is the conversion of a primary fuel source into electrical energy via a variety of power plant types depending on the fuel used. Most types of power plants found in Malaysia are Open Cycle (OC), Combined Cycle Generating Technology (CCGT), thermal and hydroelectric plants. In the larger central generating plants, chemical energy (in the form of fuel) is first converted into heat energy (in the form of steam). This process involves the burning of a fossil fuel (oil, natural gas or coal) in the furnace of a steam boiler. Steam from the boiler drives a turbine connected by a drive shaft to an electrical generator to produce electrical energy. However, in a hydroelectric plant, the turbine is driven by kinetic energy produced by water supplied from a required elevation.

The transmission stage involves the use of wires, pylons, transformers and substation facilities to enable bulk transfer of electricity between generating sites and distribution centres. The transmission network includes the interconnection and integration of dispersed generating facilities into a stable synchronized AC (alternating current) network. Within its network, the transmission function also manages the scheduling and dispatching of generating facilities to balance the demand and supply of electricity in real time. It is also responsible for managing any network crises to prevent system breakdown. The Malaysian National Grid coverage consists of 18,935 circuit-km of 132 kV, 275kV and 500kV overhead lines length with the support of 385 main intake substations (TNB, 2010).

The distribution function involves the transfer and reduction of high voltage electricity from access points in the transmission network to the end customer via localized distribution network. The distribution of electricity to residential and commercial customers depends on overhead lines in rural areas, underground cables in urban areas, and substations operating at lower voltages. From the National Grid, the supply to the end-users are made possible by a distribution system network at voltage levels of 33 kV, 22 kV, 11 kV, 6.6 kV and 415/240V. Malaysia is different from other countries because its distribution tier is responsible not only for the bulk purchase of electricity supply from generators but its sale to customers. This trading activity is backed up by meter reading, billing, and collection of customers' payments.

## **1.4 The Structure of Malaysian Electricity Supply Industry**

The electricity sector is dominated by three integrated utilities; Tenaga Nasional Berhad (TNB) serving Peninsular Malaysia, Sabah Electricity Private Limited (SESB) and Sarawak Electricity Supply Corporation (SESCO). These key players are complemented by various Independent Power Producers (IPPs), dedicated power producers and co-generators. The electricity supply change in Malaysia is different pre and post the 1992 nationwide blackout crisis.

### **1.4.1 Malaysian Scenario Pre-1992**

The Malaysian electricity supply industry (MESI) used to be vertically integrated. Prior to 1990, the National Electricity Board (NEB) was government-owned, and controlled as well as possessed most of the generation, transmission and distribution facilities in Peninsular Malaysia. It also has a monopoly in selling electric power to consumers; hence there was no competition. The NEB was incorporated in 1990, becoming Tenaga Nasional Berhad which currently owns almost RM71.4 billion in assets (TNB, 2010). TNB has been listed on the main board of the Malaysian Stock Exchange - Bursa Malaysia. It employs approximately 29,149 people, with a customer base of 7.6 million in Peninsular Malaysia, Sabah and Federal Territory of Labuan (TNB, 2010). Before 1992, the core electricity chain components for Peninsular Malaysia such as generation,

transmission and distribution were centralized and monopolized under TNB. In East Malaysia, state-owned SESB and SESCO were the utilities responsible for generating, transmitting and distributing power supply to the consumers for the two Borneo island states.

### **1.4.2 Aftermath of 1992 National Blackout Crisis**

On 29th September 1992, a massive blackout lasting almost 33 hours crippled most of the country after the breakdown of a transmission facility that was struck by lightning. Fearing the loss of investors' confidence, the government implemented changes into the local electricity supply industry (Smith, 2003). Hence, restructuring and deregulation of the electricity industry took place leading to the unbundling of the vertically integrated electricity utility.

The monopoly status of TNB came to an end when the Malaysian Government decided to deregulate the electricity utility structure. The introduction of IPPs in the generation sector was aimed not only at having adequate safety margins of capacity but also to facilitate competition among the generators. YTL Corporation Private Limited was the first IPP to be awarded the licence to construct a gas-fired power plant in 1993. Energy Commission (2010) reported that as of 2005, there were 24 IPPs operating throughout the country. Adopting the single buyer model, the IPPs and TNB Generation Division sells power to TNB through long term Power Purchase Agreement (PPA) to ensure no shortage of electricity. Under this competitive market, the recovery of investment for a new generation plant was not guaranteed. To mitigate such risks, the Malaysian government introduced PPA to protect the IPPs. The PPA was drafted in such a way that reflected a lucrative contract promising equity returns between 19% and 33% for the IPPs. Figure 1.2 illustrates the single buyer model structure which is a first step towards wholesale competition what may be termed as the total liberalization of the electricity industry. In this model, TNB as the power purchasing agency has the authority to choose a number of generators based on their energy bid prices to supply electricity to Peninsular Malaysia.

Despite the introduction of the IPPs, TNB is still a major contributor to the total industry capacity with six thermal stations and three major hydroelectric schemes. TNB



as the purchasing agency is bound by the PPA to buy electricity from the IPPs at a fixed price based on separate capacity and energy rates (Akhtar et al., 1996). Apart from enjoying subsidized gas supply from Petronas, the IPPs also secured higher selling rates through the PPA which consumes half of TNB's annual operational costs (Intelligent Insights International, 2006). This is a favourable situation to the IPPs as TNB needs to comply with the PPA's 'take or pay' concept for 21 years. The creation of huge power reserves also bleeds TNB financially as it has to pay for something which is not needed (Yee, 2010). Furthermore, all fuel price increases and any loss of electricity during the transmission and distribution process have to be absorbed by TNB. According to Consumers Association Penang (2010) the IPPs have generated excess profits at the expense of the industry and the Malaysian consumers as a result of the conservative estimates the IPPs' made at the time of the signing of the PPA. The project cost of one of new IPPs is much lower than the cost used in the determination of the IPP's capacity rates and it is believed that the difference was approximately RM1 billion (Consumers Association Penang, 2010). Despite the financial burden caused by the introduction of the IPPs, TNB still maintains market dominance by controlling most of the generation capacity, transmission and distribution networks in the country. In the partial deregulation exercise, TNB also successfully acquired 80% of stake in SESB from Sabah state government, leaving Sarawak as the only state-run utility without any intervention from TNB (Daily Express, 2009).

*This image has been removed by the author of this thesis for copyright reasons*

**Figure 1.2** Single Buyer Model Structure

## 1.5 The National Power Utility in Dilemma

The electricity reform is driven by the government's intention to increase investment growth in the country. Initial restructuring process involves only the generation tier of the Malaysian electricity supply industry. Further restructuring to create wholesale market and independent transmission ownership as well as operation is in the pipeline. Malaysia's government believe that these measures are instrumental in helping it achieve its vision of a total free market for the electricity supply industry in the country. The nature of free market, interaction between pool of suppliers and buyers would yield economically efficient market prices that could benefit consumers. Price, output and investment decisions formerly governed by regulatory rules are set free to be decided by market forces. However, a competitive environment induces a survival of the fittest atmosphere as larger firms can initially charge lower prices, driving rivals away. Once there is no competition left, the surviving firm can then charge higher prices eventually monopolising the market and defeating the objective of a free market. Consumers would be at a greater disadvantage as the service providers would pass any extra cost (such as rising fuel prices) to the bottom of the value chain. To prevent this from happening, the Malaysian government introduced a retail tariff of electricity. Malaysia practices Cost-of-Service (COS) regulation as the regulator actively monitors the electricity utilities (Rothwell & Gomez, 2003). The Energy Commission (EC) was established in 2002 to mimic competitive market conducts, promote efficiency and ensure fair practices.

Due to escalation of fuel prices and hefty overcharges by the IPPs, TNB on several occasions requested the government for a hike in tariffs to offset its operating cost. The last government increase in tariff was on 1st June 2011 which is considered to be a unique case as residential consumers who used less than 300kWh of electricity a month were exempted. The increase in tariff will help to offset the effects of rising global gas prices. However TNB was not overwhelmed with this increase because the benefits had much less of an impact on its cash position (Kok, 2011). TNB still need to absorb the rising costs of other raw materials and fuel such as coal. Despite the Malaysian's government decision to move towards a free market scenario, government regulation is still very much in place to protect consumers from exploitation. So long as this tariff remains in place, TNB as the main supplier and provider of electricity in the country

will continue to be disadvantaged by higher selling prices from IPPs and global fuel increases.

### **1.5.1 The Way Forward**

The restructuring of the electricity supply industry in Malaysia has resulted in an uneven playing field between the profitable IPPs and TNB. IPPs are being paid significantly more than what they have invested in but TNB remains at a disadvantage as it is unable to pass any additional costs incurred to its consumers because of a government tariff that regulates the selling price of electricity. In short, TNB is caught in the middle and does not have room to manoeuvre to attain a profitable solution from both parties. Given the direct impact of the IPPs and the regulated tariff towards the future of TNB, there is now an impasse for the national utility. Efforts must be made from within the organization to provide cost savings which can offset these perceived detrimental effects. By reviewing and improving its internal business processes, TNB could embark on greater cost savings. A business process is described as a procedure relevant for adding value to an organization (Scheer & Nüttgens, 2000). According to Tan (2001) and Carr and Pearson (2002), the purchasing function is an important strategy of the business process which can support the overall strategy of any firm. Organisations like General Motors, General Electric, Xerox, and Black & Decker were able to strengthen their competitive position by improvising their existing purchasing functions (Spekman, 1988). It follows that the selection of suppliers is an important activity in purchasing (Krause et al., 2001) and can be the deciding factor in ensuring superior business performance (van der Rhee et al., 2009). Any savings made from supplier selection can have long lasting impact on the financial health of the organisation (Xu & Lin, 2010). Lunsford and Glader's (2007) study showed that Boeing's production of its 787 Dreamliner airliner was severely crippled by a shortage of fasteners as a result of a poor supplier selection process. Therefore a successful organization must be able to source from reliable suppliers at the same time ensuring that supplier's related cost are kept at a minimum.

## 1.6 Statement of the Research Problem

Supplier selection is one important factor in profitability for many companies. However, in the electricity supply industry supplier selection is often completed without a clearly defined set of metrics and/or without regard to the importance placed on each metric by the key stakeholders, or even occasionally without regard to metrics at all. Notwithstanding the pivotal role of strategic sourcing within SCM, at present little work has been conducted to determine the appropriate strategic sourcing supplier selection metrics in the electricity industry supply chain. The actual underlying constructs of strategic sourcing supplier selection for ESI capital equipment has rarely been addressed and little is understood. Day et al. (1994) contend that most published studies proffer few insights into the purchasing process and virtually all articles examined fall far short of capturing the dynamics of the purchasing process. Most studies do not investigate who comprises the decision-making unit (DMU) and how criteria vary across members.

The purpose of this study is to identify the strategic sourcing supplier selection metrics for capital equipment purchases, the weight of importance the metrics are assigned, and how each of the metrics is defined among the initiators, influencers, decision-makers, buyers and users in the largest electricity utility company in Malaysia. By having an agreed-upon set of metrics and corresponding definitional dimensions identified and defined, the company may be able to develop a strategic sourcing supplier selection process that is definable, repeatable, and auditable. Consistently applied metrics may reflect upon the overall integrity in the purchasing firm's procurement process.

This study was carried out using simultaneous quantitative and qualitative approaches to identify, define, and assign a weight of importance to the strategic sourcing supplier selection metrics. Through these processes the information provided can be used to develop a policy and procedure for strategic sourcing supplier selection at the host organization as well as by other utility companies. Developing a systematic process and procedure for strategic sourcing supplier selection can provide the key stakeholders the information required to maximize the value they deliver when purchasing capital equipment. With a clear policy and procedure for supplier selection that includes a list of metrics, definitional dimensions, and weight of importance, the key stakeholders

identify the parameters required to participate in the power utility company's procurement process.

This study is not a comparison of strategic sourcing supplier selection metrics of other utility companies or an answer to why the metrics are used in this organization. It only provides a list of metrics, their corresponding definitional dimensions, and weights of importance as identified by initiators, influencers, decision-makers, buyers and users.

## **1.7 Research Aim and Objectives**

The research aims to investigate the perceptions of key stakeholders' within one company in the ESI in terms of appropriate strategic sourcing supplier selection metrics and corresponding definitional dimensions and therefore, is intended to develop a suitable strategic sourcing supplier selection decision-making framework so as to enable supply chain performance improvement. To achieve this, and to give direction to the research, the objectives were formulated. The formulated objectives for this thesis were stated as follows:

- i. To understand the supplier selection process in TNB. This will involve an in-depth analysis on the current practices of strategic sourcing evaluation and decision-making process stretching from strategic sourcing opportunity identification and appraisal to decision making and implementation of strategic sourcing supplier selection decisions.
- ii. To establish that the two proposed constructs (Supplier Competitiveness and Supplier Attractiveness) statistically distinct from one another as determined by an unconstrained factor analysis. The nature of the situation particularly in TNB where is no clear standard metrics for strategic sourcing supplier selection necessitates a need to figure out a constructive way of representing the identified eighteen metrics in a multiple perspective format.
- iii. To measure the degree of importance the key stakeholders' (initiators, influencers, decision-makers, buyers and users) place on each metric for decision support in strategic sourcing supplier selection. The researcher sought to explore if and to what

extent, the shortlisted eighteen metrics influence or determine the strategic sourcing supplier selection. Therefore this research will help to understand the successful ingredients of strategic sourcing supplier selection practices and decision-making process in the electricity supply industry with primary focus on the factors that influence the process of decision making to purchase capital equipment.

- iv. To identify whether the metrics differ among initiators, influencers, decision-makers, buyers and users since there is limited knowledge available on this subject area and no baseline of current use of these metrics, as well as evaluation of their impacts on intended decision outcomes exist.
- v. To provide the key stakeholders' perceptions on the definitional dimensions of each of the top metric for strategic sourcing supplier selection. In this exploratory study, the researcher will take a holistic view of the subject area, gathering as much information as possible before deciding which definitional dimension is important and which definitional dimension can be discarded concerning each of the top metric.
- vi. To develop a framework for a strategic sourcing supplier selection for capital equipment decision making. The current goal is to expose and solve the current problem so as to help key stakeholders improve the strategic sourcing supplier selection practices and decision making process within their organization.

## **1.8 Research Questions**

Research questions play a crucial role in deciding the selection of research methods and understanding the centrality of the questions guides the researcher in all other decisions throughout an undertaken study (Newman & Benz, 1998). The research questions in this study were established to identify the appropriate metrics to be utilized for strategic sourcing supplier selection by one company in the ESI:

- i. What is the supplier selection process in TNB?
- ii. To what extent are the two proposed constructs (Supplier Competitiveness and Supplier Attractiveness) statistically distinct from one another as determined by factor analysis?

- iii. What degree of importance do the key stakeholders' (initiators, influencers, decision-makers, buyers and users) place on each metric for decision support in strategic sourcing supplier selection?
- iv. How do the metrics differ among initiators, influencers, decision-makers, buyers and users?
- v. What are the key stakeholders' perceptions on definitional dimensions of each of the top metric for strategic sourcing supplier selection?
- vi. What is the appropriate tool to assist a strategic sourcing supplier selection for capital equipment decision making?

The relationships of the research questions, stated objectives and hypotheses are inextricably interlinked in the development of the research detailed in this thesis. A summary of these relationships is given in Table 1.1.

**Table 1.1** Relationship of research questions, objectives with hypotheses

<b>Research question</b>	<b>Correlating objective</b>	<b>Correlating hypotheses</b>
Research question (i)	Objective (i)	-
Research question (ii)	Objective (ii)	-
Research question (iii)	Objective (iii)	H1a – H1d H2a – H2n
Research question (iv)	Objective (iv)	-
Research question (v)	Objective (v)	-
Research question (vi)	Objective (vi)	-

## 1.9 Hypotheses

The need for greater strategic sourcing supplier selection effectiveness has led to an appreciation for multiple perspectives approach. In the best of today's decision making practices, a set of orthogonal perspectives (also known as dimensions) is essential to guide the identification of the most appropriate, comprehensive, and non-overlapping selection metrics. The eighteen metrics which were shortlisted in section 2.5.1 as the relevant metrics for strategic sourcing supplier selection in the electricity supply industry could be viewed from two different perspectives: supplier competitiveness and supplier attractiveness.

Solving real-world problems requires multiple points of view. Usually there is no single best answer to serious questions, nor does one person possess all the knowledge to address such multicriterion problems adequately. Figure 1.3 diagrams the relationships created by multiple perspectives approach that lead to an understanding of the dimensions and metrics for strategic sourcing supplier selection. Decision makers need to consider multiple perspectives in order to make good decisions and avoid costly and disastrous mistakes (Linstone, 1999). Basing a decision making system on multiple perspectives provides the greatest potential for improving the quality of decisions. It enables decision makers to balance the differing concerns and views of multiple stakeholders. It has the best potential for creating an effective vehicle for objective and consistent decision making as well as participative decision making.

Regarding the purpose of the study and referring to the proposed conceptual framework for supplier selection under strategic sourcing program as illustrated in Figure 1.3, the following null hypotheses were derived from the obtained outcomes in section 2.5.1 to address the third research question:

Construct 1: Supplier Competitiveness

**H1a<sub>0</sub>** Product quality is not important in determining supplier competitiveness

**H1a<sub>a</sub>** Product quality is important in determining supplier competitiveness

**H1b<sub>0</sub>** Price is not important in determining supplier competitiveness

**H1b<sub>a</sub>** Price is important in determining supplier competitiveness

**H1c<sub>0</sub>** Delivery is not important in determining supplier competitiveness

**H1c<sub>a</sub>** Delivery is important in determining supplier competitiveness

**H1d<sub>0</sub>** Support services is not important in determining supplier competitiveness

**H1d<sub>a</sub>** Support services is important in determining supplier competitiveness

Construct 2: Supplier Attractiveness

**H2a<sub>0</sub>** Production system is not important in determining supplier attractiveness

**H2a<sub>a</sub>** Production system is important in determining supplier attractiveness



**H2b<sub>0</sub>** Flexibility is not important in determining supplier attractiveness

**H2b<sub>a</sub>** Flexibility is important in determining supplier attractiveness

**H2c<sub>0</sub>** Information and Communication Technology (ICT) is not important in determining supplier attractiveness

**H2c<sub>a</sub>** ICT is important in determining supplier attractiveness

**H2d<sub>0</sub>** Financial performance is not important in determining supplier attractiveness

**H2d<sub>a</sub>** Financial performance is important in determining supplier attractiveness

**H2e<sub>0</sub>** Product innovation is not important in determining supplier attractiveness

**H2e<sub>a</sub>** Product innovation is important in determining supplier attractiveness

**H2f<sub>0</sub>** Quality Management Systems (QMS) is not important in determining supplier attractiveness

**H2f<sub>a</sub>** QMS is important in determining supplier attractiveness

**H2g<sub>0</sub>** Management and organization is not important in determining supplier attractiveness

**H2g<sub>a</sub>** Management and organization is important in determining supplier attractiveness

**H2h<sub>0</sub>** Customer training is not important in determining supplier attractiveness

**H2h<sub>a</sub>** Customer training is important in determining supplier attractiveness

**H2i<sub>0</sub>** Employee training and development is not important in determining supplier attractiveness

**H2i<sub>a</sub>** Employee training and development is important in determining supplier attractiveness

**H2j<sub>0</sub>** Performance history is not important in determining supplier attractiveness

**H2j<sub>a</sub>** Performance history is important in determining supplier attractiveness

**H2k<sub>0</sub>** Customer focus is not important in determining supplier attractiveness

**H2k<sub>a</sub>** Customer focus is important in determining supplier attractiveness

**H2l<sub>0</sub>** Corporate Social Responsibility (CSR) is not important in determining supplier attractiveness

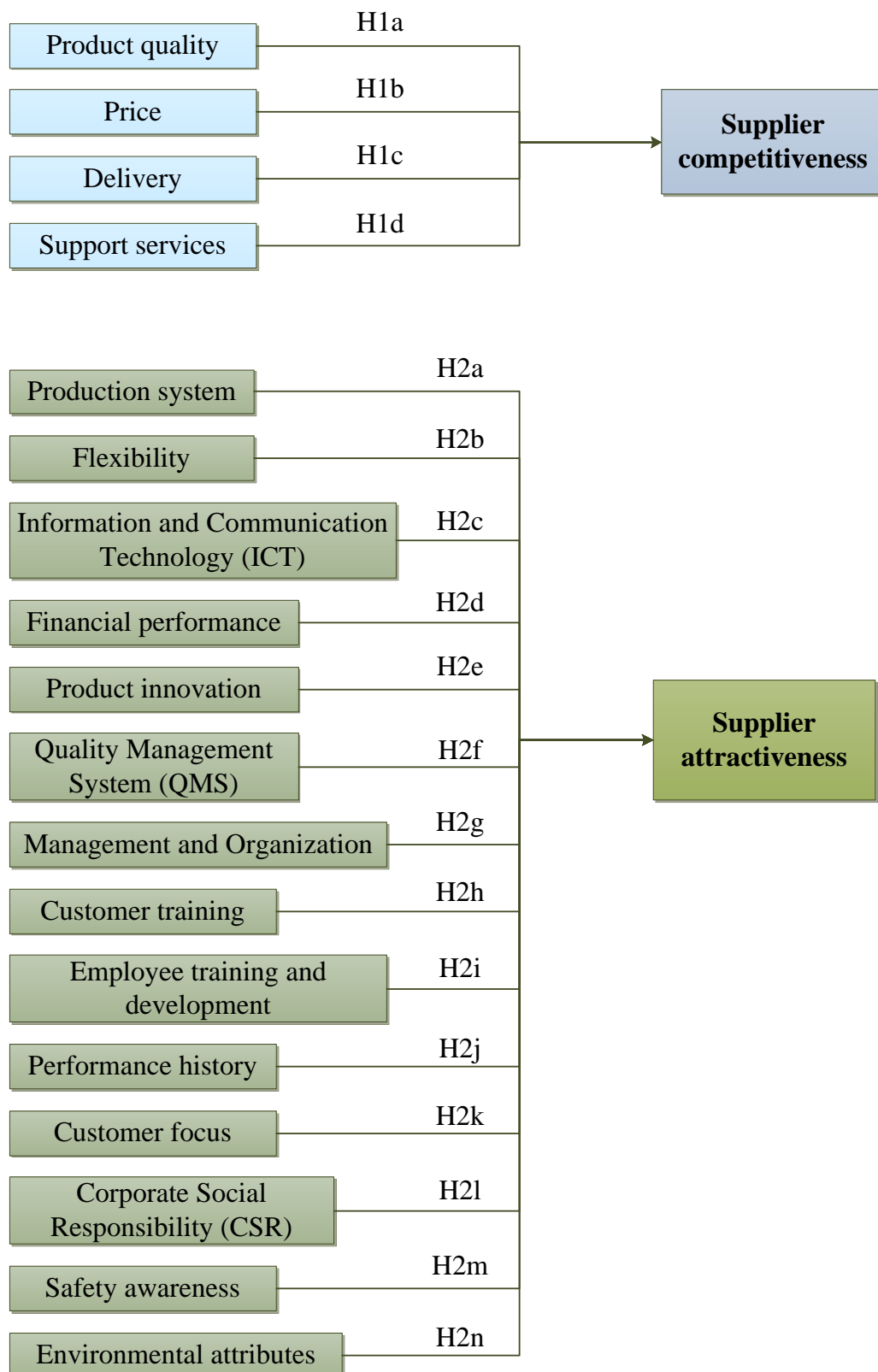
**H2l<sub>a</sub>** CSR is important in determining supplier attractiveness

**H2m<sub>0</sub>** Safety awareness is not important in determining supplier attractiveness

**H2m<sub>a</sub>** Safety awareness is important in determining supplier attractiveness

**H2n<sub>0</sub>** Environmental attributes is not important in determining supplier attractiveness

**H2n<sub>a</sub>** Environmental attributes is important in determining supplier attractiveness



**Figure 1.3** A conceptual framework for supplier selection under strategic sourcing initiative

## **1.10 Study Variables**

The dependent variables for this research study were the purchasing related personnel perceptions of the suitable metrics assessing strategic sourcing partners in the ESI. The independent variables for this research study were the corresponding definitional dimensions for the proposed metrics. This research study examined and explored the perceptions of purchasing related personnel with different roles on suitable metrics for assessing suppliers for the purchase of capital equipment in the selected host organization.

## **1.11 Nature of the Study**

The quantitative aspect of this study tends to be associated with the positivistic paradigm. The positivistic philosophy portrays the world as a fixed, measurable and objective reality with its historical background being the physical sciences. The positivist ontological view is reality is objective and singular apart from the researcher (Tuli, 2010). The epistemological assumptions are that knowledge is objective and measurable (Mack, 2010), and the axiological assumption is on the researcher's commitment to explanation (Fischer, 1990). Descriptive, comparative, correlational and causal comparative strategies and experimental research are generally the methodological assumptions for positivism (also called logical positivism and postpositivism) (Mustafa, 2011). Examining to what extent the two theorized constructs affect strategic sourcing supplier selection through the positivist lens will contribute to and broaden the body of knowledge on this topic and will be combined with the qualitative results of the study by using a mixed methods approach.

By contrast the qualitative aspect of this study tends to be associated with constructivist or interpretivist paradigms. This core tradition has its roots in philosophy and human sciences. Interpretivists believe that the reality is relative and multiple. The interpretive tradition's ontological assumptions are reality is a product of subjective experience and people construct their own meaning of events (Mack, 2010). Epistemological dimension of interpretivism understands that knowledge can be created through a person's lived

experience (Weber, 2004). The axiological positioning of an interpretivist entails that social inquiry to be value laden (Onwuegbuzie & Leech, 2005). The methodological assumptions for interpretivism include content and theme analysis and interviewing. Using a mixed methods approach that includes examining to what extent the two theorized constructs affect strategic sourcing supplier selection through the social constructivist lens will enhance the body of knowledge on this topic.

The complexity of a studied phenomenon necessitates for a new approach rather than solely depending on either quantitative or qualitative data (Creswell & Plano-Clark, 2007). The combination of quantitative and qualitative data within one study is not a new phenomenon. Utilizing a mixture of both forms of data, situating numbers within context and the words of participants of the study, can provide for the researcher a more complete analysis. Policy makers and practitioners in the field need multiple forms of evidence to inform their decisions. Mixed methods research design provides a single study, using both quantitative and qualitative data (Creswell et al., 2003). The methodology selected for this study was a concurrent triangulation, mixed methods design. This design features both types of data to be collected simultaneously for the purpose of supporting the quantitative data with qualitative data (Johnson & Onwuegbuzie, 2004). The advantages of triangulation are that it increases confidence in the research data, leads to richer data, and the findings can unearth disagreements (Johnson et al., 2007). These advantages offset the disadvantages of this approach, such as the extra effort and expertise necessary for analysis and difficulties in comparing results in both qualitative and quantitative forms (Creswell, 2003).

## **1.12 Significance of the Study**

Research in the area of SCM continues to be dynamic. The topic of strategic sourcing supplier selection is of extreme importance today. It has received increased attention from buyers, suppliers and researchers. The main aim of strategic sourcing supplier selection is to engage sourcing partners whether from within or beyond national borders to fulfil the strategic business and operational goals of the buying organization (Sollish & Semanik, 2011). The success of any sourcing strategy depends on the buyer's ability

to know and understand its supplier's background (Paquette, 2003). No doubt, there are myriad of studies on supplier selection, comprising of both empirical studies of actual practice and prescriptive studies of how suppliers should be selected (Hsu et al., 2006).

Yet, a scarcity of research has investigated ESIs executives' with various roles relating to purchasing about their beliefs, views and expectations about strategic sourcing supplier selection. No studies have investigated these perceptions within a multi-dimensional framework across two distinct constructs underlying criteria dictating the selection of preferred supplier. The current study addressed this gap in the literature review and gave purchasing related executives in the ESI an opportunity to contribute their voices to the growing body of research about strategic sourcing supplier selection. The current study provides a greater understanding of the perceptions that ESIs executives hold regarding supplier selection and the extent to which these perceptions are consistent with findings from prior studies.

The results of the research can be of value to the current and future direction of electricity utilities, and the extent to which purchasing related personnel who utilizes it as a source in their decision-making processes. Findings from the current study help in three areas:

- i. To further the research knowledge base regarding strategic sourcing supplier selection in the ESI by focusing on the perceptions of these key stakeholders.
- ii. To inform policy decisions about strategic sourcing supplier selection standards.
- iii. To aid in the development of a clear policy and procedure for strategic sourcing supplier selection.

### **1.13 Definitions of Terms**

Various theoretical and operational definitions of the concepts of interest in this study have been published in the literature. For the purposes of the current study, however, the following definitions are presented:

- i. Buyer: A person with formal purchasing authority and usually based in a purchasing department within the buying organization (Ellis, 2011).
- ii. Capital equipment: Non-expendable equipment with an acquisition cost that exceeds

- a set amount and a life expectancy of more than a year.
- iii. Decision-maker: Somebody authorized to approve purchases for the buying organization (Ellis, 2011).
  - iv. User: People who ultimately will use the product or services (Ellis, 2011).
  - v. Evaluation: The comprehensive assessment of an individual's overall ability using multiple data sources. The term is used interchangeably with assessment.
  - vi. Host organization: The organization where the research study took place is a Malaysian government-linked company. The host organization's headquarters is in Kuala Lumpur with operational facilities scattered around 13 states in Malaysia.
  - vii. Influencer: An individual that affect the decision-making procedure by providing information and occasionally criteria for evaluating suppliers (Ellis, 2011).
  - viii. Initiator: A person who makes the first request for the purchase of a product or service (Ellis, 2011).
  - ix. Perception: The term in this study refers to a form of knowing, thought, or consciousness extended from past experiences, previous attitudes, and activities toward certain objects or incidents (Bartley, 1958).
  - x. Procurement: Is a systematic process to purchase or get the needed products, services, or results from an outside source that performs the work.
  - xi. Stakeholders: Individuals or groups that have a vested interest in an organization's outcomes and services.
  - xii. Supplier: A party that supplies goods or services.

### **1.14 Key Assumptions of the Research**

The basis of the research included four assumptions. The section includes a definition of each assumption followed by its rationale. The first assumption is that the survey instrument was valid and reliable and the variables selected represent factors found to influence supplier selection outcomes. To minimize the risk, subject-matter experts were consulted to evaluate the survey instrument. A subject-matter expert can be either a chartered engineer with electrical utility background or an individual with a doctoral level of education with a focus on supply chain research and education. The second assumption is that the survey respondents would accurately and honestly respond to the

survey questions. In order to minimize the risk of inaccurately recalling their experience, the respondents were targeted from strategic business units in the selected host organization. To minimize the risk of a lack of truthfulness in given responses, engineers and managers with more experience were targeted. The third assumption is that the sample comprised individuals who are knowledgeable. To minimize the risk of this error, respondents without purchasing experience were excluded. The fourth assumption is that no environmental or industrial factors would influence the research results. To minimize the risk of this error, a single buying organization was utilized for this research.

### **1.15 Limitations**

Limitations to the research study were examined in order to take into account potential limits to the interpretation and applicability of the study results. The validity of this concurrent mixed method study was limited to the reliability of the survey instrument and of the interview questions used to examine the appropriate metrics for strategic sourcing of capital equipment within the ESI. Furthermore, there may be potential limits to the interpretation of the study results for organizations that greatly differ from the host organization in size and maturity. Following are the limitations:

- i. Since this is an exploratory study, the findings cannot be generalized to all sectors except the ESI.
- ii. The study displays data from participants who chose voluntarily to respond to the survey.
- iii. The data collection method using survey instrument tends to face limitations that normally revolve on the construction and interpretation of the survey questions; and in most cases the problem is about ambiguous questions (Creswell, 2009).
- iv. The sample size for the qualitative component was small compared to that of quantitative component (Creswell & Plano-Clark, 2007). This limitation is attributable to time and resource constraints for this study.
- v. Natural events such as illness or injury to the respondents could have been a limitation on this study.



- vi. Participants' attitudes might have changed after the study.
- vii. The study evaluated only the factors defined from the literature review and omitted other important variables.

### **1.16 Delimitation**

A delimitation of a study narrows the scope of the study (Creswell, 2003). There are several delimitations to this study that need to be addressed. The delimitations of one buying organization are deliberate due to a focus of minimizing the influence of environmental factors. The study was confined to survey managers and engineers who are involved in capital equipment purchase decision. Their degree of influence in decision-making may vary from initiator to the user. The study focused only on variables identified in the research. The research viewed strategic sourcing from the buying organization's perspective and therefore excluded the supplier's views. The study involved an organization that adopts strategic sourcing for the purchase of capital equipment. The inclination of the organization to such procurement method demonstrates that the firm understands the benefits of such practice. Organizations in the mature stage of strategic sourcing may have to work on variables not covered in this research.

### **1.17 Outline Structure of the Research Thesis**

This thesis is divided into six chapters, beginning with this introductory chapter, and is structured as follows. In Chapter 1 the introduction to the study, background information, statement of the problem, and the purpose of the study were presented. In addition, the significance of the study, research questions, and the nature of the study were included. The next section, Chapter 2 (Literature Review), presents a synthesis of the literature that highlights research on strategic sourcing supplier selection. Following that, Chapter 3 (Methodology) establishes the mixed-methods approach detailing the research design, data collection techniques and sources, and analytical procedures used in this study. Chapter 4 (Results) presents both the quantitative and qualitative results

concurrently. Chapter 5 (Discussion) provides a summary, integration, and discussion of the major findings. Chapter 6 (Conclusions) summarizes key findings and presents a discussion of theoretical and practical implications of the research findings. Finally, the overall conclusion of the study is presented followed by the thesis' contribution to knowledge and recommendations for further research. Comprising the final two sections are the references and appendices.

# Chapter 2

## Literature Review

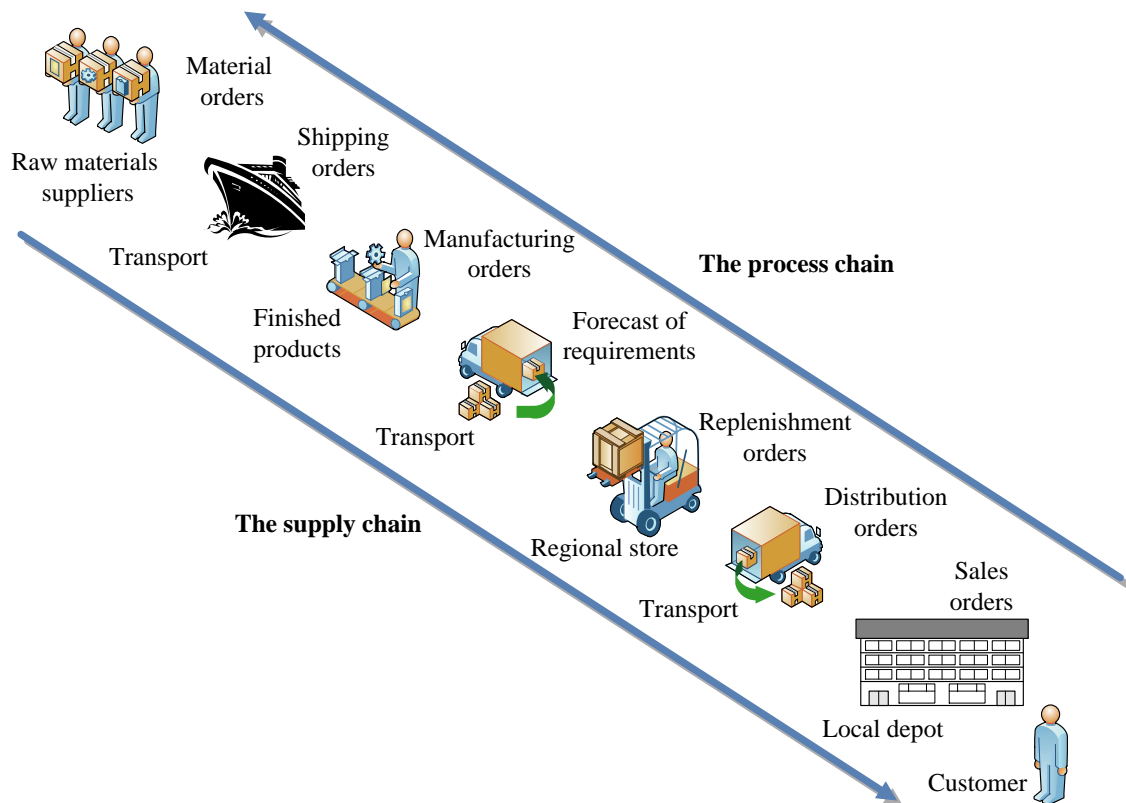
### 2.1 Introduction

The overarching purpose of this study is to explore key stakeholders' perceptions of the criteria and corresponding definitions to be used for strategic supplier selection in the ESI. The primary focus of this chapter is to survey relevant literature that form the foundation of this study. This chapter is organized into four main sections. The first section reviews the background of SCM. This section also examines emergence, definition of SCM and elements that support effective SCM. The second section provides an understanding on the role of purchasing with the supply chain. The second section also reviewed the supplier selection literature related to strategic sourcing, an area that has received much attention from researchers. The third section provided a review of organizational buying behaviour, specifically a review of organizational buying decision-making, and decision-making components (i.e., effective decision-making, rational decision-making, corporate governance in decision-making, usefulness of information in decision-making and biases in decision-making). Reviewing strategic sourcing supplier selection decision-making is important because no research exists concerning engineers' and managers' perceptions of supplier selection metrics and definitional dimensions for purchasing of capital equipment in the electricity supply industry. Literature pertaining to strategic sourcing supplier selection metrics and definitional dimensions was reviewed in the fourth section. The fourth section also included a review of current trade-offs in the supplier selection process. Finally, the last segment synthesizes the literature to identify key gaps in knowledge to be addressed in this study.

## 2.2 Background of Supply Chain Management

Organizational transformation to meet the needs of highly competitive global economy is of critical importance in the current turbulent business environment (Ireland & Hitt, 2005). Those willing to push the limits of improving performance will remain competitive within their industries. Organizations have to concentrate their focus on their entire supply chain in the quest for competitive advantage. A supply chain consists of all parties involved, directly or indirectly, in fulfilling customer demands. A typical supply chain is illustrated in Figure 2.1. Having a competitive advantage means that organizations need a unique position with respect to their rivals in order to win business. This can be achieved by manipulating various resources. In reality, the objective of an effective supply chain is to maximize its profitability. In the past, organizations have viewed the supply chain as being made up of a set isolated functional departments such as procurement, production, distribution, retailing and customer service (Wysocki, 2000) which are not mutually exclusive Ketchen et al. (2008). The development of global market forces has necessitated the integration and strategic coordination of various elements of the supply chain to ensure that costs are kept down without compromising the quality or customer satisfaction (Elmuti, 2002). Managing this chain of elements is called SCM. This indicates that the success of any supply chain should be measured as a whole and not as the success of each isolated entity involved.

Noting its significance, SCM has been recognized as a strategic tool for obtaining the desired competitive position (Spekman et al., 1998). Friedman (2005) reinforces this notion that SCM is responsible for fundamental changes in today's economy. The concept of SCM was coined in 1982 by Keith Oliver from Booz Allen Hamilton, one of the oldest management consulting firms in the world. This concept was introduced as an initiative to break down the functional silos that separated production, marketing and distribution (Russell, 2007) and has subsequently gained significant attention (Lambert & Cooper, 2000). It encompasses many different disciplines including purchasing, operations management, logistics, finance and as well as accounting, organizational behaviour, human resources etc. (Burgess et al., 2006 ; Frankel et al., 2008). However, Burgess et al. (2006) articulate that SCM has a stronger link with operations management due to its complementing theories.



**Figure 2.1** Typical supply chain

### 2.2.1 The Emergence of SCM

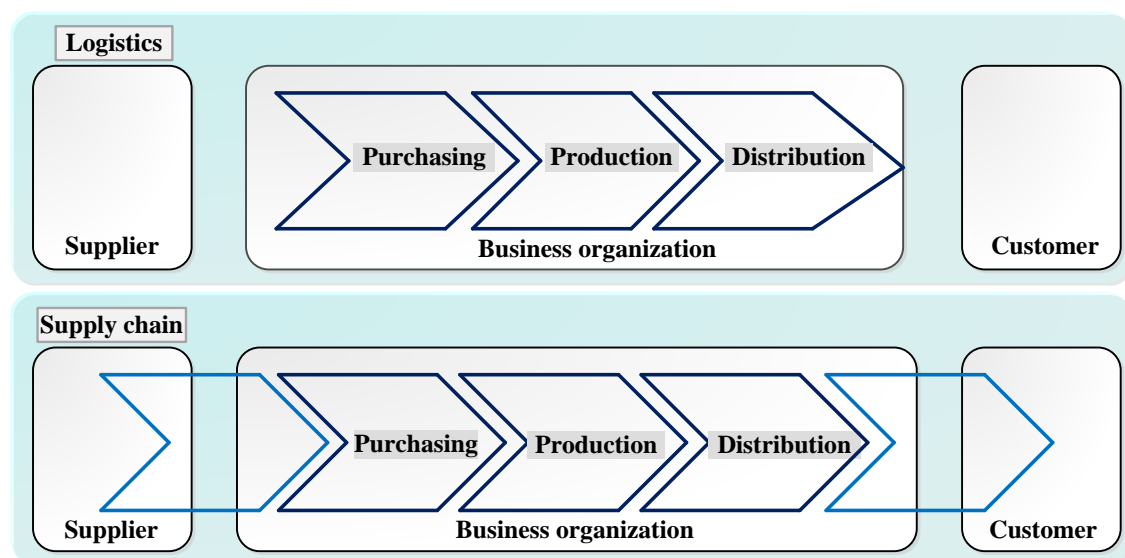
SCM is a concept that has originated and succeeded in the manufacturing industry. Leading organizations such as Wal-Mart, Toyota, Hewlett-Packard and Xerox are dependent on their supply chains to remain competitive in the market (Cooper et al., 1997; Ketchen et al., 2008). This fact was the outcome from one of the most commonly cited success stories in SCM is that of Wal-Mart, which overtook its rival Kmart within ten years, by successfully implementing SCM concepts in its business operations. As a result of this success and many others SCM has received a remarkable degree of interest for research and implementation. Today it is recognized as a source of competitive advantage by both in practitioners and academics (El-Tawy & Galliar, 2011; Mentzer et al., 2001; Porter, 1985b).

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**Figure 2.2** Transformation leading towards SCM

The history of the supply chain initiative can be associated to the evolution logistics to the current state of SCM as illustrated in Figure 2.2. Prior to 1960s, different related functions (e.g. purchasing, production planning, warehousing and packaging) were fragmented in nature with each individual function is allocated its specific budget and expected to achieve specified goals (McKinnon, 2005). Commencing in the 1960s and 1970s organizations started to portray themselves as closely linked roles whose mutual intention was to serve their customers. This trend has led to the formation of logistics which integrates both the inbound (materials management) and outbound (physical distribution) functions with more emphasis was placed on reducing inventory levels. Originally, logistics as a management discipline started as a military context which later expanded into the commercial sector as business logistics. SCM has at times been referred to as logistics. However, there is a difference, SCM comprises activities,

departments and organizations that network collectively to deliver a product to market (Hugos, 2006). In the 1980s and 1990s many organizations continued to coordinate logistics with other functions, which were not integrated, such as strategic planning and marketing. They began to realize that it is unlikely to have optimized flow of products across the supply chain if logistics is isolated from other functions. This is the essence of SCM, which suggests the boundaries to be expanded beyond logistics within an organization, and within a supply chain, to create customer value and satisfaction (Mentzer et al., 2001). More importantly, SCM has been viewed as an effort to replace pure logistics as a top management's concern (Oliver & Webber, 1992). Figure 2.3 illustrates that logistics emphasize an intra-organizational focus while SCM focuses on inter-organizational relationships. The importance of SCM kept growing and is evident by introduction of SCM related qualifications at the tertiary level towards the later part of 1990s (Russell, 2007). Its prominence became more apparent when Council of Logistics Management changed its name to the Council of Supply Chain Management in 2005 (James, 2012), which implies that logistics management is viewed as an element of the supply chain process, rather than a "stand alone" discipline.



**Figure 2.3** Logistics and supply chain management

The striking growth of SCM was influenced by political, economic and technological changes (Giannakis, 2004). These instrumental factors have triggered major theoretical developments that integrate systems theory, transaction cost economics, game theory, network theory, etc. This provides the foundation upon which the current body of SCM

knowledge is built. Historically, SCM originated from different schools of management thought as illustrated in Figure 2.4 (Russell, 2007). The evolution of scientific management discipline began in a formal way stemming from worker productivity, which was the key issue in the *Principles of Scientific Management* published in 1911 (Merkle, 1980). The era between 1920s – 1950s exhibited the displacement of scientific management principles with the advancement of statistical methods, quality assurance and quality control which were responsible for industries to embrace operations management. The modern theory of finance begin to emerge in the 1950s has impacted business decision-making with the intention to maximize the wealth of shareholders (Russell, 2007). During the 1960s, the focus shifted towards rigorous marketing approaches emphasizing the areas of consumer behaviour and the analysis of distribution system (Bowersox, 2007). Throughout the period of the 1970s, the need to improve distribution functions due to increase in petroleum price has necessitated business organizations to adopt principles of military logistics (Bowersox, 2007; Russell, 2007). The 1980s saw the beginning of human resource management with the main aim of improving productivity (Russell, 2007). Parallel to that, quality management has gained wide popularity in various types of organization. The 1990s was a decade of abundant transformation and also a period during which the importance of logistics management caught the attention of major corporations worldwide in their effort to meet the increasing demands of customers (Bowersox, 2007). As we closed out the first decade of the 21st century, logistics has been redefined as SCM, the modern frontier of management thought.



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**Figure 2.4** Evolution towards present state of SCM

### **2.2.2 The Definition of SCM**

The concept of SCM has been covered extensively in the academic literature but a consensus on its definition is yet to form. Academic and industry practitioners are struggling to come up with a universally accepted definition of SCM. The reasons for this difficulty can best be explained by looking at the historical development of the SCM concept. Albeit SCM may originally have only been associated with the logistics of materials' efficient movement (Russell, 2007), it has broadened in scope to the extent

that is becoming synonymous to “value chain” concept (Porter, 1985a; Sweeney, 2009).

While a multi-disciplinary definition of SCM is obscure, a definition mooted by the Global Supply Chain Forum stands out: “Supply Chain Management is the integration of key business processes from the end user through the original suppliers that provides products, services, and information that add value for customers and other stakeholders” (Lambert & Cooper, 2000, p. 2). Another popular definition which is well articulated by the Council of Supply Chain Management Professionals (CSCMP), formerly the Council of Logistics Management: “Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies” (Gibson, 2005).

The term SCM has been used to explain the materials and information flows as well as the logistics activities not only internally within a company but also externally between supply chain partners (Cooper & Ellram, 1993). Lummus and Vokurka (1999) state that SCM includes all activities involved in delivering products from raw material to customer, including sources of raw material and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, delivery to customers and information systems required to monitor all activity. Another definition of SCM, according to Harrington (1995), is that it is an approach dealing with production and information flows covering all supply chain partners. On the other hand, Johannson (1994) contends that SCM is more to an operations approach to procurement. Therefore, this requires all supply chain partners to be well informed which has bearing on overall performance.

Based upon the review of definitions, SCM might best be viewed as a business philosophy that focusses on organizations and their business activities within the supply chain. Therefore, SCM ensures better flow of material and information in the supply chain through coordination between companies and across functional boundaries.

### 2.2.3 Effective SCM

SCM is a vital strategic element for increasing organizational effectiveness in logistics. However, SCM is not a standalone process, but the understanding that several functions and organizations have to collaborate seamlessly for the supply chain to operate efficiently in delivering the product or service to the end user. SCM improves competitiveness, customer service, and enhances profitability (Matchette & Lewinski, 2006; Mentzer, 2000; Talib, 2010). Those unfamiliar with this school of thought may be interested to know that it basically boils down to the fact that successful implementation of SCM depends on management practices which are aligned to SCM philosophy. Previous studies have indicated that successful implementation of SCM philosophy is closely related to various crucial activities as illustrated in Figure 2.5.

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#### **Figure 2.5** Crucial activities for an effective SCM

Bowersox and Closs (1996) believe that to be fully effective in today's turbulent business environment, organizations must develop their integrated behaviour to incorporated customers and suppliers. This expansion of integrated behaviours, through external integration, is defined by the authors as SCM. The concerted effort between supply chain partners aim to provide products, services, and information that enhance value for the end customer (Cooper et al., 1997; Mentzer et al., 2001; Stank et al., 2001).

Several authors have suggested that there is a direct association between the performance of supply chains and the accessibility and quality of timely information (Chen, 2005; Corbett, 2001; Lariviere & Padmanabhan, 1997). Seidmann and Sundararajan (1998) point out four different levels of information sharing: ordering

information, operational information, strategic information, and strategic and competitive information. A pressing issue in SCM, prominently known as the bullwhip effect, could be attributed to lack of information sharing between supply chain partners (Fiala, 2005; Moyaux et al., 2007). The general idea of the bullwhip effect which is better known as Forrester effect (Forrester, 1961) is that demand variations are increasingly amplified as one moves upstream in the supply chain. As information passed on to another element of the supply chain is distorted, each of the supply chain partners tries to secure some safety stock in case of unexpected demand variations. Kainuma and Tawara (2006) articulate that manufacturers are inclined to share information with their suppliers in order to reduce uncertainty in supply chains. Most of the literature on supply chain uncertainty recognizes Davis' (1993) influence on the subject with sources of uncertainty in the supply chain defined as supplier performance, production process and customer demand. Figure 2.6 illustrates how three sources of uncertainty that plague supply chains. Supplier performance marks the first source of uncertainty in the supply chain. Supplier performance uncertainty arises from on-time performance, average lateness, and degree of inconsistency. The second source of uncertainty comes in the production process itself: process performance, machine breakdown, supply chain performance etc. The final source of uncertainty in the supply chain is customer demand which stems from forecasting errors, irregular orders, etc.

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**Figure 2.6** Effect of uncertainty in the supply chain

Effective SCM also requires supply chain partners to be willing to mutually share risks and rewards which yield higher business performance (Ellram & Cooper, 1990; Simatupang & Sridharan, 2002). Risk and reward sharing is vital to maintain the relationship between supply chain partners on long term basis (Cooper et al., 1997). What is more important, organizations should not only concentrate on their own risks, but must also pay attention on risks in other links in their supply chain (Souter, 2000). Norrman and Jansson (2004) assert that mitigating risks in SCM involves preventive measures to reduce the negative ripple effects from disasters or even minor business disruptions can have in a supply chain. For instance, Toyota's production was halted for almost two weeks following a fire in February 1997 at its brake-fluid proportioning valve supplier (Aisin Seiki). This led to the shutdown 18 plants during the period which caused \$325 million in losses (Norrman & Jansson, 2004).

SCM epitomizes a paradigm shift that amplifies appreciation of the need for cooperation with suppliers and customers (Spekman et al., 1998). Cooperation in SCM refers to creation of closer interaction between supply chain partners with an intention to benefit each other (Stadtler, 2005). Organizations must have the will to make changes cooperatively with business partners and confident that mutual effort will result in value to customers (Min & Mentzer, 2004). The desired outcomes of supply chain cooperation such as reduction of inventories and overall efficiency improvement (Mentzer, 2000) depends on two major and distinct informal mechanisms: power and trust (Ballou et al., 2000). The exercise of power by a dominant partner may coerce other partners to act as that dominant partner desires (Ke et al., 2009). For example, being a sole supplier for a particular product, he might be able to compel the buyer to purchase in a large quantity. By way of contrast, trust is defined as an expectancy of outcomes that one partner can receive based on the reliability and integrity of another partner (Ballou et al., 2000; Sahay, 2003). It is reported that the biggest stumbling block leading to inefficient and ineffective supply chain performance is the lack of trust among supply chain partners (Kwon & Suh, 2004).

SCM advocates that the supply chain be strategically managed as a single integrated chain rather than a set of individual echelons. This requires integration of the organisational elements responsible for each process and the external suppliers and customers (Samaranayake, 2005). The integration of business processes across the

supply chain encompassing purchasing, production and distribution is vital for the implementation of effective SCM (Cooper et al., 1997; Croxton et al., 2001). The integration of supply chain areas into a set of processes aims to obtain exemplary overall supply chain to add value to the end customer (Bechtel & Jayaram, 1997). The processes integration has proved to proffer other advantages: shorter delivery times; more reliable delivery promises; fewer schedule disruptions; lower stock levels; fewer quality problems; and stable prices (Christopher, 1998). Integration can be made possible through cross-functional teams, in-plant supplier personnel and third-party service providers (Mentzer, 2000). As integration cannot be achieved over a short period of time, Stephens (1989) distinguishes a four stage approach:

- i. fragmented operations of supply chain within the same individual company;
- ii. focusing on internal integration for cost reduction;
- iii. reaches full visibility of purchasing through distribution with an emphasis on efficiency rather than effectiveness; and
- iv. extending the scope of integration outside of the organization to embrace suppliers and customers.

Strategic partnerships or the inclination for two organizations to work together to address business problems, is at the heart of SCM. We no longer treat suppliers and customers as though they are separate entities. Ellram and Cooper (1990) point out that effective SCM depends on building strategic partnerships with long-term orientations. For example, Wal-Mart has effectively pursued this strategy by forming partnerships with key suppliers such as Procter and Gamble, 3M and Philips Consumer Electronics to that help both parties reduce their costs (Mentzer et al., 2000). By nature, the supplier selection process is a complicated task. Profitability and customer satisfaction are directly proportional to the effectiveness of supplier selection. Therefore, supplier selection is a crucial strategic decision for long term survival of the organization. Failure to foster close inter-organization relationships could lead to overall organization's instability at the same time it increases risk and associated costs. For instance, Boeing Aircraft was forced to declare write downs of \$2.6 billion in October 1997 due to raw material shortages, internal and supplier parts shortages (Holmes & France, 2002). The loss comprises late delivery payments, higher vendor costs, extensive overtime and expedited delivery costs. Therefore, having a relationship which

is designed to achieve long-term strategic objectives will strengthen an organization's competitive position (Mentzer et al., 2000).

Finally, sharing the same goal and focus between supply chain partners is an important building block in effective supply chain strategies. Lassar and Zinn (1995) contend that successful partnerships eliminate redundancy and overlapping while in quest of a level of cooperation that permits supply chain partners to be more effective at lower cost levels. This is possible if the supply chain partners have compatible cultures and management techniques (Mentzer et al., 2001). Good alignment, or conversely a reduction in goal and focus discrepancy can translate into less emphasis on conflicts which would impede another partner's goal pursuit (Mentzer et al., 2000).

The links between aforementioned important elements to some extent recognize the role of supplier for effective implementation of SCM. This is in accordance with the aim of SCM to leverage the supply chain to obtain the lowest initial purchase price while assuring supply (Spekman et al., 1998). The current focus on SCM, with emphasis in relationships between suppliers and buyers has heightened the purchasing process to a strategic level.

### **2.3 Role of Purchasing within the Supply Chain**

Procurement is a logistics function and is important in SCM. The terms "procurement" and "purchasing" are often interchangeably used in manufacturing. However, in the context of construction procurement is a much more complex system. Procurement encompasses all activities performed to deliver products from the supplier to the internal customer (end-user), whereas purchasing only involves the buying process (Kumar et al., 2005). Procurement spend can consume a large portion of an organization's expenditure. Karthik (2006) claims that procurement spend can account for 40-60% of the total expenditure of manufacturing firms. This is supported by Weber et al. (1991) who contend that in high technology firms, purchased materials and services represent up to 80% of total product costs.

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**Figure 2.7** Purchasing process activities

Figure 2.7 illustrates the main activities within the purchasing function. Although the purchasing process has been described in many ways, in the author's opinion, they all come down to the six basic steps identified by Van Weele (2005). The process initiates with determining specifications by internal customer (end user). Thereafter, a suitable supplier is selected based on compliance to the set terms and conditions. Contracting of suppliers involves issuance of contract document which is legally binding. During the contract period, orders for products and services can be placed with the designated supplier. However, these orders should be subject to close monitoring and inspection to ensure proper and timely delivery. The final step in the process is evaluation of the supplier.

Purchasing of products and services can be grouped according to a modern classification by Kraljic (1983) of Faris, Robinson and Wind's (1967) model. Kraljic lists four classifications namely strategic, bottleneck, leverage or routine situations. Olsen and Ellram (1997) on the other hand, posit a categorization based on competence, economic and image factors under a strategic importance theme. The complexity of managing the purchase could be determined by product, supply market and environmental characteristics. Table 2.1 explains the differences between each category of purchase.



Table 2.1 Purchasing portfolio model categories

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### 2.3.1 Purchasing in the Electricity Supply Industry

In the electricity supply industry generation, transmission and distribution components involve obtaining products and services required for set-up of new installations. This is also required for maintenance, repair and operations (MRO) activities. Table 2.2 lists the purchases used in the three core activities of a power utility (Bascom et al., 2000; Burke & Clapp, 2000; Dietzman et al., 2000; Miley & Clapp, 2000). Equipment used for generation are different from that used in the transmission and distribution stages but materials require in the latter two stages can be similar. Figure 2.8 explains the purchasing portfolio model adopted by a leading power utility company in the United States which could be used as an example to understand the different kind of supplier relationships (Olsen & Ellram, 1997).

Table 2.2 Common Equipment Purchase in Power Utility

<b>Generation</b>	<b>Transmission</b>	<b>Distribution</b>
Turbine	Transmission tower	Lighting poles
Condenser	Transformers	Meters
Boiler	Wires & Cables	Transformers
Control systems	Insulators	Wires & Cables
Pumps & Valves	Substation parts	Insulators
Fans	Others	Substation parts
Others		Others

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**Figure 2.8** Purchasing Portfolio Model for Georgia Power Company

### **2.3.2 Strategic Sourcing**

A critical aspect of the present study is that it addresses a process for selecting supplier metrics within the context of strategic sourcing activities. Strategic sourcing is critical for organizations practicing the principles of SCM (Talluri & Narasimhan, 2004). “Strategic sourcing” is a term that began to be used in the 1990s to mark a shift in the sourcing methods used by the supply chain partners. This shift was away from those that dealt with immediate price decreases based on transactional data towards methods with a more strategically directed approach that strove to address an organization’s long-term goals and objectives (Cavinato et al., 2006; Talluri & Narasimhan, 2004) (Cavinato et al., 2006; Talluri & Narasimhan, 2004). The main differences between the traditional purchasing and strategic sourcing are presented in Table 2.3.

Table 2.3 Differences between traditional purchasing and strategic sourcing

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Cavinato et al. (2006) point out that the term strategic is adopted to describe the critical impact areas in strategic sourcing such as capital equipment and commodity products which have direct and significant impact on the organization's goals and objectives. It manages the supply base in an effective manner through identification and selection of suppliers for strategic long-term partnerships (Ogden et al., 2007). Strategic sourcing promotes enhancement of supplier performance, providing benchmarks and continuous feedback to suppliers (Egbelakin & Wilkinson, 2008). Identifying suppliers who can take on partnership or alliance responsibilities is daunting. Evaluation and selection are

the two aspects that require decision support metrics that have an agreed-upon definition by key stakeholders. Organizations should periodically evaluate the supplier base and the type of relationship established with each supplier as part of the strategic sourcing process. Supplier partners that fail to maintain workable relationships will ultimately be replaced with partners who are able to do so. Therefore, the buying organization should ensure that the supplier not only able to meet the current strategic needs but also if the supplier could meet the future needs as well (Araz & Ozkarahan, 2007; Talluri & Narasimhan, 2004).

### **2.3.3 Supplier Selection**

SCM is an important part of managing and structuring business processes (Cooper et al., 1997). The term “business processes” is sometimes used interchangeably with the words “supply chain” (McAdam & McCormack, 2001). One important aspect of SCM is supplier management or supplier base management. Choosing the right supplier can help create cost savings for companies that spend on parts and machineries (Goffin et al., 1997). According to Philipson and Willis (2006), the electricity supply industry is one of the most capital intensive businesses because of its intricate but complicated infrastructure. TNB for instance, has a net asset worth of 74.1 billion ringgit as of 2010 (TNB, 2011). The cost incurred is substantial as the network coverage for electricity supply must literally encompass the utility’s entire national operation. Swift and Grubben (2000) write that supplier selection is crucial in identifying the optimal supplier who can provide the best all-round package of products and services for the organization. Haluch (2000) further asserts that increasing competition and the limitations of a product’s life cycle are key determinants for the need of an effective supplier selection process. In recent times, we have seen companies like Chrysler and General Electric turning to supplier selection as a strategy to promote faster delivery, decrease production lead time, reduce costs and increase quality (Choi & Hartley, 1996).

It is evident that supplier selection is important to the SCM. Supplier selection “commits resources while simultaneously impacting such activities as inventory management, production planning and control, cash flow requirements, and product quality” (Narasimhan, 1983, p. 27). In the electricity supply industry particularly, major

investments need to be made in the purchase of more dependable equipment that can reduce supply interruptions to customers (Willis & Garrod, 1997). A failure of a major piece of equipment in one part of the supply network can affect the stability of the entire system (Joskow, 1997). The operations reliability of an electricity utility is highly dependent on the delivery of the right products or services by the right suppliers (Nel, 1992). Selecting a wrong party could impact negatively on the buying organization. Therefore, it is imperative that the organisation acquire and manage its supply chain resources to ensure highest quality of service at the lowest possible cost (Cox, 2001).

### **2.3.3.1 Definition of Supplier Selection**

Many organizations have implemented strategic sourcing to create a linkage between sourcing strategy and organizational strategy (Leenders et al., 2006). This shows that suppliers and supply base are acknowledged as contributing factors of an organization's success. Banfield (1999) and Demirtas and Üstün (2008) confirm that the supplier selection process is the single most important outcome of the strategic sourcing process. Banfield (1999) identifies supplier selection as a valuable relationship creation with suppliers who are able to deliver promises and to commit and support the vision of the buyer. The supplier selection process itself is an activity whereby a buyer chooses a preferred supplier(s) from those qualified as suitable candidates. It involves two main tasks, which are also central to any decision-making problem (Braglia & Petroni, 2000): (1) the process of evaluation and assessment; and (2) the aggregation of evaluation and assessment to make a choice.

### **2.3.3.2 Importance of Supplier Selection Process**

Supplier selection and evaluation are important activities in SCM. Supplier selection is given more emphasis today as organizational competitiveness can be enhanced through closer and longer term relationships with suppliers (Xu et al., 2009). Kannan and Tan (2002) attest reliance on suppliers increases the need to have effective supplier selection as a prerequisite of supplier management, as does Enyinda et al. (2010) Purchasing commands a significant position in most organizations as: (1) cost of purchased goods and services represent more than 60% of costs of end products; and (2) over 50% of all quality defects can be traced back to purchased materials (Lee, 2001). Any small cost

reductions in the acquisition of products or services could increase an organization's profit margin (Goffin et al., 1997). Making a wrong decision, on the other hand could impact negatively on an organization's operational and financial positions (Degraeve & Roodhooft, 1999b). Overall supplier selection processes are deemed to be of increasing importance in the construction/ engineering sector. This is similarly deemed to be the same in the Malaysian ESI. Consequently supplier selection forms the fundamental basis of this study.

### **2.3.3.3 Supplier Selection Problems**

In the past, supplier selection was perceived to be a relatively straightforward matter. However the process now has been overshadowed by some difficulties due to: (1) the growing number of potential suppliers; (2) the growing number of attributes; (3) an increasing number of situational contexts that can affect the appropriateness of specific supplier attributes; and (4) the difficulty in identifying and defining supplier selection parameters (Altinoz et al., 2010). Larger numbers of suppliers in a market can reduce an organisation's dependency on specific suppliers and ensure better purchasing power. However the drawback of this scenario is that it remains highly likely for organisations to make mistakes in the selection process. Dickson's (1966) seminal work found 23 important attributes used for evaluation and selection of suppliers. Since then various work has considered different factors (Lambert et al., 1997; Swift, 1995; Weber et al., 1991). Because of the wide selection of options, it is becoming difficult for purchasing managers to decide on those to adopt or rank according to importance. This is further impeded by changing organisational objectives for example marketing policies and manufacturing objectives may take precedence over objective and unbiased selection of suppliers. Furthermore, intrinsic values like flexibility, responsiveness and attitudes are hard to rank as compared to extrinsic values like price and delivery performance. Sometimes decision-makers are forced to make decisions using incomplete data. Another common problem is that of how many suppliers can be used for each purchased item (Wisner et al., 2005). In single sourcing, suppliers are considered to be capable of satisfying the buyer's requirement (Xia & Wu, 2007). The purchaser only needs to make one decision, which supplier is the best. However in multiple sourcing, purchasers need to decide which are the best suppliers and how many orders should be placed with each selected supplier. Table 2.4 shows the summary made by Wisner et al. (2005), on

reasons for favouring single or multiple sourcing.

Table 2.4 Reasons favouring the use of single versus multiple sourcing

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#### **2.3.3.4 Supplier Selection and Evaluation Process**

A supplier selection strategy is adopted by firms to evaluate and select suppliers with the intentions of: (1) reducing purchase risk; (2) maximizing overall value to the purchaser; and (3) building the closeness and long term relationship between buyers and suppliers (Xu et al., 2009). De Boer et al. (2001) describe four key steps in the supplier selection process as illustrated in Figure 2.9.

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### **Figure 2.9** Supplier selection process

Decision-makers face different purchasing situations which require them to identify the requirements of a decision along with the available alternatives (Aissaoui et al., 2007). This formulation influences activities such as inventory management, production planning and control, cash flow requirements and product or service quality (Narasimhan, 1983). Decision criteria formulation is critical to select the best suppliers available. The process has significant complexity due to the existence of various (i.e. objective and subjective) selection criteria. Supplier pre-selection or pre-qualification is intended to eliminate those potential suppliers who are not capable of delivering the required capability or service level (El-Sawalhi et al., 2007). Typically this is done through the requirement prior to bidding of providing evidence of previous experience or capability within the competency that the purchase is intended to cover. Indeed this is the principle component of the PIPS procurement protocol developed by Kashiwagi and Byfield (2002). The reduction of potential supplier candidates reduces the workload on the purchasing manager's group and allows a greater depth of assessment of those bids passing this stage. During the final selection process, successful suppliers are identified, and orders are allocated among them, based on a selected decision model.

#### **2.3.3.5 Supplier Selection Methods**

There are a number of methodologies which have been developed to assist in evaluating suppliers. Selection criteria and measures used are changing and will continue to change as information technology permeates through organizations (Khurram, 2003). The supplier selection approaches are described in the following section.



### **2.3.3.5.1 Categorical Method**

The categorical model is a traditional method that classifies each supplier's performance in specific areas defined by a list of relevant performance attributes (Humphreys et al., 1998). This method is simple to use, inexpensive, and the evaluation can be done quickly. The suppliers' performance on each attribute is assessed in categorical terms such as "good", "neutral" or "unsatisfactory". The buyer then determines the supplier's overall scores. The supplier with the most "good" rating is considered the best. The drawback of this method is that all attributes are assumed to have equal importance. The categorical method also relies heavily on the experience and ability of the individual buyer (Ordoobadi, 2009). Consequently the method is highly judgemental and biased: in terms of future practice the judgment is not replicable without the experience of particular buyer.

### **2.3.3.5.2 Weighted Point Method**

The weighted point method is also known as linear weighted average method (Humphreys et al., 1998). This method utilises a relative importance weighting assigned to each attribute so that a composite performance index can be calculated and a comparison made. The evaluator rates the performance of suppliers with respect to each attribute. Purchase price is one of the key attributes that will be assessed, but is not the only attribute. Other attributes in this method are usually referred to as "non-price attributes" (Ittner et al., 1999). The performance scores are multiplied by the attribute importance weighting to calculate a supplier's overall rating. The supplier with the highest weighted score is deemed to be the best. The purchasing organization is thus able to include numerous evaluation criteria and assign them with weights according to the organization's needs. Although this method no longer treats each criterion as having equal importance, the subjectivity of the decision maker in assigning weights remains an issue (Ordoobadi, 2009).

### **2.3.3.5.3 Cost-Ratio Method**

This method evaluates supplier performance based on cost analysis (Willis & Huston, 1989). The total cost related to quality, delivery and service are calculated and expressed as a percentage of the total value of the purchase. The total purchase cost includes the selling price plus the purchaser's internal operating costs associated with

the purchases. For example, the costs associated with delivery include communications, meetings with supplier and emergency transportation costs. Overall cost ratio is applied to the supplier's quoted unit price to obtain the net adjusted cost figure. The net adjusted cost figure is used as the basis for performance comparison among bidders. The supplier who can offer the lowest cost ratio is considered to be the best. This method is more precise compared to the earlier mentioned methods. Willis and Huston (1989) argued that cost-ratio method is a complex approach, requiring a comprehensive cost-accounting system to generate the precise cost data. Furthermore, it assumes that all required data are easily available – which is often not the case.

#### **2.3.3.5.4 Vendor Profile Analysis**

Thompson (1990) introduced a modified weighted average method to address the uncertainty involved in the assignment of ratings. A Monte Carlo simulation technique is used to replace the rating based purely on intuitive judgement. The use of Monte Carlo simulation simplifies the decision maker's input to the evaluation process and provides output that has considerably more information for the decision maker. For example, the simulation provides the level of performance anticipated from each supplier. The degree of uncertainty associated with the overall performance of each vendor is shown by the variance value. The degree of overlap assists the decision maker to identify the potential similarities in performance between suppliers. This extra information allows the forecast of each supplier's performance level and potential for deviation from the expected level. However this method cannot quantify qualitative criteria effectively and it is difficult to apply to users who do not have a good understanding of the Monte Carlo technique.

#### **2.3.3.5.5 Dimensional Analysis**

Willis et al. (1993) propose the application of a mathematical technique called dimensional analysis in supplier selection evaluation. This technique provides a means of combining several criteria of different dimensions and varying relative importance into a single dimensionless entity. The evaluation process involves a series of one to one comparisons and only one supplier is evaluated at a time. When this method is applied to measure supplier performance, the different dimensions refer to the various criteria in the selection decision such as price, quality and delivery. Each criterion has a particular

unit of measure. In order to create a dimensionless entity, each criterion is divided by the desired company standard. The dimensional analysis model is given by the following equation:

$$\text{VPI} = \mathbf{W} \sqrt{\prod_{i=1}^n \left(\frac{X_i}{Y_i}\right)^{w_i}} \quad \text{Equation 2.1}$$

Where:

VPI = vendor performance index

$X_i$  = performance criterion score for supplier X

$Y_i$  = standard performance score for criterion i

$i = 1, 2, \dots, n$ th criterion

$w_i$  = weight assigned to criterion i (relative importance)

$$\mathbf{W} = \sum_{i=1}^n |w_i| \quad \text{Equation 2.2}$$

A series of pair-wise comparisons of suppliers is needed to obtain the ranking when there is a group of suppliers. The main drawback of this method is that the process becomes very time consuming if there are a large number of suppliers to be evaluated.

### 2.3.3.5.6 Analytical Hierarchy Process (AHP)

Narasimhan (1983), Nydick and Hill (1992) and Partovi et al. (1989) all discuss the use of the AHP approach for supplier selection problems. These authors contend that it is effective because of its inherent capability to handle both qualitative and quantitative criteria in suppliers' selection. AHP is a mathematically based multi-criteria decision making (MCDM) tool and was originally introduced by Saaty (1980). This method allows the decision maker to structure complex problems in the form of a hierarchy. AHP also has the ability to monitor the consistency with which a decision maker makes a judgement (Vargas, 1990). The hierarchy has at least three levels: the goal, the criteria and the alternatives. The goal is to select the best overall supplier and the alternatives are the different proposals provided by the suppliers. All criteria are compared fairly to determine their relative weights. Subsequently, the alternatives are compared with regard to each criterion. The final outcome of this process is a score for each alternative. AHP avoids the drawback of the traditional methods of assigning weights purely based on personal judgement and intuition of decision maker. However, it is still possible to

‘stack the deck’ in favour of a particular supplier solution with this system if an unscrupulous purchaser runs it.

### **2.3.3.5.7 Total Cost of Ownership**

This method attempts to include all quantifiable costs in the supplier choice that are incurred throughout the purchased item’s life cycle (De Boer et al., 2001). Optimum use of all discounts available can lead to substantial savings. Price is an important criterion, but not the only factor affecting purchasing cost. In addition to price cost factors such as quality shortcomings, transportation cost, ordering cost, reception cost need to be taken into account. Using this method, the purchaser will award the job to the supplier with the lowest unit total cost. The total cost of ownership philosophy maintains that the least expensive supplier is not necessarily the best choice if one takes into account all the possible additional costs to be generated across the supply chain (Degraeve & Roodhooft, 1999). This approach enables substantial cost savings to be achieved and it offers an opportunity to compare different purchasing strategies objectively. It can also be used in buyer-supplier negotiations to discuss recent performance. The total cost model is useful if it is precisely calculated. However the technique is expensive to implement due to its complexity, and difficult to implement because of the implied requirement to be able to correctly identify all the critical elements. The technique is also less attractive than some other because it requires more time to fully complete the evaluation process and thus harder to make timely decisions.

### **2.3.3.5.8 Multiple Attribute Utility Theory (MAUT)**

This approach enables the decision-maker to structure a complex problem in the form of a simple hierarchy and to subjectively evaluate a large number of quantitative and qualitative factors in the presence of risk and uncertainty. This makes the techniques especially useful for handling multiple conflicting criteria inherent in international supplier selection. International supplier selection is very complicated and risky, owing to variety of uncontrollable and unpredictable factors such as exchange rate, tariffs and government policies which might affect any decision taken. Utility is a measure of desirability or satisfaction and provides a uniform scale to compare and/or combine quantitative and qualitative factors. The utility function is a device which quantifies the preferences of a decision maker by assigning a numerical index to varying levels of

satisfaction of a criterion (Stewart & Mohamed, 2002). The major strength of this approach is its ability to deal with both deterministic and stochastic decision environments (Zionts, 1992).

### 2.3.3.5.9 Mathematical Programming Method

Mathematical programming is an optimization method to select several suppliers in order to maximize an objective function subject to supplier/buyer constraints. Various mathematical programming methods are used in the supplier selection literature such as listed below:

- A. **Linear Programming:** This technique is widely used. For example Moore and Fearson (1973) utilize linear programming to optimize the supplier evaluation model based on price. Anthony and Buffa (1977) similarly use this method to minimize total purchasing and storage costs based on budget, demand, satisfaction and storage constraints. Talluri and Narasimhan (2003) develop two linear programming models to maximize and minimize the performance of a supplier against the best target measures set by the buyer. These authors went on to develop another model to evaluate and select potential suppliers with respect to the strengths of existing suppliers and exclude underperforming suppliers from a telecommunication company's supply base (Talluri & Narasimhan, 2005). Ng (2008) on the other hand, developed a weighted linear programming model with an objective of maximizing supplier score in the supplier selection.
- B. **Goal Programming:** Karpak et al. (2001) constructed a goal programming model to evaluate and select the suppliers. Three goals were considered in the model: cost, quality and delivery reliability. The model was intended to determine the optimal amount of products ordered, while subjecting to buyer's demand and supplier's capacity constraint. One of the drawbacks of this method is the lack of consideration for qualitative factors. To overcome this, Cebi and Bayraktar (2003) integrated goal programming and AHP which considers both qualitative and quantitative criteria.
- C. **Data Envelopment Analysis (DEA):** DEA is another method that aids decision makers in classifying the suppliers or their bids into a group of efficient suppliers and a group of inefficient ones. This non-parametric method allows efficiency to be measured without having to specify either the form of production function or the weights for the different inputs and outputs chosen. This methodology defines a

non-parametric best practice frontier that can be used as a reference for efficiency measures (Braglia & Petroni, 2000). Its use in supplier selection was primarily discussed by Weber and Ellram (1992).

### **2.3.3.5.10 Artificial Intelligence (AI)**

AI techniques can be divided into two distinct approaches. These include:

- A. **Neural Networks:** Albino and Garavelli (1998) suggest the use of neural networks for sourcing problems, especially in the very complex case of subcontracting in the construction industry. Neural networks are systems learning directly from examples and therefore able to cope better with complexity and uncertainty than traditional methods because AI based approach are designed to be more like human judgement (De Boer et al., 2001). In modelling a problem, after considering variables and environment for that specific problem, defining the variables and environment to a different problem, three phases are considered namely, programming, testing and implementing. Initially the system is trained with a special training set representing the decisions and preferences given by the decision makers for different situations. From the training sets, the system will learn the decision maker's behaviour and relation between input and output. Next in the testing stage, the system is tested by analyzing the results with some examples which were not used in the training set. Comparisons are then made to the actual decision by the decision maker. Once implemented, the system will generate a final rating for each of the potential suppliers.
- B. **Case-Based Reasoning (CBR):** CBR is a subset of Knowledge Based Systems (KBS). CBR systems, used as purchasing decision support tools, result in faster, more accurate, more consistent, higher quality and less expensive decisions (Cook, 1997). CBR is a problem solving technique in which past cases and experiences are re-used to find a solution to particular problems (Humphreys et al., 2003). CBR simulates human-thinking processes and problem-solving strategies. The central tasks involved in CBR methods are to identify the current problem situation, find a past case similar to the new one, and use that case to suggest a solution to the current problem, evaluate the proposed solution and update the system by learning from this experience (Choy et al., 2003). Aamodt and Plaza (1994) described CBR as a cyclical process comprising the four 'Re's': (1) retrieve the most similar case(s);

(2) reuse the case(s) to attempt to solve the problem; (3) revise the proposed solution if necessary; and (4) retain the solution as part of a new case. Choy and Lee (2003) present an intelligent generic supplier management tool using the CBR technique for outsourcing to suppliers and automating the decision making process when selecting them.

### **2.3.3.5.11 Statistical Method**

Statistical methods deal with stochastic uncertainty related to supplier selection. Published statistical models only accommodate for uncertainty with regard to one criterion at a time. Although uncertainty is evident in most of the purchasing decisions, only very few methods could really handle this problem (De Boer et al., 2001). The first work using statistical method was done by Hinkle et al. (1969) adopting cluster analysis to select the best supplier. Existing models to deal with uncertainty include a decision support system by Ronen and Trietsch (1988) which focuses on lead-time management for large projects. Braglia and Petroni (2000) present a multivariate statistical method to evaluate existing suppliers' performance.

## **2.4 Organizational Buying Behavior**

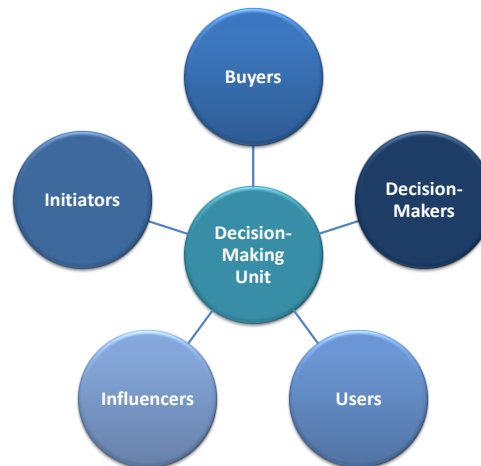
Organizational buying behaviour relates to decision-making procedures in formal organizations. It is made up of those steps or stages and behaviours engaged in by an organization as it seeks to purchase the products or services that it needs (Ward & Webster, 1991). Organizational buying is an element of organizational behaviour which takes into account the behaviour of individuals acting within some organizational structure. Organizations cannot literally make decisions: individuals are capable to carry out such deliberate action in the name of an organization (Ellis, 2011). The decision-making processes of individuals in an organizational setting are different from decision-making processes on other settings in which group dynamics are less important such as consumer buying (Ward & Webster, 1991). Organizational buying contrasts with consumer buying as it involve many individuals in the buying process, while consumer behaviour often focuses on individual processes. Although organizational buying are considered to be more deliberate than consumer buying judgements, organizational

buying decisions are subject to be influenced by indeterminate factors such as personal relationships and brand images (Ward & Webster, 1991). However, organizational buying frequently comprises more clear procedures and criteria than typical consumer buying. An understanding of the organizational buying process is of significance to the organization itself as well as to suppliers desiring to supply products and services to it. From the perspective of the organization itself, the understanding of the buying process could be potential to improve organizational efficiency. Conversely, such an understanding could accelerate supplier efforts to improve their marketing strategy.

### **2.4.1 Organizational Buying Decision-Making**

Decision-making is a central concept of organizational behavior. It can be considered as an outcome of cognitive process (Svenson, 1992). Most theories on decision-making accept the notion that the whole process comprises a number of steps or stages: recognition, formulation, generation of alternatives, information search, selection and then action (Solomon, 2011). Decision-makers usually make decisions in groups or committees having many opinions (Kardes, 2001) that result in the selection of one product/service over competing options. Organizational buying decisions are usually carried out by a decision-making unit whose members are identified by the area of their functional responsibility or by their role in the purchase decision (Ellis, 2011; Moon & Tikoo, 2002). Ellis (2011) points out that five different parties often contribute to buying decision-making as illustrated in Figure 2.10. Initiators are people who make the first request for the purchase of a product or service. This role is usually taken by the final user. Buyers usually have formal purchasing authority and commonly based in a purchasing department within the buying organization. Sometimes, buying decision-making are influenced by employees working for the buying organization or even external consultants being hired for business improvement. This group is better known as influencers who affect the decision-making procedure by providing information and occasionally criteria for evaluating suppliers. Decision-makers are those authorized personnel to approve purchases for the buying organization. Finally, users are people who ultimately will use the product or services. It is interesting to note that in many organizations, a single individual can occupy more than one of the aforementioned roles simultaneously.





**Figure 2.10** Decision-making unit

### **2.4.2 Effective Organizational Decision-Making**

Decision-making is among the many activities undertaken by managers (Hasan & Gould, 2001). SCM involves the decision-making related to resources management through the entire supply chain, from the initial suppliers to the final customers. Decision making in the context of complex problems often requires the integration of knowledge from different experts. When decision quality is of high importance, the decision-making team should be composed of members with a diversity of opinions. Indeed, major decisions are rarely made solely by an individual. Effective decision-making often depends on whether managers involve the right people in the right ways in helping them to solve problems. Raheem (2005) identifies that the problems which managers face are usually classified into three main types: (1) structured problems; (2) unstructured problems; and (3) crisis problems. Structured problems are those which are quite familiar, straightforward and clear with respect to the information needed to solve them. These kinds of problems can be expected. Therefore, managers can plan ahead and take special measures to either deal with them or to prevent their occurrence. However, unstructured problems involve ambiguities and information deficiencies. As unstructured problems often happen in untimely situations, novel solutions are required. Finally, a crisis problem is an unexpected problem that can lead to a disaster if not resolved quickly and appropriately which requires a sound crisis management plan readily available in place. Decision-makers often draw upon past experience to form

heuristics and decision routines which aid in future decision-making.

Strategic decision-making encompasses fundamental decisions which shape the future of the organization (Eisenhardt & Zbaracki, 1992). Strategic decision-making is crucial to an organization since it leads to significant allocation of resources which dictates the organizational long-term performance (Papadakis et al., 1998; Shrivastava & Grant, 1985). It is interesting to note that Hickson et al. (1986) highlight that whether or not a particular type of decision to be considered as strategic depends upon the type of industry. However, regardless of the type of industry, a typical purchasing department spends an estimated 40 to 80% (Karthik, 2006; Weber et al., 1991) of every revenue dollar on items ranging from raw materials to services. This indicates that there has been greater focus on purchasing in recent years as organizations look at means to lower their operating costs. Increasing emphasis on outsourcing of services also implies that strategic procurement decision-making will increase in importance in the future. Like most changes in the industrial world, the new role for purchasing evolved slowly from purely transactional into a strategic function (Carr & Pearson, 2002; Gadde & Håkansson, 1994). Since purchasing is considered as a strategic function, any strategic decision related to it should include the element of comprehensiveness which is embedded in the rational decision-making model (Papadakis et al., 1998; Smith et al., 1988). In this type of model, decision-makers collect all relevant information in an effort to create and evaluate all possible alternatives and choose the alternative which has the highest probability of returning the desired results.

#### **2.4.2.1 Rational Decision-Making**

The ability to make fast, widely accepted and high quality decisions on a frequent basis is a pre-requisite for an exemplary decision-making unit (Eisenhardt, 1999). A rational decision-making process is frequently adopted as the means by which decisions should be made. Although it seems to be highly unrealistic in practice (Heracleous, 1994), this model could proffer an adequate guide to effective decision-making. Commonly, what happens during rational decision-making is that the problem is identified, the options are determined and the pros and cons are evaluated. Once this has been done a decision can be made. Despite being a straight forward process, it often gets complicated, stressful and time-consuming. High stakes, time pressure, fear of making the wrong

decision and scattered information could all take their toll, causing mistakes, anxiety, inefficiency and a lack of accountability (Nutt & Wilson, 2010). Therefore, in order to overcome the shortcomings, it is necessary to make use of a structured approach (Heracleous, 1994) within which one could sort through and give relative weights to relationships and compute their corresponding values.

Rational decision-making does not allow things to happen by default as the final option is deliberately chosen from two or more options through a strictly defined sequential process. Several studies suggest that in situations constrained by extreme time pressure, higher stakes and increased ambiguities, decisions are being made based on intuition rather than by using rationally structured approaches (Dane, 2007; McNaughton, 2001). Therefore, intuitive decision-making may simply facilitate rapid decision-making at the expense of accuracy. Cervone (2005) points out that different perspectives of each member in a decision-making team on a situation can lead to different interpretations of the amount of risk and amount of uncertainty about a decision. However, this does not prohibit the team from using a consistent rational approach for decision-making. The complexity of issues being dealt could be minimized by having a consistent structure which provides a trail of how the decision was reached and what was considered. This trail is crucial if the decision has to be justified to the general public, stakeholders and outside interested parties.

A careful definition of appropriate attributes is essential to assist decision making team in the process of solving multiple criteria decision problems (Keeney, 1982). These attributes specify what information is required about the alternatives, namely the degree to which the alternatives measure up in terms of the attributes. Collier (1992) parallels the idea that application of a logical approach to decision-making could increase organizational ability to achieve superior results in turbulent business environment. Virine and Trumper (2008) highlight that organizations should follow a consistent, comprehensive and continuous decision-making process which will lead to better decision outcomes. For this research, the supplier selection problem is multi-attribute in nature, which involves suppliers being given scores based on a weighting scheme for each attribute. Therefore, having a good set of supplier selection metrics and corresponding definitions is of critical significance for the organizational success of

SCM. Despite the interest in purchasing of capital equipment, there have been little attempts to identify appropriate criteria and their definitions for quality decision-making in the electricity supply industry.

#### **2.4.2.2 Corporate Governance in Decision-Making**

The recent upsurge of awareness in corporate governance related matters in Malaysia and other developing countries is a manifestation of its rising importance for strong economic performance of organizations and nations. More broadly, corporate governance refers to a framework of rules and practices according to which an organization is directed and controlled (Daily et al., 2003). Therefore, it functions to establish and enforce policies deemed necessary for effective operation of the organization. Corporate governance can be seen as a mechanism to monitor decision-making teams and advise them in ways that align their interests with stakeholders, improving the quality of the organization's strategic decision-making (Mustakallio et al., 2002). Stovall et al. (2004) assert that corporate governance guides decision-makers to be responsible with the sole intention to maximize the stakeholders' wealth.

Corporate governance promotes transparency or opaqueness of strategic decision-making. For instance, in the United States, Sarbanes Oxley Act of 2002 (SOX) was signed into law to implement substantive corporate governance mandates which was previously unconsidered (Zhang, 2007). The bill was enacted as a reaction to the collapse of Enron in late 2001, which exposed an unprecedented accounting scandal and an allegedly seriously corrupted governance system (Jain & Rezaee, 2006). Similarly in Malaysia, the issue of integrity in public procurement is a major concern as Auditor-General Reports from 2005-2008 indicate many incidents of mismanagement (Abdullah et al., 2010). Most of the malpractices are obvious when transparency of the processes is being questioned and manipulative actions are substantial. Indeed, it is highly likely that these incidents are attributable to unethical human behaviour emphasizing self-interest without sense of justice (Stovall et al., 2004). Barnett and Vaicys (2000) suggest one should derive business decisions ethically without considering self-interest. However pragmatically this view must be considered as an exhortation caveated with the statement "in the ideal world".

In order to strengthen corporate accountability and professional responsibility with the intention to restore investors' confidence, Section 404 of SOX requires all internal controls to be repeatable, definable and auditable (Engel et al., 2007; Hammersley et al., 2008). Internal controls are simply good business practices that consist of all the measures taken by the organization to protect its resources against waste, fraud, and inefficiency (Olatunji, 2009). For the purpose of this research, the specific internal control being looked into is strategic sourcing of capital equipment. By establishing a set of metrics that can be consistently applied, with agreed-upon definitional dimensions between stakeholders, engineers and managers will be able to support decisions being made in allocating an organization's capital for current and future development. In addition to the idea that processes should be transparent, there is a sense that decisions should have greater inclusion of various actions in their revolution. Abdulaziz and Farog (1999) concur with the notion that a successful organization should allow more employee input into operations and processes. The accepted metrics and definitions could be used to produce decision-making guidelines which can assist the decision-making teams to make better ethical choices (Ford & Richardson, 1994). When decision-making teams are being guided by a systematic approach, they will be bound to apply ethical standards and values in making their choices. More importantly, this will enable the decision-making teams to defend their decisions.

### **2.4.2.3 Information in Decision-Making**

A key to decision-making is information. Decision-making teams often try to utilize whatever information is available to solve a decision problem, although the usefulness of such information could be questioned (Kardes, 2001). Subsequently, different types and amounts of information are used for different alternatives which create inconsistency in decision-making. Dietrich and Lehtonen (2004) point out that quality of the available information dictates the quality of decision being made. This is reinforced by Dean and Sharfman (1996) highlighting that decision-making relies upon the analysis of relevant exhaustive list of information. Clearly this showed that organizations require the best available information at the earliest stage in the purchasing decision-making process.

Although gathering of information consumes critical resources such as time and money,

decision-making teams depend on such information to assist them to make sound business decisions (Thomas et al., 2002). Therefore, usefulness of such information is heavily dependent on reliability and validity of the information (Kardes, 2001). Goodman (1993) articulates that most decisions are being made based upon incomplete and inaccurate information which may result in significant negative consequences for their organization. Unsystematic and inconsistent information use can lead to poor decisions. Decision options should be evaluated systematically on the same dimensions, and importance weights for each dimension should be held constant across alternatives.

The typical decision-making team comprises members representing different parts of the organization so that the group can access different sources of information when making decisions. The effectiveness of group decision-making is an increasingly vital concern for organizations. Team members frequently discuss the information that they are all aware of, and they typically fail to share unique information with one another. Without realizing the importance of sharing their unique information with others, this dysfunctional pattern undermines the very reason that organizations form integrated diverse teams. However, when all the unique information is put together, each individual errors fall off and their unique perspectives combine to create the right solution. By understanding this, meaningful aggregation of data (information) from individuals' perception, skill and experience is translated to become knowledge, making it useful for decision-making. As corporate governance emphasizes on accountability, decision-making teams should be able to construct compelling justifications for their choices. Therefore, decision-making should be based on a set of clear, specific and comprehensive metrics and definitions to avoid any ambiguities between the members of decision-making teams.

#### **2.4.2.4 Biases in Decision-Making**

Supplier selection and evaluation is considered as an important function for organizations. Collaborating with the “right” suppliers and managing them is increasingly important now with strategic partnerships being implemented with suppliers to achieve a competitive advantage and the involvement of suppliers in product development stages. Therefore effective methodologies that have the capability of evaluating and continually monitoring suppliers performance are still needed.

Effective strategic sourcing decision-making begins with a clear understanding of buyer judgement and decision processes. After developing a clear understanding of these processes, the decision-making team should scrutinize their judgment and decision processes. Although the typical decision-making team is highly intelligent and highly educated, their decisions are nevertheless susceptible to many common judgement and decision errors (Busenitz & Barney, 1997; Kardes, 2001). Schwenk (1995) identifies three such biases which might affect strategic decision-making: (i) biases in causal attributions; (ii) escalating commitment; and (iii) biases in recollection. Detailed explanations are discussed below:

- i. **Biases in causal attributions:** In evaluating past performance, decision-makers tend to attribute good outcomes to their own actions and qualities while attributing poor outcomes to external factors such as environmental events and bad luck (Schwenk, 1995). Such biased attributions are used deliberately as part of a strategy for managing perceptions of stakeholders to prove that they control the outcomes of the organization (Salancik & Meindl, 1984). However, some researchers portray these biased attributions as a way the decision-makers' to make sense of the changing environment in which they operate (Clapham & Schwenk, 1991; Huff & Schwenk, 1990). These attributions are not seen as a strategy to influence the beliefs of stakeholders but they represent the views held by the decision-makers themselves.
- ii. **Escalating commitment:** Is a tendency to increase commitment to a failing course of action (Schwenk, 1995). This may be considered to be the tendency to “reinforce failure”, or throwing good money after bad. The importance of this phenomenon became vital in understanding organizational and strategic failure. Having a sound decision framework could lead to the strongest escalation of financial commitment to a course of action (Bateman & Zeithaml, 1989).
- iii. **Biases in recollection:** Memory related constraints have a strong impact on judgement and decision-making (Kardes, 2001). Schwenk (1995) highlights that biases in recollection may hinder decision-makers' ability to learn from the past. Decision-makers' recollections of their past strategies are often biased (Golden, 1992). Therefore, decision-makers are prone to repeat mistakes for which they are unable to learn from their past experience.

Although eliminating bias may never be fully accomplished, the decision-makers would be able to improve the quality of their group decision-making by having appropriate decision-making metrics and definitions, then executing them more accurately and consistently.

## **2.5 Strategic Sourcing Decision-Making**

One of the common strategic decisions a decision making-team makes is how to manage the organization's strategic sourcing transactions. A strategic sourcing transaction is an economic exchange that provides the buying organization with a necessary input to its production processes. Managing strategic sourcing transactions is of vital importance to the competitive advantage of the organization as they affect the performance of buying organization (Fung, 1999). Decisions made related to strategic sourcing are critical because of the sheer financial impact purchased products have on the organization's total cost. Decision-makers facing different sourcing situations inevitably lead to different decisions. The sourcing process should start with finding out exactly what needs to be achieved from selecting a supplier. Suppliers are selected according to their ability to meet business requirements. The approved list of suppliers needs to be monitored closely and evaluated continuously. If any supplier cannot meet the requirements of the supplier performance appraisal, then the supplier has to be replaced by an alternative supplier. The way a supplier is selected is changing as factors other than price become more important to an organisation. In the past, price has always been the preeminent consideration in selecting a supplier (Degraeve & Roodhooft, 1999).

Over the years, purchasing organizations have realized that the cheapest supplier may not necessarily be the best. Indeed it could potentially introduce additional cost into their value chain. This has resulted in a wide range of criteria proposed as selection criteria for an optimal supplier. Price is becoming less of a focus as companies turn their attention on non-price factors. This has resulted in purchasing executives and managers constantly having to make a decision on whether to give more importance to price or non-price attributes (Min, 1994). Moreover, criteria for supplier selection is also



constantly subjected to change as information technology and progress permeates an organisation (Khurram, 2003). Cheraghi et al. (2004, p. 91) further explain that “supplier selection criteria will continue to change based on an expanded definition of excellence to include traditional aspects of performance (quality, delivery, price, service) in addition to non-traditional, evolving ones (just-in-time, communication, process improvement, SCM)”. The dynamic nature of supplier selection criteria can sometimes create a conflict between purchasing employees and the organisation. To keep abreast with global practices, an organisation may want to adopt numerous and constant changes to its supplier selection criteria. However, these changes may not necessary be endorsed or agreed upon by its employees who are directly involved in purchasing and procurement activities. Many still believe that as the people directly involved in the buying process they should be given freedom to exercise their professional judgement as to how a supplier should be selected (McDonald, 1996) .

### **2.5.1 Strategic Sourcing Evaluation Metrics and Definitions**

The decision-making process for evaluating and selecting a supplier is complicated as: (1) suppliers can be evaluated by more than one criterion; and (2) each supplier has a different specialty and thus a different criterion (Park et al., 2010). The identification and analysis of criteria for selection and evaluation of suppliers has been the central focus of many academicians and practitioners. Research on supplier selection criteria began in the early 1960s as vendor selection. The selection criteria are divided into quantitative and qualitative attributes. Basic criteria such as cost, quality and delivery performance are still widely used. However, the range of criteria considered has evolved into a wider matrix parallel with the development of the SCM philosophy. An effective supplier selection model therefore, depends on the use of appropriate criteria that can reflect an organization’s business strategy. The study on buyer-seller relationships by Cannon and Perreault (1999) argues that different criteria are needed in different purchasing situations as explained previously in section 2.3. Therefore, it is impossible to have a universally applicable decision-making model with a fixed set of criteria. Criteria or metrics used in supplier selection must reflect a strategic fit between the organization’s business model and its supply chain strategy (Huang & Keskar, 2007).

The current scenario is that the supplier selection process has evolved into a wide

spectrum of criteria (Lehmann & O'Shaughnessy, 1982). According to Beamon (1999) the criteria for performance measurement are required to satisfy the characteristics of inclusiveness (representative of all pertinent aspects), universality (allowance for comparison under various operating conditions), measurability (measurable data), and consistency (consistency to organization goals). Different researchers adopt diverse criteria in selecting suppliers, ranging from simple and basic to more complex attributes. However, Holmberg (2000) contends that some of these measurements are not derived from the company strategy and therefore do not support the business. Inappropriate and insufficient performance measurement can severely impact an organization's business performance. Therefore it is important that the organisation has at its disposal a succinctly developed metric with clear definitions of criteria that are aligned to the organisation's objectives.

In his seminal article, Dickson (1966) validates 23 criteria for assessing supplier's performance as listed in Table 2.5. According to respondents from 300 organizations, mainly manufacturing firms, the ability of each supplier to meet required quality is important. Price is the most important followed by quality, delivery, performance history, warranties and claim policies. Reciprocal arrangements are least important. Another important finding was that supplier selection criteria and their level of importance vary according to organizations.

Weber et al. (1991) re-examined Dickson's work by reviewing published works during 1966 to 1990. The authors reported that most of the researchers, 63.5% (47 out of 74) used multiple criteria as listed by Dickson for the selection process. The authors note that the important Just-In-Time (JIT) components such as quality, delivery, net price, geographical location and production facilities and capacity are given priority by many purchasing firms. Cheraghi et al. (2004) continue the review by analyzing works from the period between 1990 and 2001. They demonstrated further evolution in criteria, is the reliability, flexibility, consistency and long-term relationships becoming significant new entrants of critical success factors for supplier selection. They conclude that criteria such as operating controls, packaging ability, training, business intention, warranties and claim policies are no longer relevant to the supplier selection in the current context.

Table 2.5 Supplier's performance criteria

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This current study extends the review by considering the articles published between 2001 and 2010 to evaluate the relevance of previous findings to current market requirements. An extensive search was carried out by focusing on the refereed publications in the field of engineering, production, marketing and finance as SCM is related to this major disciplines. Table 2.6 provides the frequency of each criterion against the preference of criteria in Cheraghi et al. study (2004). Price, delivery, and quality again appear as most important criteria with the overall frequency of above 100. Similarly, production facilities and capacity, technical capability, management and organization, financial position, geographical location, repair service, performance history, and attitude could be considered as second most important while the rest of the criteria ranging from flexibility to economic situation are least important. Appendix I

shows a summary of the criteria obtained from the review of research works carried out from 2001 to date.

Table 2.6 Comparison of selection attributes (1966-2001 and 2001-2012)

Item	Criterion	Frequency (1966-2001) (Cheraghi et al., 2004)	Frequency (2001-2012)	Overall
1	Price*	81	47	128
2	Delivery*	75	47	122
3	Quality*	71	47	118
4	Production facilities and capacity*	35	25	60
5	Technical capability*	30	32	62
6	Management and organization*	17	30	47
7	Financial position*	15	23	38
8	Geographical location*	17	12	29
9	Repair service*	18	17	35
10	Performance history*	11	10	21
11	Attitude*	14	6	20
12	Flexibility	NA	23	23
13	Product development	NA	19	19
14	Reputation and position in industry*	10	8	18
15	Communication system*	7	7	14
16	Process improvement	NA	15	15
17	Reliability	NA	13	13
18	Impression*	6	4	10
19	Labour relations record*	4	6	10
20	Commitment	NA	9	9
21	Environmental and social responsibility	NA	11	11
22	Packaging ability*	5	5	10
23	Warranties and claim policies*	1	5	6
24	Integrity	NA	5	5
25	JIT	NA	4	4
26	Operating controls*	5	NA	5
27	Reciprocal arrangements*	5	NA	5

28	Desire for business*	2	3	5
29	Long-term relationship	NA	6	6
30	Occupational safety and health	NA	4	4
31	Procedural compliance*	4	NA	4
32	Professionalism	NA	4	4
33	Amount of past business*	1	2	3
34	Training aids*	3	NA	3
35	Political situation	NA	2	2
36	Economic situation	NA	1	1

\* Criteria outlined by Dickson (1966)

Strategic sourcing decisions are not only to be based upon operational metrics such as cost, quality and delivery, but should be inclusive of supplier's capabilities such as process and product improvement, management and cost reduction capabilities (Talluri & Narasimhan, 2004). From the literature review, the researcher has classified thirty-six important metrics used by researchers for supplier selection. Through informal scoping meeting with the hierarchy of the host organization, the metrics were reduced to twenty-two. Therefore, initial survey instrument (Appendix 5) contains twenty-two metrics. After the pilot testing, based on the feedback from the participants and panel of experts, the metrics were reduced to eighteen (Appendix 6). This study operationalized eighteen metrics which were deemed to be relevant to strategic sourcing supplier selection in the electricity supply industry in order to deliver the needed value to the end-user: (1) product quality ; (2) price; (3) delivery; (4) production system; (5) flexibility; (6) support services; (7) information and communication technology (ICT); (8) financial performance; (9) product innovation; (10) quality management system (QMS); (11) management and organization; (12) customer training; (13) employee training and development ; (14) performance history; (15) customer focus; (16) corporate social responsibility (CSR); (17) safety awareness; and (18) environmental attributes.

Although the issue of supplier selection is widely studied, only a few researchers have dedicated their efforts in developing metrics for choosing suitable supplier(s). Although the trend is shifting towards developing more exhaustive and detailed metrics in a systematic way, there is inconsistency in the way each set of metrics are defined. For instance, different definitions of a criterion can create ambiguity amongst researchers

and it is likely that buyers, suppliers and end-users may experience the same confusion. In building a long-term partnership with suppliers, buyers need to determine suitable metrics and its definitions based from the suppliers and end-users input (Vonderembse & Tracey, 1999). As a part of the procurement policy and procedure, this will help the purchasing executives to have a consistent decision making process. Similarly, potential suppliers will benefit by having a clear understanding of the buyer's expectations.

### **2.5.2 Trade-offs in the Supplier Selection Process**

The ultimate choice of having one or more supplier(s) who fulfil the requirements of purchasing organization involves screening of suppliers' behaviour based on pre-determined attributes (Petroni & Braglia, 2000). Purchasing managers are likely to consider both characteristics of their current suppliers and new characteristics of prospective suppliers (van der Rhee et al., 2009). However it is hard to find a supplier who can score highly in all criteria. For example, a supplier may be able to deliver a good quality product, but it may not be of the lowest price. Conversely, another supplier may be able to offer attractive prices but may have a slower delivery performance. Braglia and Petroni (Braglia & Petroni, 2000) write that tangible and intangible factors, can pose a challenge to managers in the supplier selection process.

Therefore, an actual choice generally involves a trade-off among the attribute levels of different suppliers (Mummalaneni et al., 1996) especially when switching to a new supplier (van der Rhee et al., 2009). Jian-Jun and Hui-Fen (2007) define trade-offs as compensation for lower score criteria with better ones. Understanding trade-offs in the supplier selection process involves considering the relative weightings that purchasers attach to various characteristics of their current suppliers with respect to other competitors. The quality of the supplier selection decision making could be enhanced if the importance of a criterion can be properly captured through identified weightings (Yang et al., 2008).

One such weighting method is the pair-wise comparison matrix using a scale of 1-9 (Sarkis & Talluri, 2002; Shyur & Shih, 2006). Score of 1 indicates indifference between two factors and 9 represents extreme preference for one criterion over the compared criterion. Other researchers utilize Discrete Choice Analysis (DCA) to identify the

relative weightings for each criterion based on the multinomial logit model (van der Rhee et al., 2009; Verma & Pullman, 1998). Once the relative weights have been ascertained, purchasing managers can easily use trade-offs to select the most viable alternative from a set of possible suppliers. In short, for making good decisions, the supplier selection process must be handled systematically especially in situations where best-worst criteria ratings apply.

## **2.6 Literature Review Summary**

This literature review explored the current conversation amongst scholars on the topics of SCM, purchasing, strategic sourcing and supplier selection. The chapter looked closely at two key elements used in these processes, the selection metrics and the corresponding definitional dimensions. It also examined their relevance to the procurement of capital equipment in the electricity supply industry. This literature review revealed that the metrics advocated by scholars regarding supplier selection are mainly for manufacturing industry, based primarily in the United States, Japan, Korea and United Kingdom. Manufacturing industries in Malaysia such as automotive and textile have largely adapted systematic supplier selection decision-making techniques. However, this is not the case with the Malaysian electricity supply industry. Therefore the inadequacy of knowledge in the area of supplier selection for the Malaysian electricity supply industry has built a case for the conduct of this doctoral study.

## **2.7 Research Gaps and Motivations**

In the Malaysian electricity supply industry, TNB as the key provider has a vital role to play in ensuring continuous and uninterrupted electricity supply. To do this, TNB needs to manage the electricity supply chain. This in turn requires the organisation to have an effective supplier selection process. The current supplier selection process in TNB is less than ideal. TNB has a central purchasing office that oversees the purchasing process however its role is more of policy implementation and controls. The three key business sectors (generation, transmission and distribution) that require the purchase of equipments and parts have their own individual purchasing divisions which are managed by a purchasing manager. However purchasing requests are raised and prepared by individual engineers working in the various sub-divisions of each sector. At

present, TNB's official policy specifies 4 key metrics in supplier selection namely specification and tender requirement compliances, value for money, validity of offer and period of completion (TNB, 2004). These criteria are similar to commonly used criteria in the manufacturing sector such as price, delivery, quality and service (Narasimhan, 1983). However, TNB has not investigated whether these criteria are the best ones to use for the electricity supply industry in Malaysia which as discussed earlier is uniquely structured and quite different from that of the manufacturing sector. Furthermore, the central office that is the custodian of these criteria has not released any standard guidelines that can offer a clear description of each of these criteria nor a clear ranking or weighting system that can help end-users rank these criteria in order of importance in the many different buying scenarios undertaken by the organisation. This means that end-users (i.e. engineers) are allowed to use personal judgement and opinions to not only decide on the importance of each of the four criteria but to also add or propose new criteria that they may think is important in their rationale for selecting a supplier. This has resulted in inconsistencies in the supplier selection process at divisional level and sometimes even at the individual engineers level within the same division.

These gaps need to be addressed in order for TNB to move towards a more efficient and effective SCM process. This study attempts to address these gaps by proposing a decision-making framework that can be implemented organisational-wide with all employees. To do this, the study will employ mixed methods incorporating questionnaires and semi-structured interviews to collate information from both managers and engineers in charge of purchasing. This will enable the study to identify the metrics that each of these groups think is most important in the supplier selection process. From this information, this study hopes to design a supplier selection decision-making framework with pair-wise comparisons for trade-off purposes. This decision-making framework will provide comprehensive description of each of the metrics as well as a weighting system that ranks the metrics identified in order of importance. It is hoped that with a value-based supplier selection system in place, TNB can address some of the existing gaps in its supply chain management that may eventually result in operational efficiency and cost saving measures.



Therefore, the critical objectives that need to be achieved are as follows:

- i. To understand the supplier selection process in TNB. This will involve an in-depth analysis on the current practices of strategic sourcing evaluation and decision-making process stretching from strategic sourcing opportunity identification and appraisal to decision making and implementation of strategic sourcing supplier selection decisions.
- ii. To establish that the two proposed constructs (Supplier Competitiveness and Supplier Attractiveness) statistically distinct from one another as determined by an unconstrained factor analysis. The nature of the situation particularly in TNB where is no clear standard metrics for strategic sourcing supplier selection necessitated a need to figure out a constructive way of representing the identified eighteen metrics in a multiple perspective format.
- iii. To measure the degree of importance the key stakeholders' (initiators, influencers, decision-makers, buyers and users) place on each metric for decision support in strategic sourcing supplier selection. The researcher sought to explore if and to what extent, the shortlisted eighteen metrics influence or determine the strategic sourcing supplier selection. Therefore this research will help to understand the successful ingredients of strategic sourcing supplier selection practices and decision-making process in the electricity supply industry with primary focus on the factors that influence the process of decision making to purchase capital equipment.
- iv. To identify whether the metrics differ among initiators, influencers, decision-makers, buyers and users since there is limited knowledge available on this subject area and no baseline of current use of these metrics, as well as evaluation of their impacts on intended decision outcomes exist.
- v. To provide the key stakeholders' perceptions on the definitional dimensions of each of the top metric for strategic sourcing supplier selection. In this exploratory study, the researcher will take a holistic view of the subject area, gathering as much information as possible before deciding which definitional dimension is important and which definitional dimension can be discarded concerning each of the top metric.

- vi. To develop a framework for a strategic sourcing supplier selection for capital equipment decision making. The current goal is to expose and solve the current problem so as to help key stakeholders improve the strategic sourcing supplier selection practices and decision making process within their organization.

# Chapter 3

## Research Methodology

### 3.1 Introduction

This chapter presents the methodological considerations that led to the selection of a concurrent triangulation mixed methods strategy. The study is based on a single case study research methodology, based on TNB in Malaysia. The chapter begins with a general review of the research process followed by a discussion on the nature of the research problem. The full specification of the problem considered to be key to the selection of the most appropriate research methodology. The rationale choosing for the mixed methods approach is also provided, and the method for analysing data is discussed. Potential drawbacks and limitations of such an approach are also discussed. Following the design, the sampling strategy, data collection, analysis processes and ethical considerations are described in chronological order. This chapter concludes by discussing the limitations of the methodology.

### 3.2 Restatement of Research Questions

To achieve the purposes of the study, the following research questions were addressed:

- i. What is the supplier selection process in TNB?
- ii. To what extent are the two proposed constructs (Supplier Competitiveness and Supplier Attractiveness) statistically distinct from one another as determined by factor analysis?
- iii. What degree of importance do the key stakeholders' (initiators, influencers, decision-makers, buyers and users) place on each metric for decision support in strategic sourcing supplier selection?

- iv. How do the metrics differ among initiators, influencers, decision-makers, buyers and users?
- v. What are the key stakeholders' perceptions on definitional dimensions of each of the top metric for strategic sourcing supplier selection?
- vi. What is the appropriate tool to assist a strategic sourcing supplier selection for capital equipment decision making?

### 3.3 Research Process

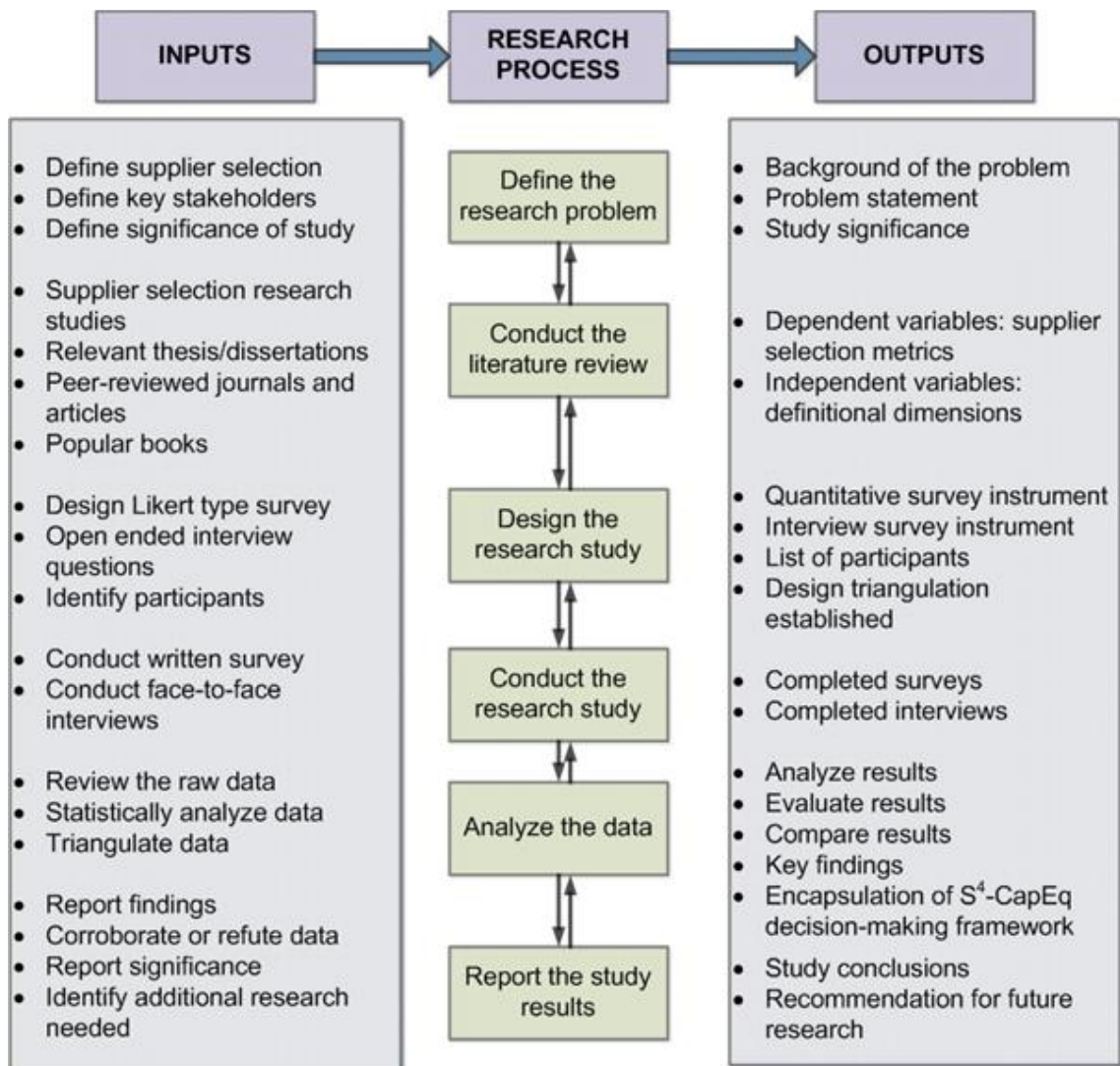
The root meaning of the word “research” is “repeated search” or “investigate carefully” (Concise Oxford English Dictionary, 2001). More specifically, research is a ‘thinking game’ and a ‘whole brain’ activity that may refine existing knowledge or indeed generate new knowledge or expand a base of knowledge (Collis & Hussey, 2009; O’Leary, 2004). O’Leary (2004) comments that the concepts ‘thinking game’ and ‘whole brain’ are critical to research because they imply planning and organisation and they allow researchers to address the following questions:

- i. What needs to be known?
- ii. What research methods are needed to generate the knowledge and valid and refine this knowledge?
- iii. What can be extracted from the research to build a knowledge base?

In essence therefore, the research methodology refers to the overall approach to the research process and can consist of the following aspects (Brannen, 2005; Cooper & Schindler, 2006):

- i. The approach (quantitative, qualitative).
- ii. The method of data collection, why and what data should be collected.
- iii. How will the data will be analysed?

Figure 3.1 is a graphical representation of the research process for this undertaken study, identifying the process steps with relevant inputs and their respective outputs.



**Figure 3.1** Graphical representation of the research process

Irrespective of discipline, researchers must select the most appropriate methodology and design relevant to their research project to achieve the original aims and objectives/research questions of the undertaken study. Research methodology is the study of these potential methods (Mackenzie & Knipe, 2006). Silverman (1994) asserts that methodologies cannot be true or false, or indeed, right or wrong; they can only be more or less useful. Ellis and Levy (2008) articulate that the starting point in all research undertakings is to focus clearly on the fact that the objective of this activity is to add to the body of accumulated knowledge. To add to this existing body of knowledge, answers to hidden truth will be discovered and researcher will attempt to create and identify solutions to the original problems. Amaratunga et al. (2002) note that prior to the commencement of a research project, the philosophical basis of the studied problem

should be established once the questions and problems have been identified.

To find a suitable research methodology, the researcher first needs to reflect the primary aim of the study. Catering to the aim, construction management research can be classified into four different categories: to describe a phenomenon as it exists (descriptive), to explore a new phenomenon (exploratory), to explain why or how something is happening (analytical or explanatory), or to predict certain phenomena (predictive research). As Neuman (2006) points out, studies may have multiple purposes, however one purpose is usually dominant. The current research falls mainly into the third category, since the research seeks to explain current purchaser behaviour.

### **3.3.1 Explanatory Research**

Explanatory research which may sometimes also known as analytical research is a continuation of descriptive research. Explanatory research often occurs when the area of research/ the subject of inquiry is well known. The researcher goes beyond merely describing the characteristics to analysing and explaining why or how the phenomenon being studied is happening (Mohammed, 2009). This type of research therefore, has been considered as appropriate for finding causal relationships between variables from theory-based expectations (Malhotra & Grover, 1998). As Fellows and Liu (2008) observe, explanatory researchers seek to test hypotheses which usually have causal explanatory characteristics, allowing a conclusion to be logically inferred. Elsewhere in the research literature, it has been asserted that explanatory study is useful in testing a theory's predictions or principle (Neuman, 2006). Neuman further points to the fact that explanatory researchers elaborate and enrich a theory's explanation. Accordingly, the research reported in this thesis is designed to test specific hypothesis. In line with Neuman's recommendation, although supplier selection is a well-known area, there are still numerous issues that the researcher was interested in explaining. This resulted in the emergence of multiple research questions, and necessitated design of a lengthy questionnaire, and the conduct of face-to-face interviews.

### **3.4 Analysis of the Problem**

The problem addressed by this study has been described as the limited acknowledgement of the key stakeholders' preferences, opinions and interpretations of key metrics in the supplier selection process for the electricity supply industry. Given the nature of the problem dictates its means of solution (Tookey, 1998), the problem has to be systematically analysed along with the research aims. To resolve the problem, it is necessary to understand the applicable metrics for supplier selection in the electricity supply industry. Therefore, sections 3.4.1 to 3.4.3 will describe the scope, nature and complexity of the research problem. Tyden (1994) asserts that these factors are significant as they influence the degree to which the research results can contribute to solving the research problem.

#### **3.4.1 Scope of the Problem**

The problem of strategic sourcing supplier selection in power utilities is both specific and generalisable. The problem is specific in that it has not been addressed in the electricity supply industry. This was established during the literature survey. However, the solution of the problem should be generalisable as possible to all power utilities. The methodological approach, as well as methods, selected must be able to deliver a broadly generalisable result.

#### **3.4.2 Nature of the Problem**

Currall et al. (1999) emphasize that a balance must be made between describing the problem qualitatively and quantitatively. This can be considered as balancing the description of 'why' a phenomenon happens versus 'what' happens. Creswell and Plano Clark (2007, p.13) state that:

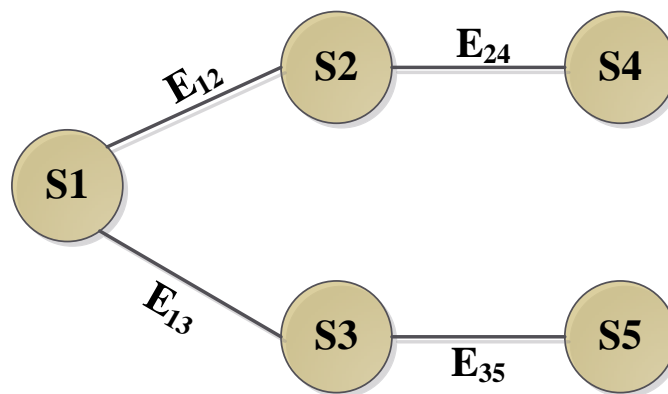
“The complexity of our research problems calls for answers beyond simple numbers in a quantitative sense or words in a qualitative sense”

Adopting a combination of both forms of data, situating numbers within context and the words of participants of the study, can provide for the researcher a more complete analysis and therefore a better understanding of the phenomenon under investigation.

Similarly, policy makers and practitioners in the field need multiple forms of evidence to inform their decisions. According to Borg et al. (2007), qualitative methods are useful to discover constructs beyond those generated through quantitative methods. Therefore, the mixed-methods approach was suitable to examining the relationship of the perception of supplier selection metrics and definitional dimensions by key stakeholders.

### 3.4.3 Complexity of the Problem

The emphasis on cost reduction, profitability and organizational flexibility in the current worldwide competitive market increases the complexity of supplier selection decisions (Ting, 2004). As described in section 2.3.3.3, supplier selection is a multi-criteria problem. One of the methods for describing supplier selection decision-making process is the use of ‘nodes’ and ‘links’ (Xu & Lin, 2010). The number of nodes and links defines the degree of complexity of the supplier selection decision-making process. Xu and Lin (2010) suggest that the supplier network can be treated as direct routed trees comprising of nodes representing suppliers and links representing flow of information and products as illustrated in Figure 3.2. The complexity of the network increases exponentially with the addition of suppliers. Therefore, the issue of strategic sourcing supplier selection in the ESI can be described as generic, quantifiable and complex. The methodological framework and methods adopted in the study must reflect these features. However, the selection of an appropriate methodology could only be made after different research paradigms have been considered (Naslud, 2002).



**Figure 3.2** Supplier network comprising different number of nodes



### **3.5 Establishing Philosophical Position of the Research**

According to Greene (2006) philosophical positions and stances refer to the core philosophical or epistemological assumptions of the methodology. It “guides the inquirer’s gaze to look at particular things in particular ways and offers appropriate philosophical and theoretical justification for this way of seeing, observing, and interpreting” (Greene, 2006, p. 93). Common elements of philosophical positions and stances are the researcher’s epistemological, ontological, axiological and rhetorical beliefs that underlie the adopted approach. The explanation for each aspect is as follows:

#### **i. Epistemology**

Epistemology is the study of knowing, that is to say, how we know what we know (Jonassen, 1991). It refers to the relationship between the researcher and the object of study, whether the researcher is detached or immersed in the setting. Solem (2003) mentions that epistemological considerations attempt to reflect the most appropriate methods through which reliable knowledge is acquired. Researchers in the quantitative paradigm separate themselves from the object of the study. Thus, they remain distant, independent and assume a passive role in relation to the object of study during data collection phase (Creswell, 1994; Onwuegbuzie & Leech, 2005). Creswell (1994) asserts that the researchers will control for bias, select a systematic sample and maintain their objectivity in assessing a situation. On the other hand, when the researchers and object of study are dependent on one another, the paradigm of the study can be considered to be qualitative research (Smith, 1983). In other words, the researchers interact with, or try to minimize the distance between those being researched. The interaction may be in the form of living with the object of study, or observing informants over a prolonged period of time to better understand the phenomenon (Creswell, 1994; Onwuegbuzie & Leech, 2005). Therefore, the researchers are involved actively in the data collection process and analysis (Sarantakos, 1997). However, mixed-methods researchers emphasize on pragmatism in that they collect both quantitative and qualitative data in order to appropriately address the research questions (Creswell & Plano-Clark, 2007; Morgan, 2007).

ii. Ontology

The ontological dimension refers to the study of “being” or “existence” (Sowa, 2000). It denotes the perceived nature of reality, which is seen in the differences in assumptions about what reality is and whether or not it is measurable. Quantitative researchers tend to believe that there is a single reality which people can agree upon, or there is common objective reality among individuals (Newman & Benz, 1998; Onwuegbuzie & Leech, 2005; Sarantakos, 1997). Creswell (1994) characterizes quantitative researchers view reality as objective, “out there” and independent of the investigator. Conversely, qualitative researchers believe that multiple realities exist and different individuals interpret the realities in different ways depending on the lens of the researchers (Newman & Benz, 1998; Onwuegbuzie & Leech, 2005; Sarantakos, 1997). Complementing both paradigms, the advocates of mixed-methods consider both singular and multiple realities (Creswell & Plano-Clark, 2007).

iii. Axiology

The term axiology refers to the nature of values (Carroll, 2008). In quantitative research methodology, the study should be value-free. This means that the values of the researcher are kept out of the study through entirely omitting statements about values and reporting the facts from the evidence gathered in the study (Creswell, 1994; Sarantakos, 1997). In contrast, for qualitative research methodology, the research is influenced to a great extent by the values of the researcher, in which the researcher admits the value-laden nature of the study and actively reports his or her values and biases, as well as the value nature of information gathered from the field (Creswell, 1994; Sarantakos, 1997). Mixed-methods researchers are in favour to incorporate both biased and unbiased perspectives in their research (Creswell & Plano-Clark, 2007).

iv. Rhetoric

Creswell (1994) describes rhetorical aspect of the language used in the research and its reporting. In quantitative research, the language used is impersonal, formal and based on accepted words such as “relationship”, “comparison” and “within-group”. Conversely, qualitative researchers construct a different language distinct from the traditional research in order to stress the qualitative paradigm. Such words, for instance are “understanding”, “discover” and “meaning”. The language is personal, informal and based on definitions that evolve during the research. In mixed methods research, both

formal and informal styles of writing are employed (Creswell & Plano-Clark, 2007).

### **3.5.1 Research Approach**

Given the nature, scope and complexity of the problem the most appropriate research approach is to adopt the mixed-methods (quantitative-qualitative) approach. The term pragmatic, mixed research, integrative methods and mixed-methods have been frequently used interchangeably in literature. A typical definition of mixed methods research is:

“a research design with philosophical assumptions as well as methods of inquiry. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis of data and the mixture of quantitative and qualitative approaches in many phases in the research process. As a method it focuses on collecting, analysing and mixing both quantitative and qualitative data in a single study or series of study. Its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone”

(Creswell and Plano-Clark, 2007, p. 5)

The statement above describes mixed methods research as the type of interactive model of research design where qualitative and quantitative approaches are used in question design, research method, data collection and analysis as well as inference of data (Creswell & Plano-Clark, 2007; Creswell et al., 2003; Greene et al., 1989; Maxwell & Loomis, 2003). Tashakkori and Teddlie (1998) and Greene et al. (1989) emphasize the importance of considering the stage of the research process where the quantitative and qualitative data collection takes place while Creswell et al. (2003) highlight the importance of ‘the combination of quantitative and qualitative research within a given stage of inquiry’ (p. 220).

Greene et al. (1989) identify five reasons why some researchers prefer a mixed methods approach. These are triangulation (convergence, corroboration, correspondence of results from the different methods), complementarity (overlapping of different facets of a phenomenon), development (using results from one method to inform another),

initiation (discovering paradoxes, contradictions and fresh perspectives) and expansion (breadth and range of inquiry). Implications of these definitions are:

- i. Triangulation: looking for convergence or corroboration by using different methods.
- ii. Complementarity: using results from one method to elaborate or clarify results from another method
- iii. Development: using results from one method to develop or inform the other method
- iv. Initiation: using different methods to look for contradictions or new perspectives on results or questions
- v. Expansion: using different methods for different components of a study to extend the range of inquiry

### **3.5.2 Being a Pragmatic Researcher**

As an increasingly used approach, mixed methods researchers are engaged in on-going debate both amongst themselves and in conjunction with researchers adopting other approaches as to the appropriate philosophical underpinning of mixed-methods research. Johnson and Onwuegbuzie (2004) point out mixed-methods could not provide an immediate solution to the problem at hand but instead to utilize a philosophy that attempts to fit together the insights provided by the qualitative and quantitative research into a workable solution. Pragmatism is strongly advocated as a suitable philosophical underpinning for mixed methods research. This is due to the need for a balanced approach that considers both quantitative and qualitative elements without inclining towards any sole philosophy or reality (Johnson & Onwuegbuzie, 2004; Mackenzie & Knipe, 2006; Tashakkori & Teddlie, 1998). Some methodological pragmatists argue that researchers should use whatever methods are needed to obtain the optimum results, even if this involves 'switching between' alternative paradigms (McEvoy & Richards, 2006). The pragmatic paradigm provides intuitive appeal, with scope to study areas that are of interest, embracing methods that are appropriate and using findings in a positive manner in harmony with the value system held by the researcher (Creswell, 2003). A pragmatic worldview focuses on the consequences of the research (i.e. the central theme posed by the research question) rather than the methods. It believes that multi (or mixed) methods can be employed to better understand the research question. Thus it is pluralistic in nature and oriented towards "what works best" in practise.

Morgan (2007) provides a useful framework for understanding what the pragmatic approach can offer as stated in Table 3.1. Abductive process moves back and forth between induction and deduction, where the inductive results from a qualitative approach can serve as inputs to the deductive goals of a quantitative approach, and vice versa.

Table 3.1 Features of qualitative, quantitative and pragmatic approaches

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The philosophical assumptions that warrant a pragmatic way of thinking about and doing social inquiry include:

- i. Pragmatic researchers believe that singular and multiple realities exist (Creswell & Plano-Clark, 2007). Pragmatists agree with the positivists/post-positivists on the existence of an external world independent of our minds whilst denying that truth could be determined once and for all (Tashakkori & Teddlie, 1998).
- ii. A pragmatic research methodology has the capability of both theory generation and testing due to its pluralistic approaches to derive knowledge about the research problem. It is partially deterministic and might have cause-effect linkages which we may not be able to pin them down (Tashakkori & Teddlie, 1998).
- iii. The researchers may be both objective and subjective in epistemological orientation over the course of studying the research question (Tashakkori & Teddlie, 1998). Pragmatists advocate practicality in research such as collection of data on the emphasis of “what works” to address the research question.
- iv. Researchers include both biased and unbiased perspectives in conducting research and in drawing conclusions from their studies (Creswell & Plano-Clark, 2007).
- v. Pragmatic authors utilize a combination of both languages from positivism and constructivism in order to stress the pragmatic paradigm. Researchers may employ both formal and informal style of writing (Creswell & Plano-Clark, 2007).

Pragmatic researchers accept that they will have a choice of inductive and deductive logic in the course of conducting research on question that needs to be answered (Tashakkori & Teddlie, 1998).

### **3.6 Research Paradigm**

A paradigm can be thought as a mental map of a situation. The path a researcher follows through their study is determined by their constructed paradigm about the nature of the world. A researcher's paradigm reflects their beliefs about what reality is (ontology), what counts as knowledge (epistemology), how one gains knowledge (methodology), and the values one holds (axiology). A number of theoretical paradigms are found in the literature such as: positivist (and post-positivist), constructivist, transformative and pragmatic paradigm. However, each paradigm is considered incommensurable and incompatible with one another (Tashakkori & Teddlie, 1998).

As noted previously, this research will be based on a pragmatic paradigm. It emerged as a new paradigm in the 1990s as a solution to the quantitative-qualitative debates, popularly known as the “paradigm wars” in social and human sciences which lasted for almost three decades between positivists and constructivists (Giddings, 2006; Tashakkori & Teddlie, 1998). Pragmatism has been widely accepted as the paradigm that provides the philosophical framework for mixed-methods research to gain a better understanding of a problem phenomenon. It quashes the orthodox beliefs that qualitative and quantitative approaches cannot be used simultaneously (Johnson & Onwuegbuzie, 2004; Leech & Onwuegbuzie, 2009; Tashakkori & Teddlie, 2003). This paradigm places greater emphasis on the questions asked on the research, rather than methods, concentrates on the consequences of the research, and problems under study are informed by the multiple methods of data collection (Creswell & Plano-Clark, 2007).

The pragmatic paradigm views knowledge or meanings as being both constructed and based on the reality of the world we experience and live in (Johnson & Onwuegbuzie, 2004). This position informs the researcher that the knowledge about TNB's managers and engineers orientations and preferences in supplier selection that will be constructed

via the interaction with TNB's managers, engineers and the researcher as the fieldwork progresses. Accordingly, the researcher will play both roles of "disinterested scientist as informer of decision makers, policy makers, and change agents" and also as a "passionate participant as facilitator of multi-voice construction" (Lincoln and Guba, 2000, p. 170-171).

### **3.7 Research Theoretical Perspectives**

Several theories exist to explain the behaviours and attitudes of individuals when they are faced with decision-making that might be applicable to strategic sourcing decision-making process especially in the ESI. Existing but not entirely encompassing theories do explain some of the behaviours a DMU display in the course of making strategic sourcing decisions. Out of all the theories related to strategic sourcing decision-making process, four of them have been found more relevant for discussion in this chapter namely: Transaction Cost Economics (TCE); Resource Based View (RBV); Knowledge Based View (KBV) and Social Exchange Theory (SET). The four theories are explored below:

#### **3.7.1 Transaction Cost Economics**

TCE mainly emphasize on organization's operational performance with the objective of profit maximization (Williamson, 1985). TCE identify the transaction as the unit of analysis and the form of contract used as the expression of a choice at the boundary of an organization. Operational outcomes are short-term oriented and therefore it enables the appraisal of short-term business performance. Moreover, operational performance of a single transaction can easily be quantified and specifically measured. Therefore, TCE can be used to evaluate discrete transactions. Nevertheless, the main aim of each party to be engaged in the transaction process is to gain benefits from the costs incurred (Byramjee et al., 2010). Hence, the TCE domain is valid for business-to-business transaction analysis. However, Williamson (1985) asserts that precaution from any kind of opportunism need to be taken during contracting process. From a strategic sourcing perspective, transaction costs rely not on the "quantity and variety of products but on

the ability of the supplier to meet buyer expectations” (Hsu et al., 2006, p. 217). Moreover, with the forging of strong partnership between buyer and suppliers, the issue of opportunism will no longer be a concern to the buyer even when highly specific assets are involved. However, TCE theory has been criticised for its lack of integration of social context into the theory (Conner & Prahalad, 1996; Madhok, 2002; Williamson, 1996). It has been subjected to further critiques due to its extreme application of opportunism and inclusion of deceit as an acceptance in our culture (Ghoshal & Moran, 1995). In addition, it fails to recognize corporate capabilities and other aspects of organizational behaviour (Espino-Rodríguez & Padrón-Robaina, 2005; Holcomb & Hitt, 2007).

### **3.7.2 Resource Based View**

As organizations develop strategies to remain competitive in business, many will target certain areas of strength within the organization to be superior in the marketplace. In order to gain and preserve a sustainable competitive advantage, these strengths must yield a unique position that other organizations within the industry cannot easily duplicate. These concepts form the premise of the RBV (Barney, 1995; Wernerfelt, 1984). Unlike TCE theory which takes the perspective that marketplace failure accounts for the organization’s structure of governance, RBV takes the opposite perspective that organization success is what accounts for the stable organizational structure. Therefore, RBV avoids the weaknesses of TCE and considers organization’s resource capabilities and competencies. Using principles from the RBV, resources that are essential for long-term organizational performance could be identified (Shook et al., 2009). RBV advocates a causal relationship between assets available to a buyer and the products/services offered to the marketplace. This is important in meeting the customer’s needs and creating sustainable value (Hsu et al., 2006). It provides a perspective to understand different levels of performance among different organizations with different asset portfolios. Some scholars perceive TCE and RBV as complementary to each other (Marshall et al., 2007) while others viewed them as interconnected approaches which strengthened one another (Leiblein, 2003). Although RBV seeks to identify sustainable advantages for organizations, it ignores the behavioural aspects of strategic sourcing.



### **3.7.3 Knowledge Based View**

KBV was developed as an extension of RBV which identifies knowledge as the core competency to any organization (Shook et al., 2009). Organizations with the ability to identify and exploit specialized knowledge are expected to adapt their resources more quickly and effectively in the marketplace than their competitors. The KBV posits that the products manufactured “by tangible resources depend on how they are combined and applied, which is a function of the firm’s know how” (Gottschalk, 2002, p. 80). Two types of knowledge are identified as crucial to sustaining performance: explicit and tacit (Zack, 1999). Explicit knowledge is defined by written procedures, recordable events and established processes that an organization employs. Conversely, tacit knowledge refers to context-specific knowledge gained from a period of experience within a company’s complex organizational routines which is difficult to be reproduced in other settings. Shook et al. (2009) highlight that organizations may establish sourcing relationships with leading resource and knowledge providers in order to gain access to knowledge and resources not currently possessed internally. Sharing information, mutual learning, joint decision-making and knowledge sharing are the key characteristics of KBV (Zardini et al., 2011). KBV focuses on improving competitiveness but does not attempt to measure behavioural outcomes.

### **3.7.4 Social Exchange Theory**

SET is identified as one of the most important theories which reflect social network structure and relational norms. The underlying premise of social exchange theory is that the reciprocal exchange made by two parties in terms of the benefits and costs (Taylor et al., 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 metrics set for a particular purchase (Narasimhan et al., 2009). A supplier who is able to exceed the buyer’s expectations in these pre-defined metrics is more likely to be retained for future transactions (Bharadwaj, 2004).

### **3.7.5 Summary**

As these theories propose, an organization's ability to create competitive advantage relies upon its ability to effectively manage sourcing decisions. This in turn necessitates the need to select suppliers based on their ability to support value creation efforts. At the core of this is the ability of suppliers to not only meet the buyer's needs in terms of product and performance, but also alignment of goals and objectives of both parties. Based on a review of the literature, the researcher operationalizes strategic sourcing supplier selection in terms of two constructs consistent with existing theories: supplier competitiveness and supplier attractiveness.

### **3.8 Research Design**

Once a researcher has decided the appropriate methodology for a study, the researcher has to decide upon specific research design that best address the research problem (Creswell & Plano-Clark, 2007). Research design develops a mechanism for "collecting, analysing, interpreting, and reporting data in research studies" (Creswell & Plano-Clark, 2007, p. 58). There are four types of mixed methods designs: the triangulation design, the embedded design, the explanatory design, and the exploratory design. Creswell and Plano-Clark (2007) strongly recommend that researchers employ only a single design that best matches their research. The relationship between supplier evaluation practices and decision-making process have been documented in the literature review. However, many of the influences that drive supplier evaluation practices and decisions arise from the needs as perceived by the decision-making team. Thus, to in order to develop the data necessary to undertake this research work, a concurrent qualitative-quantitative triangulation approach to the research study was considered the most appropriate method: a type of design in which different but complementary data were collected on the same subject.

In order to establish an overarching view of decision-making practice, it is necessary to develop an understanding of the practices from both strategic and operational perspectives. Therefore the data developed will of necessity consist of different views

from different perspectives. Thus the data will be complementary data which is necessary in order to establish strategic sourcing supplier selection metrics in the ESI from the perspective of managers and engineers in TNB. The term triangulation, borrowed from military science to signify the use of multiple reference points to locate an object's exact position, was later used to suggest that quantitative and qualitative data could be complementary. This type of design, according to Creswell and Plano-Clark (2007) and Patton (2002), is based on the premise that to bring together the differing strengths and non-overlapping weaknesses of quantitative methods (large sample size, trends, generalization) with those of qualitative methods (small sample size, details, in-depth). This design is also useful when the research is aiming to directly compare and contrast quantitative statistical results with qualitative findings or to validate or expand quantitative results with qualitative data. Creswell and Plano Clark (2007) added that the single-phase convergence model is the best approach to understand a phenomenon with valid and well-substantiated conclusions, since the design will be carried out concurrently and separately. The summary of this design is shown in Figure 3.3.

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**Figure 3.3** Triangulation Design: Convergence Model

The quantitative portion, in the form of a questionnaire, addressed key stakeholder perceptions of the strategic sourcing supplier selection metrics and definitional dimensions. Concurrent with this data collection, the qualitative portion of the study facilitates the study in greater depth, providing descriptions of relationships between the variables. This author agrees with the points of Creswell and Plano-Clark (2007) in that the design has its own advantages. Firstly, it has become a framework for thinking about mixed methods. Secondly, the single phase design promotes efficiency as both types of

data are collected roughly at the same time. Finally, this design also advocates team research as data can be collected and analysed separately by quantitative and qualitative experts. However, this design is not short of weaknesses. Firstly, it is more time consuming and expensive due to the nature of data being collected concurrently and assigned with equal weight. Secondly, researchers might face difficulty if the quantitative and qualitative results do not agree. Thirdly, researchers need to be aware of the consequences of converging the two data sets having different samples and sample sizes. Finally, converging two different types of data and their results in a meaningful way might be challenging (Creswell & Plano-Clark, 2007).

### **3.8.1 Limitations of Mixed Methods Design**

Although mixed-methods research has its advantages, it is accepted that this type of research is more time consuming and resource intensive to collect and examine quantitative and qualitative data (Patton, 2002). Similarly the researcher must be properly trained to conduct mixed-methods research (Creswell & Plano-Clark, 2007). Some researchers argue that mixed methods may not be suitable for certain types of research question and should not be adopted just for the sake of personal preference (Bryman, 2007; Jick, 1979). However given the nature of the problem described, the author believes that the mixed methods to be the most appropriate approach. Also sufficient research training was provided and facilitates its use.

### **3.9 Sampling Strategy**

A survey is most effective when directed to a particular group or population (Taylor-Powell & Hermann, 2000), such as the engineers and managers targeted here. Participants believed to be relevant to the current study were purposively chosen (Bird, 2009). Purposive sampling identifies and selects research participants by enabling the researcher to incorporate his/her research interest and purpose (Teddlie & Yu, 2007). The term purposive sampling has been used interchangeably with non-probability sampling, purposeful sampling or qualitative sampling. Purposive sampling was used in this study as it fits the purpose, budget and timeframe of this study.

Since the research aims to highlight the key features of TNB's purchasing executives in the supplier selection preferences from their own perspectives and experiences, the main participants were managers and engineers of TNB. Accordingly, the researcher approached the Group Human Resource Office of TNB for permission in recruiting the research participants. The researcher obtained the permission of TNB to advertise in the organisation's monthly online news bulletin to recruit participants (Appendix 2). The Group Human Resource Office was not be required to perform any other recruitment activities. Managers and engineers were selected because they are the staff directly responsible in the purchasing process and thus able to give first-hand knowledge on current supplier selection practices. The research participants were able to supply information on their perceptions of suitable supplier selection metrics and definitional dimensions for capital equipment purchase under strategic sourcing initiatives. Approval was obtained was obtained from the AUT University Ethical Committee (AUTEK) to conduct this study.

### **3.9.1 Participant Selection Criteria**

For semi-structured interview, the elements of the survey criteria for selecting participants were as follows:

- Senior executives serving Tenaga Nasional Berhad, and
- Senior executives who have been involved in formulation of Group Procurement policy and procedures, and
- Their ranks are Executive (Grade E15) and above.

For questionnaire aspect of the survey, the criteria are:

- Engineers and Managers serving Tenaga Nasional Berhad, and
- Experienced in dealing with procurement of generation, transmission and distribution infrastructure (involvement in financial and technical evaluation of supplier selections), and
- Their ranks are Executive (Grade E14) and below.

### **3.9.2 Sample Size**

A unit of analysis is the group or individuals selected by the researcher to study

(Creswell, 2003). The unit of analysis can be a person, a group, an organization, or a social category (Neuman, 2003). The unit of analysis for this research is engineers and managers in TNB. The sample size for both research instruments are as follows:

i. Semi-structured interviews

In this study, the number of participants to sample was a contentious issue as there was no any widely recognized formula to suggest the optimum number and provide statistical significance. However, Dick (1990) articulates that interviewing can cease once two successive interviews provide little or no additional information to be added to the analysis. The group identified for semi-structured interviews comprised of the group procurement office and core business (generation, transmission and distribution) procurement offices (12 interviewees). This was subject to review using the protocol of “adding nothing more” advocated by Dick (1990).

ii. Questionnaire Survey

The overall size of the population of the study, engineers and managers in TNB located throughout 12 different states in Malaysia is 4,952 as of 31<sup>st</sup> July 2011 (H.S. Jamaludin, personal communication, October 17, 2011). Though the sampling strategy adopted in this study is not random, the researcher decided to ensure minimal error by employing the scientific identification of the sample size (Yamane, 1967). Thus, a confidence interval was established at 95% or an alpha value at 0.05, and the t value estimated at 1.96. Due to the variation errors from sampling elements, the study error was to be accepted at 5%. In order to ascertain a design effect, the actual sample size was aimed at a greater number than estimated.

Total sample size for the study:

$$n = \frac{N}{1 + Ne^2} \quad \text{Equation 3.1}$$

Where:

n = Total sample size

N = Total population (4,952)

e = error estimation (0.05)

Therefore,

$$n = \frac{4952}{1 + (4952)(0.05)^2}$$

$$n = 370$$

However, adopting commonly accepted mail survey response rate of 70% (Brennan, 1992), it was intended to target 530 engineers and managers as a contingency to take into account of any withdrawals and unreturned questionnaires.

The above sample sizes were selected because they provided a variety of rich and in-depth data which enabled the researcher to explore the supplier selection related experiences of engineers and managers within TNB. For good decision making, it was necessary to obtain both a desirable accuracy and a desirable confidence level with minimum cost.

### **3.10 Qualitative Approach**

A qualitative approach in research aims to understand how an individual makes meaning of their social world. The social world is not something independent of individual perceptions but is created through social interactions of individuals with the world around them. The intention of this approach is “to provide an in-depth and interpreted understanding of the social world of research participants by learning about their social and material circumstances, their experiences, perspectives and histories” (Snape & Spencer, 2003, p. 3). The use of a qualitative study is also in tandem with its definition. For example, Denzin and Lincoln (2000) defined qualitative research as gathering and interpreting narrative or textual information regarding individuals’ lives, while Creswell (2007) defined qualitative approach as an inquiry “to understand the contexts or settings in which participants in a study address a problem or issue” (p. 40).

#### **3.10.1 Qualitative Design**

The qualitative aspect of this study is embodied in the semi-structured interviews. Phenomenology was employed as the approach to guide data collection and analysis, since the purpose of this research is to highlight the TNB’s managers and engineers orientations and preferences in supplier selection from their individual perspectives and experiences as an insider (Creswell, 2007; van Manen, 2007) . Phenomenology originates from one of the most influential philosophers in the twentieth century,

Edmund H. Husserl, as a way of studying how people describe objects and experience them through their senses. Phenomenology is concerned with objective phenomena such as facts, feelings, concepts, dream images, sensations, fantasies, thoughts and referential objects (Cresswell, 2007). Husserl's most basic philosophical assumption of phenomenology was that the meanings of the lived experience are gained through human consciousness. The term phenomenology has been widely adopted by many scholars and they view it from various perspectives and meanings: as a philosophy, as a paradigm, as a perspective, as a qualitative method, or as naturalistic inquiry (Patton, 2002). Creswell (2007) points out even though there are many interpretations of the meaning of phenomenology, all the philosophical perspectives are directed towards some common elements: the study of lived, conscious experiences of people and "the development of descriptions of the essences of these experiences" (p. 58).

### **3.10.2 Data Collection Methods**

Commonly data generation in phenomenological study is captured by interviews or multiple interviews with participants (Creswell, 2007). Triangulation is further used in this part of the study. The study adopts two principle methods, namely semi-structured interviews and document review.

#### **3.10.2.1 Semi-structured Interviews**

Because this study is interested in obtaining rich and participant experiential data, qualitative data collection in the form of semi-structured interviews was employed. Interviews are one of the main data collection methods used by social researchers, providing the opportunity for direct interaction between the researcher and the research participants who agreed to be interviewed. Denscombe (2003, p. 163) writes that the interviewee's agreement indicates the "consent to participate, participant's view could be treated as 'on the record' and 'for the record' and declaration of researcher's right to control the interview process". Qualitative interview is usually divided into unstructured, semi-structured and structured depending on the degree of structure and standardizations the researcher wishes to adopt (DiCicco-Bloom & Crabtree, 2006; Matthews & Ross, 2010). For this study, semi-structured in-depth interviews was selected because improvisation to the interview script is allowed and its nature supports



the investigation of participants' experiences and feelings (Denscombe, 2003; Myers & Newman, 2007). Semi-structured interviews for this study were conducted on a one-to-one basis as suggested by Denscombe (2003), because such interviews are simple to arrange, the opinions and views come from a single interviewee, and the researcher has the upper hand to control the interview. Apart from having a clear list of issues to be examined, it also permitted the researcher to be more flexible in the order of the questions asked but at the same time provide the opportunity for the participants to be candid and to speak more widely on the issues raised (Denscombe, 2003). To ensure data validity, participants were provided with their individual interview transcript for their approval prior to data analysis. The group identified for semi-structured interviews comprised of the group procurement office (i.e. the Chief Procurement Officer and the Head of Departments in charge of policy making, implementation and control) and core business (generation, transmission and distribution) procurement office's (i.e. the Procurement Manager and Procurement Officers).

### **3.10.2.2 Document Review**

Although interviews, questionnaires, observation and experiments form a vital source for social research, information gathering could be further enhanced by looking through existing sources in the form of writing, figures and electronic information (Finnegan, 2006). Therefore, document analysis was also employed during the fieldwork because it will provide rich data on various supplier selection phenomena involving TNB's purchasing executives. Document review normally comprises of an analysis of the following:

- i. Published or unpublished documents and records, in the form of hardcopy or softcopy (Denscombe, 2003) that act as resources to facilitate this research. They may be in the form of books, journals, website pages, internet, newspapers, magazines, records, letters, memos, diaries, government publications and official statistics. Nevertheless, consideration will be taken on certain issues such as document's authenticity, credibility, representativeness, and clarity of words (Denscombe, 2003); and
- ii. Researcher-generated documents (Merriam, 1998), such as researcher's written diary or log books of activities that will be prepared during the investigation period.

For the purpose of this study, the researcher reviewed purchasing proposals (termed “project working papers” in the TNB context) submitted by each of the three key business sectors (generation, transmission and distribution).

### **3.10.3 Interview Instrument Development**

As the purpose of the interviews was to further explain and interpret the findings from the questionnaire survey, the interview questions were developed from the questions included in the questionnaire survey. In the following steps, the questions were approved by the research supervisors at the AUT University before they were used in the interviews. The questions being open-ended allowed the participants to elaborate more on their opinions, beliefs and experiences on the issues raised and this made possible the expansion of data gathered from the questionnaire survey. However, the initial questions were reviewed by a panel of experts<sup>1</sup>. The final questions used in the interviews were as follows:

- i. In your opinion do you think that in the current TNB practices that all buyers, suppliers and end-users (engineers and managers) have the same understanding of each of the supplier selection metrics?
- ii. Do you think that having a standard supplier decision model with clear descriptions of each metrics and a ranking of importance for each can improve the supplier selection process in TNB. Give reasons for your answers.
- iii. TNB’s existing practices for supplier selection are based on four basic metrics: price, quality, delivery and service. What is your understanding of each of these criteria?
- iv. Do you think that TNB needs to expand on this list? What would you suggest as new metrics that must be added to the list? Give reasons for your answers.
- v. How would you rank each of the metrics you proposed in order of importance with number 1 being the most important and number 18 being the least important? Give

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<sup>1</sup> The credentials of the four experts include: a retired power station general manager who is currently doing freelance consulting work in Malaysia and has a Masters in Electrical Engineering; a full-time faculty member of AUT University in the Faculty of Business and Law with a PhD who has vast working experience in the area of Logistics; a retired operations manager who worked for a Fortune 500 company with a Masters in Operations Management; and finally, a full-time faculty member of Universiti Tenaga Nasional in the School of Business with a PhD who specializes in supply chain management.

reasons for your ranking.

- vi. What other information do you think a supplier decision model should have? Give reasons for your answers.

### **3.10.4 Data Collection Process**

During the fieldwork, all qualitative data was reviewed as the research journey progressed. Data gathered from interviews was summarised and clarified to participants, and respondent validation was sought prior to the data analysis stage. Throughout the qualitative data collection process, a standard practice was adopted for all one-to-one interviews as stated below to ensure validity and reliability of data collection:

- i. Purposive sampling was employed to select participant for this study;
- ii. Semi-structured interviews meetings was to be applied to gather data;
- iii. English language was to be used as the medium of communication for all data collection methods;
- iv. The time and venue for the interviews was to be based on the convenience of the participants. The researcher prepared the guided questions and handouts and confirmed the appointment time and place for interviews two days before the interviews;
- v. The researcher was to arrive at the interview location early. Then, the researcher located the actual place for the interview and set up the interview materials;
- vi. The researcher prepared a brief handout regarding information of the study such as consent form (Appendix 3), participant information sheet (Appendix 4), rights of the participants, notebooks for taking down notes during interview, clock or watch to keep track of time and labelling techniques for interview information such as participant's name, time and date;
- vii. Written consent of participants will be obtained before interviews;
- viii. The researcher started the interview by developing rapport with the participants to make sure they were comfortable with the situation;
- ix. The researcher used the guided questions to conduct the interview. The researcher took notes on the participant's comments and decided to explore a certain topic or not. As a primary instrument to gathering the data directly from participants, the

researcher will continuously note down his observations of the interview to denote any non-verbal actions or issues that might need further clarifications;

- x. Probing was to be used to encourage participants to share their feelings without asking a lot of detailed questions;
- xi. Finally, the researcher kept the interviews within the promised time duration; and
- xii. The researcher closed the interviews by inviting the final input from the participants.

If the participants had no further comments, the researcher expressed appreciation for their participation. Then, the researcher labelled the interview, according to the participant's name, time and date of the interview.

All the transcripts, participant Consent Forms, and the Confidentiality Agreement Forms will be kept at a secured location in the university.

### **3.10.5 Data Analysis**

In general, data analysis meant a search for patterns in data – recurrent behaviours, and objects. It involves examining, sorting, categorizing, evaluating, comparing, synthesizing, and contemplating the data as reviewing the raw and recorded data (Neuman, 2003). This section presents the qualitative data analysis procedures used for the semi-structured interviews and document review.

#### **3.10.5.1 Semi-structured Interviews**

A phenomenological approach encourages investigation of important statements, meaning units, textural and structural descriptions and descriptions of the essence (Cresswell, 2007). Therefore, data analysis took place parallel with data collection to permit the researcher to generate an emerging understanding about the research questions, which in turn informed both the sampling and the questions being asked (DiCicco-Bloom & Crabtree, 2006). The data collection and analysis were carried out repeatedly and ceased when a saturation point was reached where no new categories or themes emerge.

Basically there are three schools of thought in a phenomenological approach: descriptive, interpretive and hermeneutic phenomenology. A descriptive phenomenology school of thought believes in bracketing or epoch in which

preconceived ideas are recognized and temporarily put aside, to enable the researcher to experience the process of discovering the phenomenon first hand and through direct contact with the participants (Moustakas, 1994). The data analysis process, as explained by Creswell (2007) and Patton (2002), involves reduction of data into significant statements, or horizontalization and combination of statements or clusters of meanings into themes. Based on the themes, the researcher then describes what the participants experienced (textural description) and how they experienced it (structural description). Finally, the researcher presents the essence of the phenomenon. Advocates of this approach have different opinions whether the researcher should validate the findings with the participants. Some agree and some disagree (Polit & Beck, 2008).

Polit and Beck (2008) highlight that interpretive phenomenology stresses the idea of hermeneutic circle. This circle denotes the process in which the researcher moves back and forth between the parts and the whole text under study, in order to interpret the true meanings of the contents. The end product of the analysis process is termed constitutive pattern, which “expresses the relationships between relational themes and is present in all the interviews of texts” (p. 522).

Hermeneutic phenomenology is a combination of descriptive and interpretive phenomenology (van Manen, 2007). Proponents of this approach do not believe in bracketing, and the researcher’s pre-understandings always inform him or her in the process. According to van Manen (2007), in order to capture the meanings of the experience under study, the researcher has to uncover the thematic aspects of the phenomenon by using three methods:

- i. The holistic or sententious approach;
- ii. The selective or highlighting approach; and
- iii. The detailed or line-by-line approach.

According to Radnor (2001) six steps were identified on how to conduct data analysis for an interpretive study:

- i. Topic ordering: This is the stage in which the researcher prepares the data for analysis during the designing of the research, even before conducting the fieldwork. It involves designing a structure of data based on what type of questions to ask of the participants. This structure is arranged according to some relevant topics, even

- though the findings are uncertain until data analysis is conducted;
- ii. Constructing categories: The researcher needs to read the interview transcripts a number of times to become familiar with the data. As categories start emerging from the data, the researcher begins to construct them as subheadings to each topic previously prepared. Categories of data can be either explicit or implicit. The former category can easily be detected from the words of the participants, while the latter is constructed by the researcher based on his or her reflexive action;
  - iii. Reading for content: The researcher begins to read through the transcripts and start marking main quotes. The researcher then starts to write code names and category numbers next to the marked texts;
  - iv. Completing the coded sheets: All the code names and category numbers are transferred into each category prepared in the earlier stage;
  - v. Generating coded transcripts: Using a word processor, the researcher uses copy and paste function to transfer the marked quotes from each interview transcript into each constructed category. Marked quotes do not necessarily appear in just one category, because they may have information that is relevant to many categories; and
  - vi. Analysis to interpret the data: The researcher reads the data under each category to find different nuances of meaning. This is the stage where interpretive process prevails over descriptive procedure. The researcher then interprets the findings, writes a summary of statements for each category and forms a solid background of understanding the phenomenon under study.

### **3.10.5.2 Document Review**

For document analysis, nine documents from three important divisions (Generation, Transmission and Distribution) were systematically reviewed. First of all, the mentioned documents were obtained from the respective division's procurement office. The researcher read through all the documents to gain general understanding of their content and seek policy statements related to strategic sourcing supplier selection metrics. Thereafter, utilizing seven strategic sourcing supplier selection metrics as a priori theme, the researcher reviewed the documents with the aim of identifying and highlighting any policy provision that speaks to standardization of strategic sourcing supplier selection metrics. Key words or phrases related to strategic sourcing supplier selection metrics, such as price, quality, delivery, support service, past experience,

customer training, and safety awareness, were used as codes to locate information of interest. Eventually, a table was created indicating level of presence of the strategic sourcing supplier selection metrics in these documents. Notations G, T, and D were used to indicate the respective divisions. As honoring the host organization's request for confidentiality, there will be no further descriptions of the particular purchase (capital equipment) revealed in this thesis.

### **3.10.6 Ensuring Rigour in Qualitative Study**

The trustworthiness of the qualitative approach is frequently questioned by positivists, perhaps because their concepts of validity and reliability cannot be easily addressed in naturalistic work. More trustworthy findings could be obtained if a rigorous research process is demonstrated (Given, 2008). Rigour is a concept of legitimizing the naturalistic research process (Tobin & Begley, 2004), or the way by which the researcher ensures research quality (Giddings & Grant, 2009). In qualitative research, four important elements determine how rigorous or trustworthy research is. These are credibility, transferability, dependability and confirmability (Lincoln & Guba, 1985).

Lincoln and Guba (1985) define "credibility" as a fit between participants' views and the researcher's interpretations of them (Tobin & Begley, 2004). "Transferability" refers to the degree to which the findings of an inquiry can be transferred or applicable to a new situation (Hoepfl, 1997). "Dependability" exhibits the ability of the conducted study in adapting to changes in the studied environment and to new inputs over the time during research (Hamberg et al., 1994). Finally, "confirmability" focuses on the neutrality of the findings which are clearly extracted from the data, without considering figments of the researcher's imagination (Brown et al., 2002).

The researcher ensures the various phases in this study maintain sufficient rigour for external review. As the qualitative data will be used to support the quantitative findings, it is important to have both accounts of participants and researcher's interpretation, work hand in hand to produce accurate and credible findings that can be trusted.

### **3.11 Quantitative Approach**

Since a triangulated mixed methods approach will be utilized (Creswell & Plano Clark, 2007), quantitative approach will be used to provide complementary data to the qualitative findings previously discussed. The quantitative phase of this research will primarily explore strategic sourcing supplier selection practices in the Malaysian ESI. It also will fathom the preference metrics in multi attributes decision-making phenomenon through data from a Likert scale questionnaire given to the engineers and managers in TNB.

#### **3.11.1 Quantitative Design**

Questionnaires are designed to gather information in the form of facts and opinions by questioning participants directly (Denscombe, 2003). Mail surveys have been used previously in studies on supplier selection (Dickson, 1966; Kannan & Tan, 2002; Shahadat, 2003). In this quantitative study, a postal self-completion questionnaire survey will be adopted to collect the data.

The potential strengths and weaknesses of postal self-complete questionnaires have been studied in many contexts (Frazer & Lawley, 2000; Williams, 2003). Strong empirical evidence is lacking too many of the concerns and questions that currently exist. Bird (2009) provides a comprehensive list of major strengths and potential weaknesses of mail survey methods, which can be readily assessed in relation to this research. The strengths of postal self-completion questionnaires that were capitalized on during this research include:

- i. cost-effective
- ii. able to have a greater coverage area
- iii. ensures anonymity
- iv. provide participant time to consider responses
- v. interviewer cannot shape questions

(Source: Bird, 2009)



The potential weaknesses of mail surveys which are identified by Bird (2009):

- i. limited survey length
- ii. limited complexity
- iii. researcher has no control over who completes the survey
- iv. response rates can be poor
- v. difficult to check non-response biases

### **3.11.2 Survey Instrument Development**

Identification of critical metrics for the research and preparation of questionnaire is a crucial step for the success of the survey. Significant work has already been done on supplier selection metrics and there is a well-documented and peer-reviewed set of selection metrics available in the literature. For this research, the questionnaire has been developed by incorporating the key selection metrics reported in the literature. A total of 18 metrics were identified under two broad categories namely supplier competitiveness and supplier attractiveness. The questionnaire contained three parts. Section A had 5 items to investigate current supplier selection practices in TNB, Section B contained 18 items on assessing supplier selection metrics and definitional dimensions Section C had questions regarding demographics of the participant and the respondent's organization. Section A and C also contained items on current supplier selection practices and demographic details that allowed multiple responses. The questions in Sections A (Question A5) and Section B used a 5-point Likert-type scale with response choices of 1 (not at all important) to 5 (extremely important). Likert scale is proposed because it can provide the participants with the ability to state their level of agreement with the given statements (Black, 2005). However, there are two questions which operationalized different response choices due to suitability issues. Question A4 has response choices of 1 (totally ineffective) to 5 (very effective) and Question C5 with 1 (never) and 5 (very frequently). Demographic information included multiple choice responses. Items were extracted and adapted from questionnaires of prior research studies as discussed in Section 2.5.1. The questionnaire was divided into subsections (B1 to B18) to address each construct. Table 3.2 presents each construct, measure and the number of questions related to the measure.

### **3.11.3 Pilot Testing**

A pilot test of the criterion instrument (Appendix 5), specifically designed for this study by the researcher was conducted. The pilot test determined each criterion instrument's ease of use and understanding. The pilot test was administered to 30 participants selected purposively with expectation of similar characteristics of the target population, and reflected as close as possible, the research environment conditions and procedures. The total number of pilot study participants was based on 5% of the estimated sample size (530). Changes in clarity and wording to the final research instrument were made to reflect the results and suggestions from the pilot test participants. Table 3.3 presents the pilot study evaluations by the participants.

Twenty engineers and managers of TNB responded to the pilot study. The final data analysis does not reflect the data collected in the pilot test study. There was a cross-sectional representation of key stakeholders. Several of the participants had been closely involved in the newly launched SCM initiatives for TNB. The participants appeared mixed in their level of motivation to participate in the pilot study. Generally, a consensus was obtained in all areas of evaluation. The modified version questionnaire is shown in Appendix 6.

Table 3.2 Construct and measure descriptions with questions distribution

<b>Construct</b>	<b>Measure</b>	<b>Number of Questions</b>
<b>Supplier competitiveness</b>	Product quality	4
	Price	4
	Delivery	5
	Support Services	6
<b>Supplier attractiveness</b>	Production system	6
	Flexibility	5
	ICT	6
	Financial performance	6
	Product innovation	6
	QMS	4
	Management and organization	6
	Customer training	4
	Employee training and development	4
	Performance history	3
Customer focus	9	
CSR	4	
Safety awareness	9	
Environmental attributes	10	

Table 3.3 Pilot evaluations by participants

Action item	Disposition	Issues/concerns	Level of criticality for deploying survey*
<b>Participant Information Sheet</b>	Commented it was rather lengthy and too detailed	All the original contents were retained due to research ethical requirements.	1
<b>Participant Information Sheet</b>	Ensure sponsoring organization is identified	Add Universiti Tenaga Nasional as research sponsoring body	1
<b>Participant Information Sheet</b>	Reduce the amount of time to answer the questionnaire	Ensure participants are inclined to answer the questionnaire	1
<b>Questionnaire Demographic details</b>	Relocate the section towards the end of questionnaire	Avoid personal particulars in the beginning of questionnaire	3
<b>Questionnaire Demographic details</b>	Want consideration to expand list of companies	Add more companies under TNB	1
<b>Questionnaire Demographic details</b>	Add role of participants	Ensure participants could identify their role in the supplier selection process	2
<b>Questionnaire Demographic details</b>	Want consideration on past procurement experiences	Add procurement modes and type of items procured	2
<b>Questionnaire</b>	Relocate to first section of the questionnaire	Consensus was to relocate the section	2

<b>Investigation of supplier selection practices</b>			
<b>Questionnaire</b>			
<b>Investigation of supplier selection practices</b>	Remove Questions B1 due to organizational sensitivity issues	Eliminate Question B1	3
<b>Questionnaire</b>			
<b>Investigation of supplier selection practices</b>	Want consideration to include types of decision-making methods	Refine Question B2 and B5 to include types of decision-making methods	3
<b>Questionnaire</b>			
<b>Investigation of supplier selection practices</b>	Want consideration to reduce the number of supplier selection metrics	Refine Question A5 by eliminating certain irrelevant criteria and merging some	3
<b>Questionnaire</b>			
<b>Assessment of supplier selection metrics and definitions</b>	Want consideration to reduce the number of supplier selection metrics and definitional dimensions	Refine Questions B1 to B18 by eliminating certain irrelevant metrics and merging some	3

\*Scale: 1 = “Not critical to change”, 2 = “Needed clarity”, 3 = “Must be corrected”

### 3.11.4 Data Collection Process

Data Collection is an important aspect of any type of research study since inaccurate data collection can impact the results of a study and ultimately lead to invalid results. For this study, the questionnaire was designed to be cross-sectional since it is planned to collect quantitative data only at one point in time. Data for the main study was collected during September to November 2011. Upon contact by the interested participants, the questionnaire was posted by the researcher. The package included cover letter (Appendix 7), participant information sheet (Appendix 8) and the questionnaire. Two weeks after the initial mailing, a reminder was sent to participants to remind them to complete the questionnaire (Appendix 9). A second reminder was sent after the fourth week (Appendix 10). No further contact regarding the survey was made after 4 weeks as such contact might have been seen as unwelcomed solicitation comprising the voluntariness of the study (Schirmer, 2009). No incentives were provided to participants to complete the questionnaire in order to maintain ethical integrity (Williams, 2003). Whilst the response rate of self-complete questionnaire survey has been a subject of strong debate (Frazer & Lawley, 2000; Williams, 2003), as the current participants were accustomed to this approach, it was anticipated that the response rate was likely to be higher than other methods.

Throughout the quantitative data collection process, a standard practice was adopted to ensure validity and reliability of data collection whilst aiming for a higher response rate:

- i. Purposive sampling was employed to select participants for the questionnaire;
- ii. English language was used as the medium of communication for all data collection methods;
- iii. White, stamped envelopes was used to contact participants (Williams, 2003);
- iv. Sending the questionnaire package with a pre-paid envelopes for participant's replies (Williams, 2003);
- v. Sending a cover letter that has been signed in blue-ink (Williams, 2003);
- vi. Official letterhead on high quality paper will be used for all correspondence (Williams, 2003);
- vii. Anonymity of the survey will be stressed (Williams, 2003);
- viii. Brightly coloured paper was used to print the questionnaire (Williams, 2003);

- ix. Two reminders were sent to non-participants with another copy questionnaire and a pre-paid envelope (Williams, 2003);
- x. Questionnaires will be subsequently kept at a secured location in AUT University in compliance with Ethics Approval Protocol.

### **3.11.5 Data Management**

Data from the questionnaires were transferred by the researcher to a Statistical Package for the Social Sciences (SPSS). Coding is a process of converting questionnaire data into meaningful categories to facilitate analysis. The coding scheme for this study was decided upon after modification of the survey instrument following pilot survey. This permitted the researcher to enter data directly from the questionnaire into the database for analysis. For this research, the coding scheme for the questionnaire was checked by a statistician to filter any mistakes prior to printing.

Data cleaning is an important task before conducting statistical analyses, because it aims at enhancing data accuracy through identification of missing data, outliers, and the fit of statistical assumptions like normality and linearity (Mertler & Vannatta, 2005). As a solution to overcome blank responses, the analysis adopted Sekaran's (2005) suggestion to assign a mid-point number to an interval-scaled item, or to program the computer to ignore blank responses during analysis, or giving the mean value of all the responses for the particular items.

### **3.11.6 Data Analysis**

The data was analysed statistically by correlation analysis using SPSS. Descriptive analysis was conducted to identify characteristics of participants and the means, standard deviations, and frequency of each metric and definitional dimension. Histograms were examined for kurtosis and skewness. Factor analysis and coefficient alpha tests were conducted to measure internal reliability of the survey instrument. Following successful establishment of reliability several steps were taken in the data analysis process. These steps focused on hypothesis testing of the eighteen null hypotheses stated previously.

Correlation analysis attempted to decide whether and to what degree, a relationship existed between two or more variables. Once a relationship was established, a correlation coefficient, which is a number between -1.00 and +1.00, identified it. Values less than 0.05 directed the researcher to reject the null hypothesis, and values greater than 0.05 directed the researcher to retain the null hypothesis. Retaining the hypothesis occurs when the assumption is that the null hypothesis is true unless there is strong enough reason to reject it. The findings of this quantitative analysis are discussed in Chapter Four of this thesis.

### **3.11.7 Reliability and Validity in Quantitative Study**

In quantitative research, reliability refers to the repeatability of research findings and validity represents the extent to which the research findings accurately represent the true construct of interest (Welman et al., 2005). These two elements are always given emphasis by research funding organizations. As a researcher we must be aware that a measure can be very reliable but could be invalid (Holton & Burnett, 2005). Forza (2009) agrees that analysis relying upon unreliable and/or invalid measurements, capable of making incorrect inferences and misleading conclusions.

Reliability in the context of this study is the degree to which the questionnaire has similar results each time it is used under similar conditions with the same participants (Nunnally & Bernstein, 1994). Reliability is assessed after data collection, by four most common methods: (1) test-retest method; (2) alternative form method; (3) split halves method; and (4) internal consistency method (Forza, 2009). Of the listed, the most preferred test falls within the internal consistency method employing the Cronbach's coefficient alpha as reliability indicator. Cronbach (1951) built upon the Kuder-Richardson formula for the coefficient of equivalence to create what has become a statistical standard for researchers calculating a reliability coefficient for their instruments. Santos (1999) points out that the "Cronbach's alpha is an index reliability associated with the variation accounted for by the true score of the underlying construct". Researchers accept that a coefficient of higher than 0.70 is acceptable for basic research (Kahn, 2001; Pikkarainen, 2004).



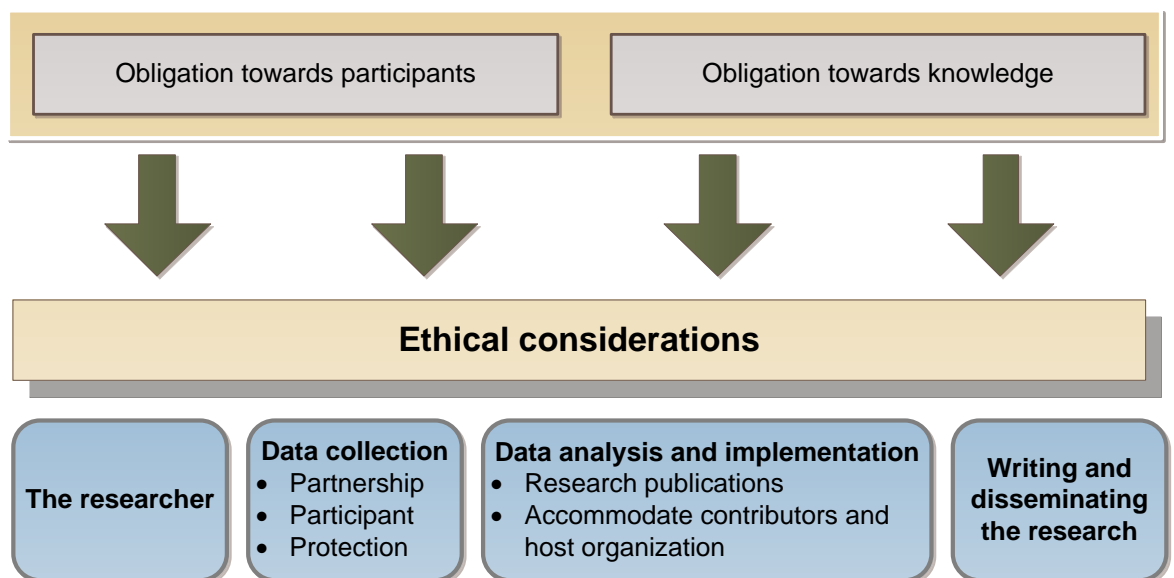
Common threats to validity in quantitative research are statistical conclusion validity, internal validity, construct validity, external validity and content validity (Creswell, 2003; Shadish et al., 2002). Threats to statistical conclusion validity arise from “inadequate statistical power or the violation of statistical assumptions” (Creswell, 2003, p. 171). This threat has been addressed in this study through the use of sampling procedures that ensure enough power to reveal significant differences. There are no significant threats to internal validity since there was no treatment or experimental procedure in this study. Threats to external validity, drawing “incorrect inferences from the sample data to other persons, other settings, and past or future situations” (Creswell, 2003, p. 171), are significant in that some readers may wish to extend the results to faculty members in other institutions, institutions in other states, or future situations that reflect a different environment. This threat was minimized by including a limitations section in the thesis that reminds readers to use caution in applying the results of this case study beyond the bounds of the case. Threats to construct validity occur when researchers use “inadequate definitions and measures of variables” (Creswell, 2003, p. 171). This threat was minimized by using a new survey instrument that is developed utilizing previously used frameworks which is heavily tailored specifically for ESI. This threat was further minimized by working with a panel of experts who checked the final instrument for construct validity. A fifth threat to validity is to content validity. Content validity is described as how well the content of an instrument samples the content of the domain of interest (Messick, 1989). Similar to the approach taken to minimize the threat of construct validity, this threat was minimized by developing the survey from literature and by having the instrument reviewed by a panel of experts<sup>2</sup>.

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<sup>2</sup> The credentials of the four experts include: a retired power station general manager who is currently doing freelance consulting work in Malaysia and has a Masters in Electrical Engineering; a full-time faculty member of AUT University in the Faculty of Business and Law with a PhD who has vast working experience in the area of Logistics; a retired operations manager who worked for a Fortune 500 company with a Masters in Operations Management; and finally, a full-time faculty member of Universiti Tenaga Nasional in the School of Business with a PhD who specializes in supply chain management.

### 3.12 Ethical Considerations

McMurray et al. (2004) highlight that the term ethics in research represents the study and practice of making good and right decisions while engaging in research. Therefore, as part of the planning and design of the research, the researcher placed strong emphasis on steering the research in an ethical, responsible and accountable manner (Shamoo & Irving, 1993). As illustrated in Figure 3.4, these ethical considerations were based on two major responsibilities: (1) towards the participants; and (2) towards the research community. Ethics approval from Auckland University of Technology Ethical Committee (AUTEK) (Appendix 11) was received prior to the fieldwork being undertaken.



**Figure 3.4** Ethical considerations in the research

#### 3.12.1 The Researcher

The role of the researcher is significant in that the scholar conducting the research needs to possess a host of core skills (Yin, 2003). These core skills comprises of “the ability to ask good questions, being a good listener, being adaptive and flexible, having a firm grasp of issues being studied and being unbiased by preconceived notions” (Yin, 2003, p. 59). The researcher is a sponsored staff member of Universiti Tenaga Nasional (UNITEN) which is wholly-owned subsidiary of TNB. However, this research study is carried out with the sole intention for the researcher’s doctoral study. This fact-finding

mission is only for academic purposes and is not carried out on behalf of TNB to assess its employees on the supplier selection issues. Therefore, the outcome of this study has no financial interest to the researcher, UNITEN or TNB.

### **3.12.2 Data Collection**

The Treaty of Waitangi is the founding document of New Zealand. Therefore, the Treaty should be respected by all researchers in New Zealand and, where applicable, should be incorporated into research conduct. Three principles of the Treaty of Waitangi (Partnership, Participation and Protection) have been incorporated in the design and implementation of this project. This research combines the qualitative and quantitative approaches to achieve the objectives of the project.

#### **i. Partnership**

This research was not intended to benefit any specific group but will instead treat all participants irrespective of race, religion or creed with respect and dignity. This research ensured that all participants and the researcher act honourably and in good faith towards each other through a mutual sharing of information and knowledge between all stakeholders.

#### **ii. Participation**

The primary role of participants in this research was about sharing of knowledge and information. To inform the research participants about the research project, a written Participant Information Sheet will be given to the participants (Appendix 4 for semi-structured interviews; and Appendix 8 for questionnaire survey). The translated version in the Malay Language is not required because the participants are well-versed in the English Language. Participants were not responsible or involved in other research nor were they required to participate in the analysis and design of the supplier selection decision support model. Participants were required to give their consent (Appendix 3) of all transcripts obtained from the semi-structured individual interviews prior to the analysis of such information. Participants who were interested in participating in the research contacted the researcher directly. The researcher ensured that the time and place for data collection did not interfere with the normal duties of the participants.

iii. Protection

To protect each participant from deceit or harm and to ensure the privacy of each individual, the identities of participants was not revealed in the presentation of the findings or in the final thesis. There was no potential threat of power imbalances in the individual semi-structured interviews and questionnaires as these are conducted on a one-to-one basis with the researcher. Participants should not experience any physical or social discomfort or embarrassment and psychological implications as a result of this research project. The participants were given clear and detailed briefing on the aims and purposes of this research and no identities of any individual will be revealed in the findings. Where individuals need to be referred to a pseudonym may be employed if necessary. The researcher took special care in ensuring that cultural diversity was respected and observed at all times during data collection.

### **3.12.3 Data Analysis and Implementation**

During data analysis, the primary consideration was the anonymity of the participants in the study. To ensure participants' privacy and confidentiality, their real names are not used in the thesis. Pseudonyms are used and all identifiable personal information is concealed. The demographic section in the questionnaire survey has been structured in such a way that it will be practically impossible to identify any of the participants. A summary of the research findings will be sent to participants who wish to receive it. The researcher kept all information of participants confidential and will not be sharing the data collected with the host organization. TNB as the host organisation will only be given a summary of the findings at the end of the research. Data collected in the forms of transcripts and questionnaires will be kept securely in AUT City Campus. These data are only to be viewed by the researcher and his main supervisor. Findings from this research will be used for the purpose of the researcher's PhD studies and will not be distributed for commercial purposes. Therefore, there are no potential conflicts of interest from the conduct of this study.

### **3.12.4 Writing and Disseminating the Research**

It is expected the research findings will be of interest to the Malaysian electricity supply industry, Ministry of Energy, Green Technology and Water (Malaysia), policy makers

and researchers, who are involved in researching supplier selection best practices, particularly in the context of Malaysia. These findings will be disseminated through various forms of information sharing platforms such as in national and international research conferences, and in refereed publications. Therefore, the researcher is responsible to deliver accurate interpretation of the data (Rodríguez, 1992). Any act of intentionally withholding or misrepresenting the data represents an ethical violation.

### **3.13 Limitations**

This study was deemed to have several possible limitations. Firstly, the unit of analysis in this study was engineers and managers in TNB located in 12 different states in Malaysia: participating regional offices and headquarters were solicited from Kuala Lumpur and other capital cities for reasons of physical manageability and data accessibility. The researcher selected all the states in the Peninsular Malaysia excluding the two states in the East Malaysia. Sarawak is excluded as its power supply is under state-owned company, SESCO (Sarawak Electric Company) and Sabah Electricity Sdn. Bhd. (SESB) is a joint-venture between the state government and TNB. As the management of SESB is unique compared to the administration of other entities owned by TNB, this might not reflect the actual procurement process embraced by TNB Holdings. Thus, this purposive sampling design may potentially not represent the general population of engineers and managers working for TNB. Furthermore, the engineers and managers within the chosen offices were self-selected volunteers and they might not be representative of all engineers and managers in those offices. In addition, the participants who volunteered were those willing to do so and might not have been representative of the offices, chosen by the high, moderate and low positive degrees of responses on the questionnaire questions. It is possible that the engineers and managers whose responses belonged to the moderate or low categories might not choose to participate in the study and those who did volunteer were those in the high category. Finally, data collection in all stages may be limited by the participants' willingness to give honest responses, their individual ability to offer accurate information concerning their past experiences and self-selected accounts of events and their sensitivities to their own perceptions of changes in beliefs and practices.

### **3.14 Chapter Summary**

This chapter provided a description of the methodology adopted for the conduct of this research and given the justification for choice of the research instrument. The philosophical construct of the research and positioning of its design has been highlighted. Also, this chapter reviewed the criterion instrument used in the data collection, as well as described the participants and setting for the research study. Moreover, this chapter highlighted the type of analysis to be used to examine the data. The next chapter will present the description of the participants and results of the statistical analyses and description of the findings from the data collected for this study.

# Chapter 4

## Data Presentation and Analysis

### 4.1 Introduction

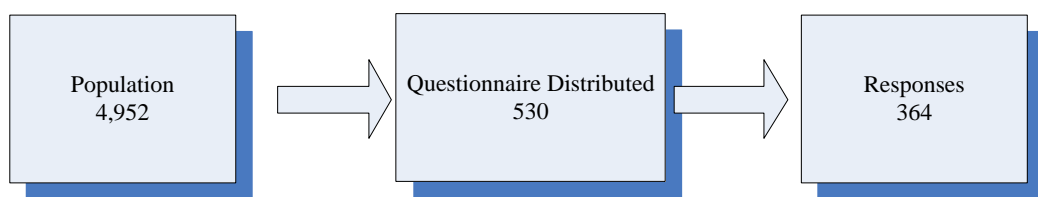
This chapter presents the findings from the research undertaken in order to meet the aim and some of the objectives set out in section 1.6. The research has also been conducted in accordance with the research methodology set out in chapter 3. A single-phased, concurrent triangulation strategy, mixed methods correlational study research design was used to collect data. The purpose of collecting the data was to examine key stakeholders' perceptions of suitable strategic sourcing supplier selection metrics and their corresponding definitional dimensions. The chapter will summarize the research findings in two distinct sections. Section 4.2 discusses the quantitative (statistical) data. Section 4.3 will examine the results of the semi-structured interview and document review approaches to the research.

### 4.2 Quantitative Analysis

For the purpose of quantitative data analysis, the SPSS version 19.0 was used. SPSS was chosen due to the fact that it could tabulate data, perform hypotheses testing, correlation analysis and could display the results in a wide variety of graphical formats.

### 4.2.1 Response Rate

Response rates are commonly seen as an important measure of validity. Higher response rates are assumed to minimize non-response bias. However, when determining validity and the generalizability of the results, it is more important that respondents be representative of the population being studied (Budd, 1987; Nunnally, 1978). From the 530 questionnaires distributed (assuming response rate of 70% as explained in section 3.9.2), 378 sets were returned of which 364 responses were useful for analysis. Figure 4.1 shows the population, sample size and number of responses. Fourteen questionnaires were discarded because participants: (1) perceived that the questionnaire was also meant for assessing suppliers for commodities; (2) were not involved in supplier selection process; and (3) did not answer at least a minimum of 25% of the questions. This response represents 69% of the proposed sample size.



**Figure 4.1** Total number of population, questionnaire distributed and responses of the study

According to Roscoe (2008), for questionnaire distribution method, in order to avoid sample bias, the response rate should be more than 10% and at least a minimum of 30% responses must be collected for the analysis (Sekaran, 2003). Since the response rate for the study is 98%, there is no sample bias and the response received could be assumed to represent the population. The higher percentage of response was due to several key factors:

- i. Starting in July 2012 the host organization, TNB launched major initiatives on effective supply chain management at the corporate level. Data collection for current study was timely when the engineers and managers were still fresh and having significant interest about issues in SCM especially procurement;
- ii. The researcher was requested to conduct a presentation at every regional office to provide a brief overview of the undertaken study. Prospective participants were more encouraged to participate in this study as they perceive that their voice would



be heard to improvise the organization's performance in supplier selection issues. For this purpose, the researcher travelled to 12 states in Peninsular Malaysia during the data collection process;

- iii. The provision of a supporting letter from Group Human Resource Office of the host organization (Appendix 12); and
- iv. The provision of a supporting letter from Universiti Tenaga Nasional as the research sponsoring body (Appendix 13).

## **4.2.2 Demographics**

The participants varied concerning a number of demographic profiles such as division/subsidiary, working experience, current role, past procurement involvement, involvement in supplier selection process and items procured. Each of these demographics factors is discussed below:

### **4.2.2.1 Division/Subsidiary**

Of the 364 participants, 33.5% of them are from Generation Division, 24.2% from Transmission Division, 9.6% from Distribution Division and others accounting 32.7%. The initial survey instrument only listed three main divisions of TNB and has another option called others. The pilot study demonstrates the need to list all the main subsidiaries of TNB which could be seen in Appendix 6 (the final survey instrument). The final questionnaire was answered by those who were involved in supplier selection and decision-making process in TNB. Table 4.1 shows the distributions of participants by division/subsidiary. This was deemed to be representative of the organization as a whole.

### **4.2.2.2 Working Experiences**

Working experiences is another demographic variable in which the participants showed a lot of variation. Most of the participants have more than 6 years working experiences (66.7%) and followed by 0-5 years (33.2%). The summation of both values is not reflecting 100% due to rounding errors. Table 4.1 shows the distributions of sample profile by working experiences. The implications of this being that the participants had enough experience to extrapolate their supplier selection preferences.

### 4.2.2.3 Current Role

The participants also differed with regards to their current role in supplier selection process. Initiators form the largest group, accounting for 34.3%, followed by the users who accounted for 29.9% and influencers 13.5%. Approximately 13.2% of the participants played the role as decision-makers. The remaining 9.1% of the participants are the buyers (procurement officers). Table 4.1 shows the distributions of sample by current role in supplier selection process.

### 4.2.2.4 Past Procurement Involvement

Past procurement modes is another demographic variable in which the participants showed considerable variation. There are 6 different procurement modes adopted by TNB in its business operations namely open tenders, restricted tendering, pre-qualification, selective tendering, procurement by negotiations and procurement using schedule rates. All of the respondents had had some experience of procurement during their careers. A total of 31.2% of the respondents had experience of only one type of procurement mechanism. The largest constituency of these ‘single experience’ respondents had used open tenders (23.9%), followed by procurement by negotiations (2.7%), selective tendering (1.6%) and pre-qualification (1.4%). Only 0.8% of the participants are experienced in both restricted tendering and procurement using schedule rates.

The majority of individuals had experience of two or more types of procurement (63.3%) mechanisms – these we may consider to be ‘multiple experience’ respondents. However, only a very few had experienced all 6 types of procurement mechanism (5.5%). These individuals we can consider to be ‘highly experienced’ in the context of TNB procurement methods. Table 4.1 shows the distributions of sample profile by past procurement involvement. The implications of this being that the participants proven they are knowledgeable about procurement practices in TNB.

### 4.2.2.5 Involvement in Supplier Selection Process

The participants also differed in terms of frequency of involvement in supplier selection process. Most of the participants are in the category of *sometimes* (39.6%), followed by *often* (32.1%), rarely (20.1%) and *very frequently* (8.2%). Table 4.1 shows the

distributions of sample by frequency of involvement in supplier selection process. Although 20% of the participants were rarely involved in the supplier selection process, they still had a viewpoint on this issue. This is due to the circumstances that they might be in the category of end-users who might not have direct access to share their opinions with the hierarchy of the organization.

#### 4.2.2.6 Items Procured

The participants showed a lot of variations in items procured, ranging from equipment purchase, engaging service and maintenance contract and combination of both tasks. The majority of the participants are experienced in procuring both products and services (53.6%). This is followed by engaging service and maintenance contracts (25.35%) and equipment purchase (21.2%). Table 4.1 shows the distributions of sample by frequency of involvement in supplier selection process.

Table 4.1 Demographic information

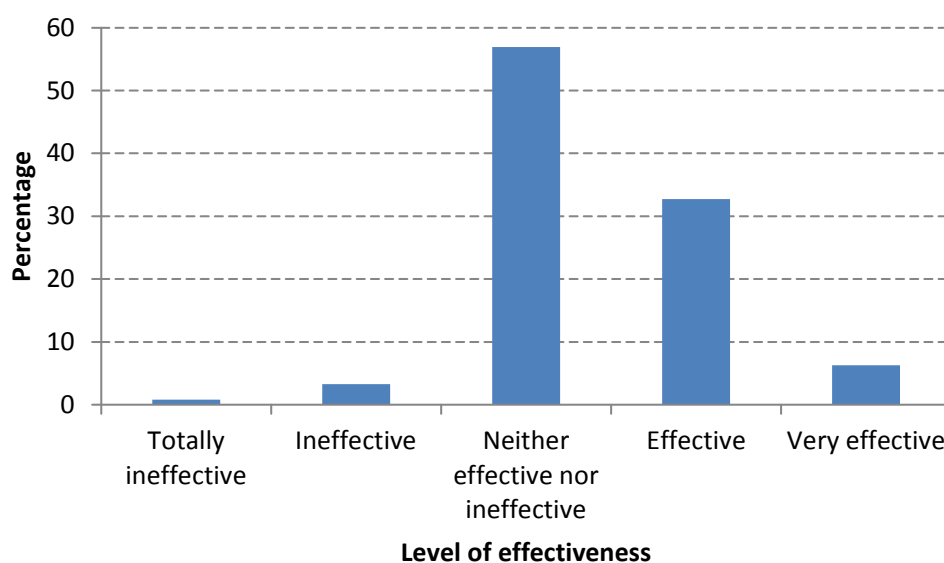
<b>Division/Subsidiary</b>		<b>Past procurement modes</b>	
Generation		Single procurement system	
	33.5%	experience:	
Transmission	24.2%	-Open tenders	23.9%
Distribution	9.6%	-Restricted tendering	0.8%
Others	32.7%	-Pre-qualification	1.4%
		-Selective tendering	1.6%
		-Negotiations	2.7%
<b>Working experiences</b>		<b>Supplier selection</b>	
0 to 5 years	33.2%	-Schedule rates	0.8%
6 to 10 years	19.8%	Experience with all 6 types of procurement mechanism	
11 to 15 years		Experience of two or more types of procurement mechanism	
	17.0%		63.3%
16 to 20 years	9.3%		
21 to 25 years	4.7%		
above 25 years	15.9%	Rarely	20.1%
		Sometimes	39.6%
		Often	32.1%
		Very frequently	8.2%
<b>Current role</b>		<b>Items procured</b>	
Initiator	34.3%	Equipment	21.2%
Influencer	13.5%	Service and maintenance	25.3%
Decision-maker	13.2%	Both	53.6%
Buyer	9.1%		
User	29.9%		

### 4.2.3 Current Supplier Selection Practices

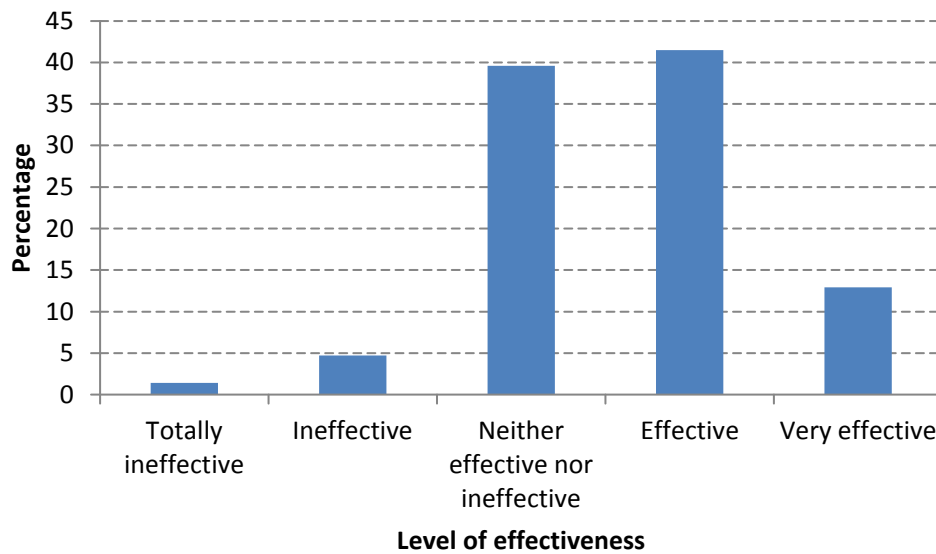
Participants were asked to evaluate their organization's supplier selection practices in terms of decision-making methods, application of software in supplier selection, reasons of not adopting decision-making software and rate organization's judgment on supplier selection. Each of these questions is discussed below:

#### 4.2.3.1 Decision-making Methods

Of the ten listed decision-making methods, the participants selected pros and cons analysis and cost-benefit analysis as the common decision-making methods adopted in their supplier selection process. Response options ranged from 1 to 5, with 1 representing lowest score (totally ineffective) and 5 highest score (very effective). Concerning how participants rate the level of effectiveness of the pros and cons analysis, descriptive statistics indicate that participants rate the level of effectiveness somewhere between neither effective nor ineffective ( $M = 3.40$ ,  $SD = .696$ ,  $n = 364$ ). For the cost-benefit analysis (CBA), analysis of descriptive statistics indicates that the organization is effectively using cost-benefit analysis for supplier selection ( $M = 3.60$ ,  $SD = .822$ ,  $n = 364$ ) because a mean score of 3.60 is very close to 4, which represents a score for effective. Figure 4.2 and 4.3 illustrates the participants' perceptions on pros and cons analysis and cost-benefit analysis.



**Figure 4.2** Effectiveness of using pros and cons analysis



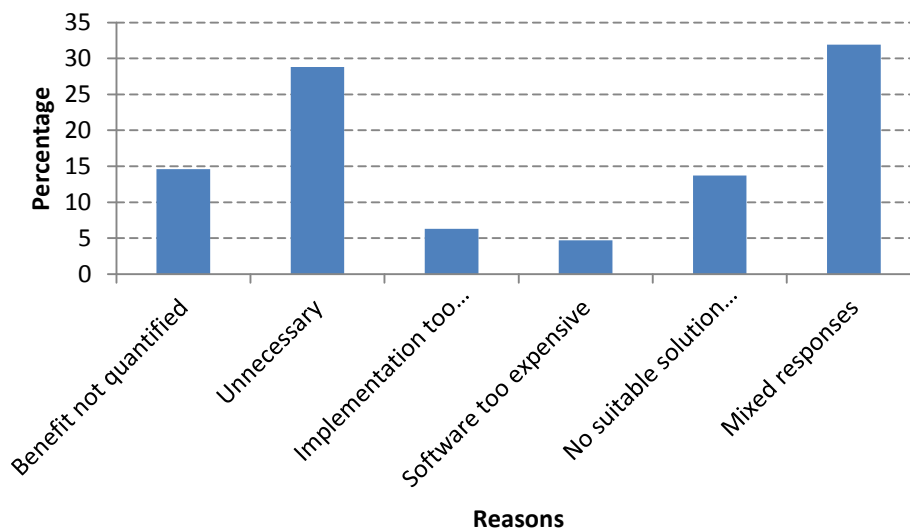
**Figure 4.3** Effectiveness of using cost-benefit analysis

#### 4.2.3.2 Decision-making Software Used

Of the 364 participants, only 24 of them have experienced using commercial software in supplier selection decision-making, followed by 53 participants using in-house software and 287 participants never used any decision-making software at all. Participants were requested to indicate the level of effectiveness for both commercial and in-house software. A Likert scale was used with 1 = totally ineffective to 5 = very effective. Statistics show that the mean scores for both commercial ( $M = 3.83$ ,  $SD = .963$ ,  $n = 24$ ) and in-house ( $M = 3.47$ ,  $SD = .723$ ,  $n = 53$ ) software range from 3.47 to 3.83, indicating participants' perceptions are close to a score of 4 that represents effective.

#### 4.2.3.3 Reason for Not Using Decision-making Software

The 287 participants who admitted that they never used any supplier selection software were asked to state the reason why the organization did not cultivate such practice. Leading as the main reason is *unnecessary* (28.8%), followed by *benefit not quantified* (14.6%), *no suitable solution available* (13.7%), *implementation too expensive* (6.3%) and software too expensive (4.7%). However, participants are also faced by mixed responses which accounted for the remaining 31.9%. Figure 4.4 illustrates the participants' perceptions on the reason for not using any supplier selection decision-making software.



**Figure 4.4** Reasons for not using decision-making software

#### 4.2.3.4 Judgment on Organization's Supplier Selection Practice

Participants were requested to indicate the level of effectiveness for host organization's judgment on supplier selection. A Likert scale was used with 1 = totally ineffective to 5 = very effective. Descriptive statistics show that the participants rate the level of effectiveness somewhere between neither effective nor ineffective ( $M = 3.39$ ,  $SD = .717$ ,  $n = 364$ ).

#### 4.2.4 Assessing Reliability

The researcher assessed the degree to which the instrument possessed internal consistency through a reliability analysis that measured the extent to which the items collectively were internally consistent. Cronbach's coefficient alpha ( $\alpha$ ), the most popular measure of internal reliability, was the procedure adopted to measure the intercorrelation of the items and estimated the proportion of the variance in all the items that was accounted for by a common factor (Forza, 2009). Sekaran (2003) asserts that the higher the coefficient alpha, the better is the reliability of what the instrument intends to measure.

In this study, tests for internal consistency using Cronbach's alpha were conducted for each individual scales and the overall measures as reported in Table 4.2 and Table 4.3. The purpose was to secure evidence regarding the reliability with which the instrument measurement measured what it intended to measure, the extent to which the items

functioned homogeneously and to determine if there was consistency in the scores among the individual items. This analysis helped determine which items to include or to exclude from each scale. The objective was to select a set of items that yielded a summed score that was more strongly related to the scale than any other possible set of items. Budd (1987) suggests a coefficient value between .50 to about .80, however, Hair et al. (1995) argue that .3 as significant, loadings greater than .4 are considered more important and loadings of .50 or greater are considered as very significant. Nunnally (1978) highlights that in basic research, reliabilities between .50 to .60 would suffice and any effort to increase the reliability beyond .80 is considered as wasting research resources. In short, a rule of thumb is .60 which is the lower level of acceptability for Cronbach's coefficient alpha (Bassioni et al., 2008).

Cronbach's alphas were computed for both theorized constructs and eighteen separate scales. Item analyses were conducted on the items in each scale in order to reduce the number of items in the survey and to strengthen the reliability of each scale. The Cronbach's alpha values for all the scales in the study are well above than .60 which has been specified by Nunnally (1978) and Bassioni et al. (2008), suggesting good to strong reliability and that the items in the individual scales were highly correlated. For the main composite scale, the computed Cronbach's alpha values for two theorized constructs: supplier competitiveness (.75); and supplier attractiveness (.93). The Cronbach's alpha values for the eighteen separate scales are as follow: product quality (.86); price (.83); delivery (.82); production system (.87); flexibility (.86); support services (.89); ICT (.91); financial performance (.94); product innovation (.89); QMS (.91); management and organization (.91); customer's training (.91); employee training and development (.916); performance history (.83); customer focus (.93); CSR (.91); safety awareness (.95); and environmental attributes (.95). The overall Cronbach's alpha value for the separate scales is chartered at .89. Thus, based on Table 4.2 and 4.3, the researcher concludes that the scales can be applied for the analysis with acceptable reliability.

Table 4.2 Internal consistency of the main composite scale

Scale	M	SD	Cronbach's $\alpha$
<b>Supplier competitiveness</b>			<b>.75</b>
Product quality	4.58	.632	
Price	4.24	.747	
Delivery	4.30	.732	
Support services	4.18	.721	
<b>Supplier attractiveness</b>			<b>.93</b>
Production system	3.80	7.92	
Flexibility	3.80	7.31	
ICT	3.68	.826	
Financial performance	3.96	.824	
Product innovation	3.70	.830	
QMS	3.90	.856	
Management and organization	3.71	.854	
Customer training	3.95	.801	
Employee training and development	3.83	.894	
Performance history	4.10	.786	
Customer focus	4.03	.753	
CSR	3.34	.978	
Safety awareness	4.17	.826	
Environmental attributes	3.93	.832	



Table 4.3 **Internal consistency of the independent scales**

Scale	M	SD	Cronbach's $\alpha$
<b>Product quality</b>			<b>.86</b>
Meets specification	4.51	.632	
Improve conformance	4.31	.663	
Reduce defective rates	4.29	.723	
Reduces breakdowns	4.38	.708	
<b>Price</b>			<b>.83</b>
Reasonable price	4.45	.651	
Allows space for price negotiations	4.20	.704	
Estimates cost accurately	4.18	.768	
Willing to show breakdown of unit price	4.19	.783	
<b>Delivery</b>			<b>.82</b>
Deliver on time	4.48	.690	
Correct quantity	4.50	.666	
Reduces manufacturing lead time	4.13	.755	
Accurate information	4.25	.721	
Geographical location	3.55	.971	
<b>Production system</b>			<b>.87</b>
Optimum arrangement of plant layout	3.78	.783	
Accepts orders in small quantity	3.77	.770	
Uses MRP	3.72	.830	
Reduces production setup time	3.73	.817	
Adopts TPM	3.72	.849	
Continuously produce same product	3.71	.792	
<b>Flexibility</b>			<b>.86</b>
Solving conflict resolution	4.08	.756	
Willing to change order volumes	3.94	.698	
Able to make design changes	4.03	.753	
Responds to changes in planned delivery dates	4.09	.727	
Rapidly changes the mix of different products	3.77	.790	
<b>Support services</b>			<b>.89</b>
Performs the service right the first time	4.33	.739	
Provides services at the promised/due time	4.41	.676	
Willing to customize services	4.17	.697	
Open to off-peak services	4.01	.733	

Provide qualified personnel	4.29	.695	
Provide spare parts	4.30	.725	
<b>ICT</b>			<b>.91</b>
Collaborative technologies	3.70	.790	
Transaction processing system	3.63	.780	
EDI	3.65	.824	
Advanced tracking system	3.82	.834	
ERP	3.70	.799	
Helpline	3.95	.838	
<b>Financial performance</b>			<b>.94</b>
Average return on investment	3.79	.833	
Profit as percentage of sales	3.79	.848	
Net income before taxes	3.72	.841	
Present value	3.73	.818	
Cash flow	3.99	.836	
Liquidity	3.82	.809	
<b>Product innovation</b>			<b>.89</b>
Designs new products	3.77	.767	
Develops customized products	3.93	.702	
Develops new product functions	3.87	.743	
Quickly in introducing new products	3.63	.794	
Willing to share key technological information	4.06	.760	
Adopts new production technology	3.90	7.24	
<b>QMS</b>			<b>.91</b>
Manual and procedure for its quality system	4.11	.817	
Improves quality assurance system	4.09	.824	
Effective product database	4.03	.795	
Achieves various quality system certifications	4.05	.806	
<b>Management and organization</b>			<b>.91</b>
Complete organizational structure	3.85	.827	
Management policies	3.85	.777	
Management attitude	3.95	.782	
Degree of alignment with customer's future plans	3.91	.768	
Stable workforce employment	3.96	.758	
Compatibility of ethical standards with the customer	3.96	.740	

<b>Customer's training</b>			<b>.91</b>
Competent instructors	4.28	.710	
Provides adequate training materials	4.23	.725	
Provides training tailored for different skill levels	4.18	.699	
Provides training specific to the needs of the customer	4.28	.719	
<b>Employee training and development</b>			<b>.92</b>
Undergo occupational health tests	3.88	.820	
Provides career advancement and training development	3.77	.820	
Well-planned training module	3.84	.800	
Sufficient funds for training	3.78	.820	
<b>Performance history</b>			<b>.83</b>
Local/international track record	4.19	.774	
Number of completed jobs	4.11	.761	
Pending or possible legal suits	3.98	.792	
<b>Customer focus</b>			<b>.93</b>
Strong sense of loyalty to its customers	4.13	.716	
Dedicates manpower and resources	4.18	.740	
Encourages visits to its facilities	3.93	.764	
Long term partnership	4.03	.742	
Keeps us informed	4.04	.756	
Willing to make a long-term investment	3.18	.797	
Provides information	4.04	.747	
Strengthening of warranties	4.13	.737	
Handles complaints promptly	4.23	.733	
<b>CSR</b>			<b>.91</b>
Commitment to use a portion of its profits to help nonprofits	3.48	.838	
Corporate giving to community programmes	3.47	.797	
Code of ethics is published and distributed to employees	3.59	.830	
Encouragement in recycling and use of recycled products	3.54	.840	
<b>Safety awareness</b>			<b>.95</b>
Zero number of lost times from accidents	4.10	.770	
Provides adequate personal protection equipment	4.24	.778	
Provides adequate safety instructions	4.20	.806	
Has an emergency plan and evacuation procedure	4.19	.774	
Has periodic safety audit	4.10	.845	

Provides safety training for employees	4.15	.759	
Has certifications for safety practices	4.18	.802	
Has a safety officer	4.20	.758	
Satisfy safety requirements at customer's premise	4.28	.737	
<b>Environmental attributes</b>			<b>.95</b>
Reduced consumption of material	3.79	.750	
Reduced consumption of energy	3.88	.788	
Reuse, recycle, recovery of material, and component parts	3.75	.814	
Avoid/reduce usage of hazardous products	3.97	.806	
EMS	3.92	.819	
ISO 14001 certification	3.93	.807	
Total quality environmental management	3.95	.791	
Environment friendly product design	3.89	.788	
Cleaner production	3.88	.770	
Green packaging	3.81	.853	
<b>OVERALL</b>	<b>NA</b>	<b>NA</b>	<b>.89</b>

#### 4.2.5 Construct Validity

Construct validation is applied because content validity alone is not sufficient as it pertains to the content of the test whereas descriptions and decisions are made based on participants' responses to the test items (Tu, 2002). The data was examined using maximum likelihood as the extraction technique and direct oblimin as the method of rotation. An exploratory factor analysis conducted in this study used the scales loading with eigenvalues greater than 1.0. Items intended to measure the same scale demonstrated higher factor loadings (>.40) on a single component (Comrey & Lee, 1992). All explanations on factor loadings are elaborated in section 4.2.6. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is used as the indicator to determine good dimensions. KMO varies from 0 to 1.0 and it is recommended to have a KMO value of .50 or greater before proceeding with factor analysis (Field, 2005). Generally, small values of KMO statistic (less than 0.5) indicate that the correlations between the pairs of variables cannot be explained by other variables and that factor analysis may not be appropriate. Bartlett's test of Sphericity tests the null hypothesis that in the population the correlation matrix for the outcome variables is an identity

matrix but has no correlation with the other variables. Table 4.4 illustrates all measures of those factors which have higher than recommended KMO cut-off point of .50. This indicates the sampling adequacy for a satisfactory factor analysis to proceed and Bartlett's test shows all factors were significant which means that correlation matrix is an identity matrix. Values from KMO and Bartlett's test of Sphericity indicate that factor analysis is appropriate.

Table 4.4 **KMO and Bartlett's test for Sphericity measures**

<b>Scales</b>	<b>KMO test</b>	<b>Bartlett's (sig.)</b>	<b>Numbers of Scales</b>
<b>Dependent scales:</b>			
Supplier selection metrics	.93	.00	18
<b>Independent scales:</b>			
Product quality	.78	.00	4
Price	.77	.00	4
Delivery	.78	.00	5
Support services	.86	.00	6
Production system	.88	.00	6
Flexibility	.86	.00	5
ICT	.90	.00	6
Financial performance	.90	.00	6
Product innovation	.87	.00	6
QMS	.85	.00	4
Management and organization	.90	.00	6
Customer training	.84	.00	4
Employee training and development	.85	.00	4
Performance history	.67	.00	3
Customer focus	.94	.00	9
Corporate Social Responsibility CSR	.84	.00	4
Safety awareness	.94	.00	9
Environmental attributes	.93	.00	10

#### **4.2.6 Skewness and Kurtosis Test**

Many parametric statistics assume that certain variables are distributed normally (Leech et al., 2008). Skewness is checked to determine normality of the data. A variety

of opinions can be found concerning the acceptable level of skewness (the symmetry of a distribution) and kurtosis (the clustering of scores toward the center of a distribution). Some statisticians are more liberal in accepting both skewness and kurtosis within  $\pm 1.000$  range (George & Mallery, 2003; Leech et al., 2008; Morgan et al., 2001). However, George and Mallery (2009) argue that a value  $\pm 2.000$  has been accepted in many cases. Table 4.5 and 4.6 shows the skewness and kurtosis for all items listed under main composite scale and independent scales. Since only one item from the main composite scale slightly exceeds the arbitrary guideline of  $\pm 1.000$ , the rest of the collected data can be assumed to be normally distributed which dismisses the use of nonparametric statistic in this study (George & Mallery, 2009).

**Table 4.5 Skewness and kurtosis for dependent scales**

Scale	N	Skewness		Kurtosis	
	Statistics	Statistics	SE	Statistics	SE
Product quality	364	-.1.215	.128	.346	.255
Price	364	-.506	.128	-.786	.255
Delivery	364	-.709	.128	-.224	.255
Support services	364	-.322	.128	-.878	.255
Production system	364	-.034	.128	-.526	.255
Flexibility	364	-.058	.128	-.199	.255
ICT	364	-.131	.128	-.240	.255
Financial performance	364	-.250	.128	-.641	.255
Product innovation	364	-.097	.128	-.311	.255
QMS	364	-.434	.128	-.170	.255
Management and organization	364	-.130	.128	-.399	.255
Customer training	364	-.395	.128	-.009	.255
Employee training and development	364	-.328	.128	-.350	.255
Performance history	364	-.381	.128	-.730	.255
Customer focus	364	-.249	.128	-.670	.255
CSR	364	-.134	.128	-.226	.255
Safety awareness	364	-.621	.128	-.345	.255
Environmental attributes	364	-.217	.128	-.819	.255

Table 4.6 Skewness and kurtosis for independent scales

Scale	N	Skewness		Kurtosis	
	Statistics	Statistics	SE	Statistics	SE
<b>Product quality</b>					
Meets specification	364	-.910	.128	-.224	.255
Improve conformance	364	-.436	.128	-.755	.255
Reduce defective rates	364	-.598	.128	-.563	.255
Reduces breakdowns	364	-.747	.128	-.502	.255
<b>Price</b>					
Reasonable price	364	-.828	.128	-.116	.255
Allows space for price negotiations	364	-.441	.128	-.385	.255
Estimates cost accurately	364	-.505	.128	-.388	.255
Willing to show breakdown of unit price	364	-.698	.128	-.307	.255
<b>Delivery</b>					
Deliver on time	364	-.958	.128	-.340	.255
Correct quantity	364	-.975	.128	-.226	.255
Reduces manufacturing lead time	364	-.373	.128	-.697	.255
Accurate information	364	-.465	.128	-.810	.255
Geographical location	364	-.439	.128	.248	.255
<b>Production system</b>					
Optimum arrangement of plant layout	364	-.078	.128	-.557	.255
Accepts orders in small quantity	364	.026	.128	-.636	.255
Uses MRP	364	-.129	.128	-.291	.255
Reduces production setup time	364	-.011	.128	-.523	.255
Adopts TPM	364	-.210	.128	-.042	.255
Continuously produce same product	364	.005	.128	-.577	.255
<b>Flexibility</b>					
Solving conflict resolution	364	-.330	.128	-.638	.255
Willing to change order volumes	364	-.064	.128	-.563	.255
Able to make design changes	364	-.327	.128	-.237	.255
Responds to changes in planned delivery dates	364	-.313	.128	-.530	.255
Rapidly changes the mix of different products	364	-.105	.128	-.184	.255

**Support services**

Performs the service right the first time	364	-.735	.128	-.384	.255
Provides services at the promised/due time	364	-.715	.128	-.607	.255
Willing to customize services	364	-.298	.128	-.738	.255
Open to off-peak services	364	-.055	.128	-1.104	.255
Provide qualified personnel	364	-.519	.128	-.637	.255
Provide spare parts	364	-.662	.128	-.363	.255

**ICT**

Collaborative technologies	364	-.148	.128	-.062	.255
Transaction processing system	364	.195	.128	-.580	.255
EDI	364	-.084	.128	-.253	.255
Advanced tracking system	364	-.216	.128	-.459	.255
ERP	364	-.098	.128	-.163	.255
Helpline	364	-.320	.128	-.660	.255

**Financial performance**

Average return on investment	364	-.023	.128	-.834	.255
Profit as percentage of sales	364	-.120	.128	-.611	.255
Net income before taxes	364	.059	.128	-.822	.255
Present value	364	.042	.128	-.750	.255
Cash flow	364	-.330	.128	-.757	.255
Liquidity	364	-.135	.128	-.636	.255

**Product innovation**

Designs new products	364	-.181	.128	.046	.255
Develops customized products	364	-.184	.128	-.258	.255
Develops new product functions	364	-.036	.128	-.667	.255
Quickly in introducing new products	364	.192	.128	-.622	.255
Willing to share key technological information	364	-.173	.128	-1.037	.255
Adopts new production technology	364	-.110	.128	-.493	.255

**QMS**

Manual and procedure for its quality system	364	-.606	.128	-.121	.255
Improves quality assurance system	364	-.546	.128	-.253	.255
Effective product database	364	-.356	.128	-.610	.255
Achieves various quality system certifications	364	-.380	.128	-.665	.255



**Management and organization**

Complete organizational structure	364	-.189	.128	-.671	.255
Management policies	364	-.221	.128	-.221	.255
Management attitude	364	-.256	.128	-.373	.255
Degree of alignment with customer's future plans	364	-.358	.128	.014	.255
Stable workforce employment	364	-.352	.128	-.018	.255
Compatibility of ethical standards with the customer	364	-.108	.128	-.748	.255

**Customer's training**

Competent instructors	364	-.690	.128	.361	.255
Provides adequate training materials	364	-.513	.128	-.495	.255
Provides training tailored for different skill levels	364	-.260	.128	-.942	.255
Provides training specific to the needs of the customer	364	-.654	.128	.081	.255

**Employee training and development**

Undergo occupational health tests	364	-.231	.128	-.477	.255
Provides career advancement and training development	364	-.220	.128	-.336	.255
Well-planned training module	364	-.117	.128	-.657	.255
Sufficient funds for training	364	-.184	.128	-.247	.255

**Performance history**

Local/international track record	364	-.766	.128	.475	.255
Number of completed jobs	364	-.531	.128	.052	.255
Pending or possible legal suits	364	-.472	.128	.173	.255

**Customer focus**

Strong sense of loyalty to its customers	364	-.327	.128	-.555	.255
Dedicates manpower and resources	364	-.472	.128	-.285	.255
Encourages visits to its facilities	364	-.139	.128	-.687	.255
Long term partnership	364	-.175	.128	-.820	.255
Keeps us informed	364	-.381	.128	-.139	.255
Willing to make a long-term investment	364	-.009	.128	-.928	.255
Provides information	364	-.337	.128	-.176	.255
Strengthening of warranties	364	-.458	.128	-.043	.255
Handles complaints promptly	364	-.480	.128	-.720	.255

**CSR**

Commitment to use a portion of its profits to help nonprofits	364	.089	.128	-.288	.255
Corporate giving to community programmes	364	-.008	.128	-.116	.255
Code of ethics is published and distributed to employees	364	-.093	.128	-.107	.255
Encouragement in recycling and use of recycled products	364	-.061	.128	-.031	.255

**Safety awareness**

Zero number of lost times from accidents	364	-.467	.128	-.182	.255
Provides adequate personal protection equipment	364	-.686	.128	-.093	.255
Provides adequate safety instructions	364	-.787	.128	.400	.255
Has an emergency plan and evacuation procedure	364	-.551	.128	-.485	.255
Has periodic safety audit	364	-.718	.128	.328	.255
Provides safety training for employees	364	-.455	.128	-.564	.255
Has certifications for safety practices	364	-.559	.128	-.435	.255
Has a safety officer	364	-.505	.128	-.613	.255
Satisfy safety requirements at customer's premise	364	-.704	.128	.091	.255

**Environmental attributes**

Reduced consumption of material	364	-.189	.128	-.068	.255
Reduced consumption of energy	364	-.321	.128	-.133	.255
Reuse, recycle, recovery of material, and component parts	364	-.006	.128	-.555	.255
Avoid/reduce usage of hazardous products	364	-.363	.128	-.319	.255
EMS	364	-.361	.128	-.284	.255
ISO 14001 certification	364	-.354	.128	-.423	.255
Total quality environmental management	364	-.238	.128	-.627	.255
Environment friendly product design	364	-.108	.128	-.580	.255
Cleaner production	364	-.091	.128	-.698	.255
Green packaging	364	-.324	.128	-.118	.255

### **4.2.7 Factor Analysis**

The research is unique in that the variables included have not been studied collectively in the Malaysian electricity supply industry context before. Given the uniqueness of the data set and the lack of research utilizing these variables, a factor analysis was determined to be the most appropriate methodology to examine the possible relationships among the variables. The current study applied an unconstrained factor analysis which studied the construct validity of the survey items as explained in section 4.2.5 and analyzed patterns of intercorrelation among the variables. The most common factor analysis assumptions are that there are notable correlations between the variables and adequate sample size (Stevens, 2002). The data in this study meet these basic assumptions, so that the application of a factor analysis is considered valid. The factor analysis used an oblique Oblimin with Kaiser Normalization rotation method, an approach that is valid with the assumptions of correlations between factors (Field, 2005). The idea of rotation is to reduce the number of factors on which the variables under investigation have high loadings. Rotation does not alter anything but makes the interpretation of the analysis easier (Field, 2005). By using the Maximum Likelihood extraction method for this study, it was also assumed that there would be correlations between factors.

#### **4.2.7.1 Dependent Variables Factor Analysis**

The main purpose of factor analysis was not necessarily to reduce the number of survey items, but to determine whether the factors that emerged through unforced statistical analysis matched the two theorized constructs. The method for extracting the factors was Maximum Likelihood analysis with oblique rotation which enabled the large number of items (eighteen) to be reduced to a smaller number of factors (two) that could be conceptually and statistically grouped together (Burt et al., 2003). This served in part as data reduction technique (Burt et al., 2003) in which the factors represent a more succinct set of measures (Burt et al., 2003). An item with low item-total correlation indicates that the item is not drawn from the same domain and should be deleted to reduce error and unreliability (Nunnally, 1978). Therefore, eigenvalues and variance explained (%) are considered important values in factor analysis. Dimensions with similar loading on two factors and dimensions with loading less than .40 were removed

because loadings above .60 are considered high and those below .40 are low (Field, 2005). The eighteen dependent variables loaded onto two factors. Factor 1 containing 14 items, returned an eigenvalue of 8.26 and explained 43.18% of the total variation. In addition, factor 2 contains four items, returned an eigenvalue of 1.76 and explained 7.01% of the total variation. Both factors explained 50.18% of the total variation. Factor 1 was labeled as supplier attractiveness and factor 2 as supplier competitiveness. Table 4.7 provides an analysis of construct validity testing the theorized constructs.

Table 4.7 Oblimin rotated factor loadings matrix for dependent variables

<b>Items</b>	<b>Factor 1</b>	<b>Factor 2</b>
QMS	.823	
CSR	.820	
Management and organization	.811	
Employee training and development	.776	
Product innovation	.749	
Environmental attributes	.741	
ICT	.736	
Financial performance	.634	
Production system	.587	
Safety awareness	.586	
Customer training	.549	
Customer focus	.540	
Flexibility	.517	
Performance history	.436	
Product quality		.726
Delivery		.725
Price		.566
Support service		.478
Eigenvalue	8.26	1.76
Variance (%)	43.18	7.01

### 4.2.7.2 Independent Variables Factor Analysis

Independent variables factor analyses were performed to identify whether items intended to measure the same scale or not.

#### i. Product quality

As shown in Table 4.8, the four items loaded onto one factor with an eigenvalue of 2.83 and explained 61.22% of the total variation. As all factor loadings were greater than .40, no item was removed.

Table 4.8 Factor loadings matrix for product quality

Items	Factor 1
Meets specification	.664
Improve conformance	.685
Reduce defective rates	.883
Reduces breakdowns	.871
Eigenvalue	2.83
Variance (%)	61.22

#### ii. Price

As shown in Table 4.9, the four items loaded onto one factor with an eigenvalue of 2.66 and explained 55.79% of the total variation. As all factor loadings were greater than .40, no item was removed.

Table 4.9 Factor loadings matrix for price

Items	Factor 1
Reasonable price	.637
Allows space for price negotiations	.790
Estimates cost accurately	.806
Willing to show breakdown of unit price	.743
Eigenvalue	2.66
Variance (%)	55.79

## iii. Delivery

As shown in Table 4.10, the five items loaded onto one factor with an eigenvalue of 3.08 and explained 52.84% of the total variation. As all factor loadings were greater than .40, no item was removed.

Table 4.10 **Factor loadings matrix for delivery**

<b>Items</b>	<b>Factor 1</b>
Deliver on time	.831
Correct quantity	.853
Reduces manufacturing lead time	.705
Accurate information	.757
Geographical location	.436
Eigenvalue	3.08
Variance (%)	52.84

## iv. Support services

As shown in Table 4.11, the six items loaded onto one factor with an eigenvalue of 3.86 and explained 57.39% of the total variation. As all factor loadings were greater than .40, no item was removed.

Table 4.11 **Factor loadings matrix for support services**

<b>Items</b>	<b>Factor 1</b>
Performs the service right the first time	.760
Provides services at the promised/due time	.812
Willing to customize services	.778
Open to off-peak services	.612
Provide qualified personnel	.810
Provide spare parts	.756
Eigenvalue	3.86
Variance (%)	57.39

## v. Production system

As shown in Table 4.12, the six items loaded onto one factor with an eigenvalue of 3.69 and explained 54.58% of the total variation. As all factor loadings were greater than .40, no item was removed.

Table 4.12 **Factor loadings matrix for production system**

<b>Items</b>	<b>Factor 1</b>
Optimum arrangement of plant layout	.742
Accepts orders in small quantity	.561
Uses MRP	.864
Reduces production setup time	.836
Adopts TPM	.798
Continuously produce same product	.573
Eigenvalue	3.69
Variance (%)	54.58

## vi. Flexibility

As shown in Table 4.13, the five items loaded onto one factor with an eigenvalue of 3.24 and explained 52.84% of the total variation. As all factor loadings were greater than .40, no item was removed.

Table 4.13 **Factor loadings matrix for flexibility**

<b>Items</b>	<b>Factor 1</b>
Solving conflict resolution	.688
Willing to change order volumes	.749
Able to make design changes	.785
Responds to changes in planned delivery dates	.830
Rapidly changes the mix of different products	.683
Eigenvalue	3.24
Variance (%)	56.12

## vii. ICT

As shown in Table 4.14, the six items loaded onto one factor with an eigenvalue of 4.15 and explained 63.31% of the total variation. As all factor loadings were greater than .40, no item was removed.

Table 4.14 **Factor loadings matrix for ICT**

<b>Items</b>	<b>Factor 1</b>
Collaborative technologies	.801
Transaction processing system	.846
EDI	.827
Advanced tracking system	.852
ERP	.801
Helpline	.624
Eigenvalue	4.15
Variance (%)	63.31

## viii. Financial performance

As shown in Table 4.15, the six items loaded onto one factor with an eigenvalue of 4.55 and explained 70.90% of the total variation. As all factor loadings were greater than .40, no item was removed.

Table 4.15 **Factor loadings matrix for financial performance**

<b>Items</b>	<b>Factor 1</b>
Average return on investment	.880
Profit as percentage of sales	.890
Net income before taxes	.893
Present value	.834
Cash flow	.767
Liquidity	.779
Eigenvalue	4.55
Variance (%)	70.90

## ix. Product innovation

As shown in Table 4.16, the six items loaded onto one factor with an eigenvalue of 3.91 and explained 58.31% of the total variation. As all factor loadings were greater than .40, no item was removed.



Table 4.16 **Factor loadings matrix for product innovation**

<b>Items</b>	<b>Factor 1</b>
Designs new products	.771
Develops customized products	.786
Develops new product functions	.869
Quickly in introducing new products	.716
Willing to share key technological information	.708
Adopts new production technology	.719
Eigenvalue	3.91
Variance (%)	58.31

## x. QMS

As shown in Table 4.17, the four items loaded onto one factor with an eigenvalue of 3.18 and explained 72.58% of the total variation. As all factor loadings were greater than .40, no item was removed.

Table 4.17 **Factor loadings matrix for QMS**

<b>Items</b>	<b>Factor 1</b>
Manual and procedure for its quality system	.870
Improves quality assurance system	.871
Effective product database	.859
Achieves various quality system certifications	.806
Eigenvalue	3.18
Variance (%)	72.58

## xi. Management and organization

As shown in Table 4.18, the six items loaded onto one factor with an eigenvalue of 4.18 and explained 63.61% of the total variation. As all factor loadings were greater than .40, no item was removed.

Table 4.18 **Factor loadings matrix for management and organization**

Items	Factor 1
Complete organizational structure	.766
Management policies	.789
Management attitude	.851
Degree of alignment with customer's future plans	.798
Stable workforce employment	.801
Compatibility of ethical standards with the customer	.778
Eigenvalue	4.18
Variance (%)	63.61

## xii. Customer training

As shown in Table 4.19, the four items loaded onto one factor with an eigenvalue of 3.13 and explained 71.18% of the total variation. As all factor loadings were greater than .40, no item was removed.

Table 4.19 **Factor loadings matrix for customer training**

Items	Factor 1
Competent instructors	.820
Provides adequate training materials	.909
Provides training tailored for different skill levels	.846
Provides training specific to the needs of the customer	.796
Eigenvalue	3.13
Variance (%)	71.18

## xiii. Employee training and development

As shown in Table 4.20, the four items loaded onto one factor with an eigenvalue of 3.20 and explained 73.58% of the total variation. As all factor loadings were greater than .40, no item was removed.

Table 4.20 Factor loadings matrix for employee training and development

<b>Items</b>	<b>Factor 1</b>
Undergo occupational health tests	.746
Provides career advancement and training development	.885
Well-planned training module	.891
Sufficient funds for training	.900
Eigenvalue	3.20
Variance (%)	73.58

## xiv. Performance history

As shown in Table 4.21, the three items loaded onto one factor with an eigenvalue of 2.25 and explained 64.63% of the total variation. As all factor loadings were greater than .40, no item was removed.

Table 4.21 **Factor loadings matrix for performance history**

<b>Items</b>	<b>Factor 1</b>
Local/international track record	.790
Number of completed jobs	.949
Pending or possible legal suits	.643
Eigenvalue	2.25
Variance (%)	64.63

## xv. Customer focus

As shown in Table 4.22, the nine items loaded onto one factor with an eigenvalue of 5.65 and explained 58.12% of the total variation. As all factor loadings were greater than .40, no item was removed.

Table 4.22 **Factor loadings matrix for customer focus**

<b>Items</b>	<b>Factor 1</b>
Strong sense of loyalty to its customers	.703
Dedicates manpower and resources	.736
Encourages visits to its facilities	.772
Long term partnership	.787
Keeps us informed	.801
Willing to make a long-term investment	.772
Provides information	.788
Strengthening of warranties	.762
Handles complaints promptly	.736
Eigenvalue	5.65
Variance (%)	58.12

## xvi. CSR

As shown in Table 4.23, the four items loaded onto one factor with an eigenvalue of 3.17 and explained 72.61% of the total variation. As all factor loadings were greater than .40, no item was removed.

Table 4.23 **Factor loadings matrix for CSR**

<b>Items</b>	<b>Factor 1</b>
Commitment to use a portion of its profits to help nonprofits	.848
Corporate giving to community programmes	.921
Code of ethics is published and distributed to employees	.826
Encouragement in recycling and use of recycled products	.809
Eigenvalue	3.17
Variance (%)	72.61

## xvii. Safety awareness

As shown in Table 4.24, the nine items loaded onto one factor with an eigenvalue of 6.37 and explained 67.17% of the total variation. As all factor loadings were greater than .40, no item was removed.

Table 4.24 **Factor loadings matrix for safety awareness**

<b>Items</b>	<b>Factor 1</b>
Zero number of lost times from accidents	.749
Provides adequate personal protection equipment	.848
Provides adequate safety instructions	.880
Has an emergency plan and evacuation procedure	.850
Has periodic safety audit	.865
Provides safety training for employees	.875
Has certifications for safety practices	.769
Has a safety officer	.758
Satisfy safety requirements at customer's premise	.767
Eigenvalue	6.37
Variance (%)	67.17

## xviii. Environmental attributes

As shown in Table 4.25, the ten items loaded onto one factor with an eigenvalue of 6.83 and explained 64.66% of the total variation. As all factor loadings were greater than .40, no item was removed.

Table 4.25 **Factor loadings matrix for customer focus**

<b>Items</b>	<b>Factor 1</b>
Reduced consumption of material	.702
Reduced consumption of energy	.762
Reuse, recycle, recovery of material, and component parts	.737
Avoid/reduce usage of hazardous products	.778
EMS	.874
ISO 14001 certification	.835
Total quality environmental management	.887
Environment friendly product design	.806
Cleaner production	.825
Green packaging	.814
Eigenvalue	6.83
Variance (%)	64.66

### 4.2.8 Correlation Testing

For quantitative variables measured by a numerical scale, statistical association is called correlation. Two such quantitative variables are correlated when the values of one of them can be predicted with some precision from the values of the other variable. Pearson's correlation coefficients allowed the researcher to evaluate the relationship between the independent variables and the dependent variables of strategic sourcing supplier selection metrics. Pearson's correlation coefficients, developed in a correlation matrix, provided data to determine if a relationship existed. The form, direction, and magnitude of the association with the independent variables were also analysed. Creswell (2003) points out that scores from .20 to .35 indicate a slight relationship, scores between .35 and .65 show the variables are useful for a limited correlation, and scores between .66 and 1.0 show there is good correlation. A significance score of  $<.05$  indicates the coefficient statistics are significantly correlated (Creswell, 2003). The intent of the analysis was to determine the statistical relationship between the independent variables and the dependent variables. Tables 4.26 – 4.43 show the results of correlation testing conducted for this study.

i. B1 - Product quality

From Table 4.26, it is observed that four items namely B1.1 - “meets specification”, B1.2 - “improve conformance”, B1.3 - “reduce defective rates” and B1.4 - “reduce breakdowns” have coefficients of correlation between .35 and .65, which indicates the variables are useful for correlation. This means that in general the four items are good predictors of product quality.

Table 4.26 **Correlation between product quality and its predictors**

	<b>B1</b>	<b>B1.1</b>	<b>B1.2</b>	<b>B1.3</b>	<b>B1.4</b>
<b>B1</b>	1	.503	.450	.412	.442
<b>B1.1</b>	.503	1	.575	.554	.571
<b>B1.2</b>	.450	.575	1	.598	.565
<b>B1.3</b>	.412	.554	.598	1	.782
<b>B1.4</b>	.442	.571	.565	.782	1

## ii. B2 - Price

From Table 4.27, it is observed that two items namely B2.1 - “reasonable price” and B2.2 - “allow space for price negotiations” have coefficients of correlation between .35 and .65, which indicates the variables are useful for correlation. However, the remaining two items B2.3 - “estimates cost accurately” and B2.4 - “willing to show breakdown of unit price” have coefficients of correlation between .20 and .35, which indicates the existence of slight relationship. This means that in general the four items are acceptable predictors of price.

Table 4.27 Correlation between price and its predictors

	<b>B2</b>	<b>B2.1</b>	<b>B2.2</b>	<b>B2.3</b>	<b>B2.4</b>
<b>B2</b>	1	.400	.359	.250	.283
<b>B2.1</b>	.400	1	.594	.471	.419
<b>B2.2</b>	.359	.594	1	.617	.556
<b>B2.3</b>	.250	.471	.617	1	.652
<b>B2.4</b>	.283	.419	.556	.652	1

## iii. B3 - Delivery

From Table 4.28, it is observed that four items namely B3.1 - “deliver on time”, B3.2 - “correct quantity”, B3.3 - “reduces manufacturing lead time” and B3.4 - “accurate information” have coefficients of correlation between .35 and .65, which indicates the variables are useful for correlation. Conversely, B3.5 - “geographical location” has a coefficient of correlation between .20 and .35, which indicates the existence of slight relationship. This means that in general the five items are acceptable predictors of delivery.

Table 4.28 Correlation between delivery and its predictors

	<b>B3</b>	<b>B3.1</b>	<b>B3.2</b>	<b>B3.3</b>	<b>B3.4</b>	<b>B3.5</b>
<b>B3</b>	1	.449	.408	.437	.439	.311
<b>B3.1</b>	.449	1	.770	.547	.581	.209
<b>B3.2</b>	.408	.770	1	.540	.615	.281
<b>B3.3</b>	.437	.547	.540	1	.653	.455
<b>B3.4</b>	.439	.581	.615	.653	1	.422
<b>B3.5</b>	.311	.209	.281	.455	.422	1

## iv. B4 - Production system

From Table 4.29, it is observed that four items namely B4.1 - “optimum arrangement of plant layout”, B4.3 - “uses materials requirement planning (MRP)”, B4.4 - “reduces production setup time” and B4.5 - “adopts total productive maintenance (TPM)” display coefficients of correlation between .35 and .65, which indicates the variables are useful for correlation. On the contrary, the remaining two items B4.2 - “accepts orders in small quantity” and B4.6 - “continuously produce same product” have coefficients of correlation between .20 and .35, which indicates the existence of slight relationship. This means that in general the six items are acceptable predictors of production system.

**Table 4.29** Correlation between production system and its predictors

	<b>B4</b>	<b>B4.1</b>	<b>B4.2</b>	<b>B4.3</b>	<b>B4.4</b>	<b>B4.5</b>	<b>B4.6</b>
<b>B4</b>	1	.450	.335	.451	.483	.396	.338
<b>B4.1</b>	.450	1	.408	.638	.647	.590	.362
<b>B4.2</b>	.335	.408	1	.504	.460	.392	.429
<b>B4.3</b>	.451	.638	.504	1	.703	.703	.506
<b>B4.4</b>	.483	.647	.460	.703	1	.675	.490
<b>B4.5</b>	.396	.590	.392	.703	.675	1	.433
<b>B4.6</b>	.338	.362	.429	.506	.490	.433	1

## v. B5 - Flexibility

From Table 4.30, it is observed that four items namely B5.1 - “solving conflict resolution”, B5.2 - “willing to change order volumes”, B5.4 - “responds to changes in planned delivery dates” and B5.5 - “rapidly changes the mix of different products” show coefficients of correlation between .35 and .65, which indicates the variables are useful for correlation. Conversely, the remaining item B5.3 - “able to make design changes” has a coefficient of correlation between .20 and .35, which indicates the existence of slight relationship. This means that in general the five items are acceptable predictors of flexibility.



**Table 4.30** Correlation between flexibility and its predictors

	<b>B5</b>	<b>B5.1</b>	<b>B5.2</b>	<b>B5.3</b>	<b>B5.4</b>	<b>B5.5</b>
<b>B5</b>	1	.379	.376	.328	.407	.503
<b>B5.1</b>	.379	1	.558	.508	.567	.470
<b>B5.2</b>	.376	.558	1	.591	.592	.524
<b>B5.3</b>	.328	.508	.591	1	.674	.518
<b>B5.4</b>	.407	.567	.592	.674	1	.573
<b>B5.5</b>	.503	.470	.524	.518	.573	1

## vi. B6 - Support services

From Table 4.31, it is observed that four items namely B6.1 - “performs the service right the first time”, B6.2 - “provides services at the promised/due time”, B6.3 - “willing to customize services” and B6.5 - “provide qualified personnel” have coefficients of correlation between .35 and .65, which indicates the variables are useful for correlation. On the other hand, B6.4 - “open to off-peak services” and B6.6 - “provide spare parts” have a coefficient of correlation between .20 and .35, which indicates the existence of slight relationship. This means that in general the six items are acceptable predictors of support services.

**Table 4.31** Correlation between support services and its predictors

	<b>B6</b>	<b>B6.1</b>	<b>B6.2</b>	<b>B6.3</b>	<b>B6.4</b>	<b>B6.5</b>	<b>B6.6</b>
<b>B6</b>	1	.392	.360	.395	.320	.358	.335
<b>B6.1</b>	.392	1	.660	.568	.412	.599	.595
<b>B6.2</b>	.360	.660	1	.627	.427	.657	.612
<b>B6.3</b>	.395	.568	.627	1	.677	.600	.545
<b>B6.4</b>	.320	.412	.427	.677	1	.493	.389
<b>B6.5</b>	.358	.599	.657	.600	.493	1	.665
<b>B6.6</b>	.335	.595	.612	.545	.389	.665	1

## vii. B7 - ICT

From Table 4.32, it is observed that all six items namely B7.1 - “collaborative technologies”, B7.2 - “transaction processing system”, B7.3 - “electronic data interchange (EDI)”, B7.4 - “advanced tracking system”, B7.5 - “enterprise resource planning (ERP)” and B7.6 - “helpline” have coefficients of correlation between .35 and

.65, which indicates the variables are useful for correlation. This means that in general the six items are acceptable predictors of ICT.

**Table 4.32** Correlation between ICT and its predictors

	<b>B7</b>	<b>B7.1</b>	<b>B7.2</b>	<b>B7.3</b>	<b>B7.4</b>	<b>B7.5</b>	<b>B7.6</b>
<b>B7</b>	1	.478	.458	.397	.401	.526	.408
<b>B7.1</b>	.478	1	.725	.660	.667	.586	.541
<b>B7.2</b>	.458	.725	1	.726	.695	.654	.491
<b>B7.3</b>	.397	.660	.726	1	.697	.680	.435
<b>B7.4</b>	.401	.667	.695	.697	1	.719	.580
<b>B7.5</b>	.526	.586	.654	.680	.719	1	.535
<b>B7.6</b>	.408	.541	.491	.435	.580	.535	1

viii. B8 - Financial performance

From Table 4.33, it is observed that all six items namely B8.1 - “average return on investment”, B8.2 - “profit as percentage of sales”, B8.3 - “net income before taxes”, B8.4 - “present value”, B8.5 - “cash flow” and B8.6 - “liquidity” display coefficients of correlation between .35 and .65, which indicates the variables are useful for correlation. This means that in general the six items are acceptable predictors of financial performance.

**Table 4.33** Correlation between financial performance and its predictors

	<b>B8</b>	<b>B8.1</b>	<b>B8.2</b>	<b>B8.3</b>	<b>B8.4</b>	<b>B8.5</b>	<b>B8.6</b>
<b>B8</b>	1	.437	.413	.405	.445	.443	.423
<b>B8.1</b>	.437	1	.813	.785	.714	.682	.643
<b>B8.2</b>	.413	.813	1	.808	.711	.654	.675
<b>B8.3</b>	.405	.785	.808	1	.768	.644	.672
<b>B8.4</b>	.445	.714	.711	.768	1	.650	.694
<b>B8.5</b>	.443	.682	.654	.644	.650	1	.719
<b>B8.6</b>	.423	.643	.675	.672	.694	.719	1

ix. B9 - Product innovation

From Table 4.34, it is observed that five items namely B9.1 - “designs new products”, B9.2 - “develops customized products”, B9.3 - “develops new product functions”, B9.4 - “quickly in introducing new products” and B9.6 - “adopts new production technology” have coefficients of correlation between .35 and .65, which indicates the variables are

useful for correlation. Conversely, the remaining item B9.5 - “willing to share key technological information” has a coefficient of correlation between .20 and .35, which indicates the existence of slight relationship. This means that in general the six items are acceptable predictors of product innovation.

**Table 4.34** Correlation between product innovation and its predictors

	<b>B9</b>	<b>B9.1</b>	<b>B9.2</b>	<b>B9.3</b>	<b>B9.4</b>	<b>B9.5</b>	<b>B9.6</b>
<b>B9</b>	1	.392	.378	.426	.432	.337	.350
<b>B9.1</b>	.392	1	.634	.709	.592	.471	.456
<b>B9.2</b>	.378	.634	1	.685	.519	.576	.549
<b>B9.3</b>	.426	.709	.685	1	.608	.594	.607
<b>B9.4</b>	.432	.592	.519	.608	1	.487	.574
<b>B9.5</b>	.337	.471	.576	.594	.487	1	.651
<b>B9.6</b>	.350	.456	.549	.607	.574	.651	1

x. B10 - QMS

From Table 4.35, it is observed that all four items namely B10.1 - “manual and procedure for its quality system”, B10.2 - “improves quality assurance system”, B10.3 - “effective product database” and B10.4 - “achieves various quality system certifications” display coefficients of correlation between .35 and .65, which indicates the variables are useful for correlation. This means that in general the four items are acceptable predictors of QMS.

**Table 4.35** Correlation between QMS and its predictors

	<b>B10</b>	<b>B10.1</b>	<b>B10.2</b>	<b>B10.3</b>	<b>B10.4</b>
<b>B10</b>	1	.403	.427	.499	.495
<b>B10.1</b>	.403	1	.767	.745	.689
<b>B10.2</b>	.427	.767	1	.740	.698
<b>B10.3</b>	.499	.745	.740	1	.710
<b>B10.4</b>	.495	.689	.698	.710	1

xi. B11 - Management and organization

From Table 4.36, it is observed that all six items namely B11.1 - “complete organizational structure”, B11.2 - “management policies”, B11.3 - “management attitude”, B11.4 - “degree of alignment with customer's future plans”, B11.5 - “stable workforce employment” and B11.6 - “compatibility of ethical standards with the

customer” have coefficients of correlation between .35 and .65, which indicates the variables are useful for correlation. This means that in general the six items are acceptable predictors of management and organization.

Table 4.36 Correlation between management and organization and its predictors

	<b>B11</b>	<b>B11.1</b>	<b>B11.2</b>	<b>B11.3</b>	<b>B11.4</b>	<b>B11.5</b>	<b>B11.6</b>
<b>B11</b>	1	.439	.443	.411	.380	.403	.385
<b>B11.1</b>	.439	1	.710	.661	.565	.575	.564
<b>B11.2</b>	.443	.710	1	.707	.595	.583	.551
<b>B11.3</b>	.411	.661	.707	1	.657	.684	.635
<b>B11.4</b>	.380	.565	.595	.657	1	.671	.698
<b>B11.5</b>	.403	.575	.583	.684	.671	1	.671
<b>B11.6</b>	.385	.564	.551	.635	.698	.671	1

xii. B12 - Customer training

From Table 4.37, it is observed that two items namely B12.3 - “provides training tailored for different skill levels” and B12.4 - “provides training specific to the needs of the customer” display coefficients of correlation between .35 and .65, which indicates the variables are useful for correlation. However, the remaining two items B12.1 - “competent instructors” and B12.2 - “provides adequate training materials” have coefficients of correlation between .20 and .35, which indicates the existence of slight relationship. This means that in general the four items are acceptable predictors of customer training.

Table 4.37 Correlation between customer training and its predictors

	<b>B12</b>	<b>B12.1</b>	<b>B12.2</b>	<b>B12.3</b>	<b>B12.4</b>
<b>B12</b>	1	.329	.338	.434	.416
<b>B12.1</b>	.329	1	.764	.677	.630
<b>B12.2</b>	.338	.764	1	.761	.711
<b>B12.3</b>	.434	.677	.761	1	.712
<b>B12.4</b>	.416	.630	.711	.712	1

xiii. B13 - Employee training and development

From Table 4.38, it is observed that all four items namely B13.1 - “undergo occupational health tests”, B13.2 - “provides career advancement and training development”, B13.3 - “well-planned training module” and B13.4 - “sufficient funds for

training” display coefficients of correlation between .35 and .65, which indicates the variables are useful for correlation. This means that in general the four items are acceptable predictors of employee training and development.

**Table 4.38** Correlation between employee training and development and its predictors

	<b>B13</b>	<b>B13.1</b>	<b>B13.2</b>	<b>B13.3</b>	<b>B13.4</b>
<b>B13</b>	1	.352	.427	.434	.426
<b>B13.1</b>	.352	1	.689	.651	.659
<b>B13.2</b>	.427	.689	1	.783	.791
<b>B13.3</b>	.434	.651	.783	1	.811
<b>B13.4</b>	.426	.659	.791	.811	1

xiv. B14 - Performance history

From Table 4.39, it is observed that all three items namely B14.1 - “local/international track record”, B14.2 - “number of completed jobs” and B14.3 - “pending or possible legal suits” display coefficients of correlation between .35 and .65, which indicates the variables are useful for correlation. This means that in general the three items are acceptable predictors of performance history.

**Table 4.39** Correlation between performance history and its predictors

	<b>B14</b>	<b>B14.1</b>	<b>B14.2</b>	<b>B14.3</b>
<b>B14</b>	1	.436	.460	.396
<b>B14.1</b>	.436	1	.750	.508
<b>B14.2</b>	.460	.750	1	.610
<b>B14.3</b>	.396	.508	.610	1

xv. B15 - Customer focus

From Table 4.40, it is observed that eight items namely B15.1 - “strong sense of loyalty to its customers”, B15.3 - “encourages visits to its facilities”, B15.4 - “long term partnership”, B15.5 - “keeps us informed”, B15.6 - “willing to make a long-term investment”, B15.7 - “provides information”, B15.8 - “strengthening of warranties” and B15.9 - “handles complaints promptly” display coefficients of correlation between .35 and .65, which indicates the variables are useful for correlation. However, the remaining item B15.2 - “dedicates manpower and resources” has a coefficient of correlation

between .20 and .35, which indicates the existence of slight relationship. This means that in general the nine items are acceptable predictors of customer focus.

**Table 4.40** Correlation between customer focus and its predictors

	<b>B15</b>	<b>B15.1</b>	<b>B15.2</b>	<b>B15.3</b>	<b>B15.4</b>	<b>B15.5</b>	<b>B15.6</b>	<b>B15.7</b>	<b>B15.8</b>	<b>B15.9</b>
<b>B15</b>	1	.376	.306	.387	.423	.409	.410	.370	.380	.405
<b>B15.1</b>	.376	1	.627	.570	.573	.524	.537	.491	.491	.542
<b>B15.2</b>	.306	.627	1	.525	.536	.572	.554	.581	.558	.596
<b>B15.3</b>	.387	.570	.525	1	.699	.635	.585	.608	.530	.526
<b>B15.4</b>	.423	.573	.536	.699	1	.661	.597	.590	.572	.533
<b>B15.5</b>	.409	.524	.572	.635	.681	1	.637	.637	.594	.573
<b>B15.6</b>	.410	.537	.554	.585	.597	.637	1	.649	.590	.530
<b>B15.7</b>	.370	.491	.581	.608	.590	.637	.649	1	.648	.563
<b>B15.8</b>	.380	.491	.558	.530	.572	.594	.590	.648	1	.668
<b>B15.9</b>	.405	.542	.596	.526	.533	.573	.530	.583	.668	1

xvi. B16 - CSR

From Table 4.41, it is observed that all four items namely B16.1 - “commitment to use a portion of its profits to help nonprofits”, B16.2 - “corporate giving to community programmes”, B16.3 - “code of ethics is published and distributed to employees” and B16.4 - “encouragement in recycling and use of recycled products” show coefficients of correlation between .35 and .65, which indicates the variables are useful for correlation. This means that in general the four items are acceptable predictors of CSR.

**Table 4.41** Correlation between CSR and its predictors

	<b>B16</b>	<b>B16.1</b>	<b>B16.2</b>	<b>B16.3</b>	<b>B16.4</b>
<b>B16</b>	1	.460	.533	.514	.454
<b>B16.1</b>	.460	1	.793	.705	.651
<b>B16.2</b>	.533	.793	1	.745	.748
<b>B16.3</b>	.514	.705	.745	1	.704
<b>B16.4</b>	.454	.651	.748	.704	1

xvii. B17 - Safety awareness

From Table 4.42, it is observed that all nine items namely B17.1 - “zero number of lost times from accidents”, B17.2 - “provides adequate personal protection equipment”, B17.3 - “provides adequate safety instructions”, B17.4 - “has an emergency plan and evacuation procedure”, B17.5 - “has periodic safety audit”, B17.6 - “provides safety

training for employees”, B17.7 - “has certifications for safety practices”, B17.8 - “has a safety officer” and B17.9 - “satisfy safety requirements at customer's premise” show coefficients of correlation between .35 and .65, which indicates the variables are useful for correlation. This means that in general the nine items are acceptable predictors of safety awareness.

Table 4.42 **Correlation between safety awareness and its predictors**

	<b>B17</b>	<b>B17.1</b>	<b>B17.2</b>	<b>B17.3</b>	<b>B17.4</b>	<b>B17.5</b>	<b>B17.6</b>	<b>B17.7</b>	<b>B17.8</b>	<b>B17.9</b>
<b>B17</b>	1	.376	.396	.413	.403	.409	.437	.383	.372	.442
<b>B17.1</b>	.376	1	.691	.647	.662	.657	.642	.546	.517	.561
<b>B17.2</b>	.396	.691	1	.791	.718	.734	.726	.652	.569	.609
<b>B17.3</b>	.413	.647	.791	1	.776	.759	.742	.691	.603	.671
<b>B17.4</b>	.403	.662	.718	.776	1	.742	.748	.590	.655	.608
<b>B17.5</b>	.409	.657	.734	.759	.742	1	.774	.615	.661	.661
<b>B17.6</b>	.437	.642	.726	.742	.748	.774	1	.692	.693	.680
<b>B17.7</b>	.383	.546	.652	.691	.590	.615	.692	1	.694	.642
<b>B17.8</b>	.372	.517	.569	.603	.655	.661	.693	.694	1	.678
<b>B17.9</b>	.442	.561	.609	.671	.608	.661	.680	.642	.678	1

xviii. B18 - Environmental attributes

From Table 4.43, it is observed that eight items namely B18.1 - “reduced consumption of material”, B18.2 - “reduced consumption of energy”, B18.5 - “Environmental Management Systems (EMS)”, B18.6 - “ISO 14001 certification”, B18.7 - “total quality environmental management”, B18.8 - “environment friendly product design”, B18.9 - “cleaner production” and B18.10 - “green packaging” display coefficients of correlation between .35 and .65, which indicates the variables are useful for correlation. However, the remaining two items B18.3 - “reuse, recycle, recovery of material, and component parts” and B18.4 - “avoid/reduce usage of hazardous products” have coefficients of correlation between .20 and .35, which indicates the existence of slight relationship. This means that in general the ten items are acceptable predictors of customer focus.

Table 4.43 Correlation between environmental attributes and its predictors

	<b>B18</b>	<b>B18.1</b>	<b>B18.2</b>	<b>B18.3</b>	<b>B18.4</b>	<b>B18.5</b>	<b>B18.6</b>	<b>B18.7</b>	<b>B18.8</b>	<b>B18.9</b>	<b>B18.10</b>
<b>B18</b>	1	.366	.361	.337	.309	.477	.469	.438	.375	.422	.424
<b>B18.1</b>	.366	1	.707	.650	.583	.559	.528	.613	.525	.569	.545
<b>B18.2</b>	.361	.707	1	.678	.710	.641	.581	.626	.603	.589	.592
<b>B18.3</b>	.337	.650	.678	1	.607	.602	.571	.647	.571	.570	.603
<b>B18.4</b>	.309	.583	.710	.607	1	.673	.586	.672	.650	.639	.602
<b>B18.5</b>	.477	.559	.641	.602	.673	1	.842	.835	.643	.675	.676
<b>B18.6</b>	.469	.528	.581	.571	.586	.842	1	.823	.625	.648	.614
<b>B18.7</b>	.438	.613	.626	.647	.672	.835	.823	1	.671	.696	.683
<b>B18.8</b>	.375	.525	.603	.571	.650	.643	.625	.671	1	.787	.780
<b>B18.9</b>	.422	.569	.589	.570	.639	.675	.648	.696	.787	1	.802
<b>B18.10</b>	.424	.545	.592	.603	.602	.676	.614	.683	.780	.802	1

### 4.2.9 One Sample t-test for Ranking of Dependent Variable

This analysis aims to identify the most important metrics for strategic sourcing supplier selection. For this purpose, the responses obtained from Section A5 of the questionnaire will be utilized. The arithmetic means and rank orders of the identified metrics were derived from the total sample to determine the level of importance. Since all metrics should have a mean which is different from zero, a one-sample t-test was conducted. The one sample t-test was carried out to determine whether the population considered a specific metric to be important or otherwise (Ahadzie et al., 2008). The mean ranking of each metric was tabulated to provide a clearer picture of the consensus reached by the participants. A summary of the test results is shown in Tables 4.44 – 4.47. The mean for each metric including the associated standard deviation and standard error is reported in Table 4.44.

For each metric, the null hypothesis was that the metric 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 and was fixed at 3.5 (Ekanayake & Ofori, 2004). The test was conducted at a 5% level of significance (Sharpe et al., 2010). Thus, based on the five-point Likert rating scale, a metric was deemed important if the mean is of 3.5 or more. Where two or more metrics have the same mean, the one with the lowest standard deviation was assigned the highest importance ranking (Sharpe et al., 2010). According to Field (2005), the standard error is the standard deviation of sample means and it is a measure of how representative a sample is likely to be to the population. The standard



error associated with the means was relatively close to zero suggesting that the sample chosen in this research is an accurate reflection of the population (see Table 4.44). Furthermore, the standard deviations less than 1.0 also indicates that there is little variability in the data and consistency in agreement among the participants.

**Table 4.44 Results of t-test showing one sample statistics**

	<b>N</b>	<b>M</b>	<b>SD</b>	<b>SE</b>
Product quality	364	4.58	.632	.033
Price	364	4.24	.747	.039
Delivery	364	4.30	.732	.038
Support services	364	4.18	.721	.038
Production system	364	3.80	.792	.042
Flexibility	364	3.80	.731	.038
ICT	364	3.68	.826	.043
Financial performance	364	3.96	.824	.043
Product innovation	364	3.70	.830	.043
QMS	364	3.90	.856	.045
Management and organization	364	3.71	.854	.045
Customer training	364	3.95	.801	.042
Employee training and development	364	3.83	.894	.047
Performance history	364	4.10	.786	.041
Customer focus	364	4.03	.753	.039
CSR	364	3.34	.978	.051
Safety awareness	364	4.17	.826	.043
Environmental attributes	364	3.93	.832	.044

The mean scores of each perceived metric for all participants were calculated and they were ranked in descending order according to the mean score values as shown in Table 4.46. The significance levels derived from one sample t-test are illustrated in Table 4.45. The results confirm that the significance levels of all the metrics in the one sample t-test are less than .05 indicating that they are all statistically significant. The summary shows that product quality (M = 4.58, SD = .632, n = 364) emerged as extremely important metrics. This is followed by sixteen metrics receiving a mean score of 3.5 or above which are deemed as important metrics: delivery (M = 4.30, SD = .732, n = 364); price (M = 4.24, SD = .747, n = 364); support services (M = 4.18, SD = .721, n = 364); safety awareness (M = 4.17, SD = .826, n = 364); performance history (M = 4.10, SD = .786, n = 364); customer focus (M = 4.03, SD = .753, n = 364); financial performance (M = 3.96, SD = .824, n = 364); customer training (M = 3.95, SD = .801, n = 364);

environmental attributes (M = 3.93, SD = .832, n = 364); QMS (M = 3.90, SD = .856, n = 364); employee training and development (M = 3.83, SD = .894, n = 364); production system (M = 3.80, SD = .792, n = 364); flexibility (M = 3.80, SD = .731, n = 364); management and organization (M = 3.71, SD = .854, n = 364); product innovation (M = 3.70, SD = .830, n = 364); and ICT (M = 3.68, SD = .826, n = 364). CSR emerged as the least favoured metric somewhere between neither important nor unimportant (M = 3.40, SD = .696, n = 364).

**Table 4.45 One sample test: dependent variable**

	Test Value = 3.5					
	t	df	Sig. (2-tailed)	Mean difference	95% Confidence Interval of the Difference	
					Lower	Upper
Product quality	32.526	363	.000	1.077	1.01	1.14
Price	18.937	363	.000	.742	.66	.82
Delivery	20.895	363	.000	.802	.73	.88
Support services	17.881	363	.000	.676	.60	.75
Production system	7.279	363	.000	.302	.22	.38
Flexibility	7.892	363	.000	.302	.23	.38
ICT	4.060	363	.000	.176	.09	.26
Financial performance	10.625	363	.000	.459	.37	.54
Product innovation	4.674	363	.000	.203	.12	.29
QMS	8.817	363	.000	.396	.31	.48
Management and organization	4.726	363	.000	.212	.12	.29
Customer training	10.727	363	.000	.451	.37	.53
Employee training and development	6.977	363	.000	.327	.23	.42
Performance history	14.531	363	.000	.599	.52	.68
Customer focus	13.511	363	.000	.533	.46	.61
CSR	-3.161	363	.002	-.162	-.26	-.06
Safety awareness	15.490	363	.000	.670	.59	.76
Environmental attributes	9.891	363	.000	.431	.35	.52

Table 4.46 Summary of t-test showing rankings

	<b>M</b>	<b>SD</b>	<b>Ranking</b>
Product quality	4.58	0.632	1
Delivery	4.30	0.732	2
Price	4.24	0.747	3
Support services	4.18	0.721	4
Safety awareness	4.17	0.826	5
Performance history	4.10	0.786	6
Customer focus	4.03	0.753	7
Financial performance	3.96	0.824	8
Customer training	3.95	0.801	9
Environmental attributes	3.93	0.832	10
QMS	3.90	0.856	11
Employee training and development	3.83	0.894	12
Production system	3.80	0.792	13
Flexibility	3.80	0.731	14
Management and organization	3.71	0.854	15
Product innovation	3.70	0.830	16
ICT	3.68	0.826	17
CSR	3.34	0.978	18

#### 4.2.9.1 Hypotheses Testing

Based on the adopted method as explained in Section 4.2.7, Table 4.47 summarizes the hypotheses testing. Seventeen null hypotheses were rejected and only one hypothesis was accepted. The rejected hypotheses were null hypotheses which indicated the particular metric was not important. Therefore, this indicates that the rejection of 17 null hypotheses testify that 17 metrics were considered important in the strategic sourcing supplier selection in the electricity supply industry.

Table 4.47 Hypotheses testing

<b>Hypotheses</b>	<b><math>H_a: \mu &gt; 3.5</math></b>	<b>Accept/Reject <math>H_o</math></b>
H1a: Supplier's product quality significantly affects supplier's competitiveness level	Yes	Reject
H1b: Supplier's delivery significantly affects supplier's competitiveness level	Yes	Reject
H1c: Supplier's price significantly affects supplier's competitiveness level	Yes	Reject
H1d: Supplier's support services significantly affects	Yes	Reject

supplier's competitiveness level		
H2a: Supplier's production system significantly affects supplier's attractiveness level	Yes	Reject
H2b: Supplier's flexibility significantly affects supplier's attractiveness level	Yes	Reject
H2c: Supplier's ICT level significantly affects supplier's attractiveness level	Yes	Reject
H2d: Supplier's financial performance significantly affects supplier's attractiveness level	Yes	Reject
H2e: Supplier's product innovation level significantly affects supplier's attractiveness level	Yes	Reject
H2f: Supplier's QMS level significantly affects supplier's attractiveness level	Yes	Reject
H2g: Supplier's management and organization significantly affects supplier's attractiveness level	Yes	Reject
H2h: Supplier's customer training significantly affects supplier's attractiveness level	Yes	Reject
H2i: Supplier's employee training and development significantly affects supplier's attractiveness level	Yes	Reject
H2j: Supplier's performance history significantly affects supplier's attractiveness level	Yes	Reject
H2k: Supplier's customer focus significantly affects supplier's attractiveness level	Yes	Reject
H2l: Supplier's CSR level significantly affects supplier's attractiveness level	No	Accept
H2m: Supplier's safety awareness significantly affects supplier's attractiveness level	Yes	Reject
H2n: Supplier's environmental attributes significantly affects supplier's attractiveness level	Yes	Reject

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#### **4.2.10 One Sample t-test for Ranking of Independent Variables**

This analysis aims at identifying the appropriate definitional dimensions (independent variables) corresponding to selection metric (dependent variable) for strategic sourcing supplier selection. For this purpose, the responses obtained from Section B1-B18 of the questionnaire will be utilized. A summary of the test results for each independent variable are shown below.

## i. B1 - Product quality

Product quality is measured by four different items. From Table 4.48, it is observed that participants considered B1.1 - “meets specification” as extremely important ( $M = 4.51$ ,  $SD = .632$ ) while categorizing the remaining items B1.2 - “improve conformance” ( $M = 4.31$ ,  $SD = .663$ ), B1.3 - “reduce defective rates” ( $M = 4.29$ ,  $SD = .723$ ) and B1.4 - “reduce breakdowns” ( $M = 4.38$ ,  $SD = .708$ ) as very important. The results also confirm that the significance levels of all the items in the one sample t-test are less than 0.05 indicating that they are all statistically significant.

Table 4.48 Results of t-test showing one sample statistics (product quality)

	<b>N</b>	<b>M</b>	<b>SD</b>	<b>SE</b>	<b>Sig.</b>
Meets specification	364	4.51	.632	.033	.000
Improve conformance	364	4.31	.663	.035	.000
Reduce defective rates	364	4.29	.723	.038	.000
Reduce breakdowns	364	4.38	.708	.037	.000

## ii. B2 - Price

Price is measured by four different items. From Table 4.49, it is observed that participants considered B2.1 - “reasonable price” ( $M = 4.45$ ,  $SD = .651$ ) as extremely important while the remaining items such as B2.2 - “allow space for price negotiations” ( $M = 4.20$ ,  $SD = .704$ ), B2.3 - “estimates cost accurately” ( $M = 4.18$ ,  $SD = .768$ ) and B2.4 - “willing to show breakdown of unit price” ( $M = 4.19$ ,  $SD = .783$ ) as very important. The results also confirm that the significance levels of all the items in the one sample t-test are less than 0.05 indicating that they are all statistically significant.

Table 4.49 Results of t-test showing one sample statistics (price)

	<b>N</b>	<b>M</b>	<b>SD</b>	<b>SE</b>	<b>Sig.</b>
Reasonable price	364	4.45	.651	.034	.000
Allow space for price negotiations	364	4.20	.704	.037	.000
Estimates cost accurately	364	4.18	.768	.040	.000
Willing to show breakdown of unit price	364	4.19	.783	.041	.000

## iii. B3 - Delivery

Delivery is measured by five different items. From Table 4.50, it is observed that participants considered B3.1 - “deliver on time” ( $M = 4.48$ ,  $SD = .690$ ) and B3.2 - “correct quantity” ( $M = 4.50$ ,  $SD = .666$ ) as extremely important. The items pertaining

to B3.3 - “reduces manufacturing lead time” (M = 4.13, SD = .755), B3.4 - “accurate information” (M = 4.25, SD = .721) and B3.5 - “geographical location” (M = 3.55, SD = .971) are regarded as very important. The results also confirm that the significance levels of all the items in the one sample t-test are less than 0.05 indicating that they are all statistically significant except for “geographical location”.

Table 4.50 Results of t-test showing one sample statistics (delivery)

	<b>N</b>	<b>M</b>	<b>SD</b>	<b>SE</b>	<b>Sig.</b>
Deliver on time	364	4.48	.690	.036	.000
Correct quantity	364	4.50	.666	.035	.000
Reduces manufacturing lead time	364	4.13	.755	.040	.000
Accurate information	364	4.25	.721	.038	.000
Geographical location	364	3.55	.971	.051	.306

#### iv. B4 - Production system

Production system is measured by six different items. From Table 4.51, it is observed that participants considered B4.1 - “optimum arrangement of plant layout” (M = 3.78, SD = .783), B4.2 - “accepts orders in small quantity” (M = 3.77, SD = .770), B4.3 - “uses MRP” (M = 3.72, SD = .830), B4.4 - “reduces production setup time” (M = 3.73, SD = .817), B4.5 - “adopts TPM” (M = 3.72, SD = .849), and B4.6 - “continuously produce same product” (M = 3.71, SD = .792) as very important. The results also confirm that the significance levels of all the items in the one sample t-test are less than 0.05 indicating that they are all statistically significant.

Table 4.51 Results of t-test showing one sample statistics (production system)

	<b>N</b>	<b>M</b>	<b>SD</b>	<b>SE</b>	<b>Sig.</b>
Optimum arrangement of plant layout	364	3.78	.783	.041	.000
Accepts orders in small quantity	364	3.77	.770	.040	.000
Uses MRP	364	3.72	.830	.043	.000
Reduces production setup time	364	3.73	.817	.043	.000
Adopts TPM	364	3.72	.849	.045	.000
Continuously produce same product	364	3.71	.792	.041	.000

#### v. B5 - Flexibility

Flexibility is measured by five different items. From Table 4.52, it is observed that participants considered B5.1 - “solving conflict resolution” (M = 4.08, SD = .756), B5.2 - “willing to change order volumes” (M = 3.94, SD = .698), B5.3 - “able to make design

changes” (M = 4.03, SD = .753), B5.4 - “responds to changes in planned delivery dates” (M = 4.09, SD = .727) and B5.5 - “rapidly changes the mix of different products” (M = 3.77, SD = .790) as very important. The results also confirm that the significance levels of all the items in the one sample t-test are less than 0.05 indicating that they are all statistically significant.

Table 4.52 Results of t-test showing one sample statistics (flexibility)

	<b>N</b>	<b>M</b>	<b>SD</b>	<b>SE</b>	<b>Sig.</b>
Solving conflict resolution	364	4.08	.756	.040	.000
Willing to change order volumes	364	3.94	.698	.037	.000
Able to make design changes	364	4.03	.753	.039	.000
Responds to changes in planned delivery dates	364	4.09	.727	.038	.000
Rapidly changes the mix of different products	364	3.77	.790	.041	.000

vi. B6 - Support services

The metric of support services is measured by six different items. From Table 4.53, it is observed that participants considered B6.1 - “performs the service right the first time” (M = 4.33, SD = .739), B6.2 - “provides services at the promised/due time” (M = 4.41, SD = .676), B6.3 - “willing to customize services” (M = 4.17, SD = .697), B6.4 - “open to off-peak services” (M = 4.01, SD = .733), B6.5 - “provide qualified personnel” (M = 4.29, SD = .695) and B6.6 - “provide spare parts” (M = 4.30, SD = .725) as very important. The results also confirm that the significance levels of all the items in the one sample t-test are less than 0.05 indicating that they are all statistically significant.

Table 4.53 Results of t-test showing one sample statistics (support services)

	<b>N</b>	<b>M</b>	<b>SD</b>	<b>SE</b>	<b>Sig.</b>
Performs the service right the first time	364	4.33	.739	.039	.000
Provides services at the promised/due time	364	4.41	.676	.035	.000
Willing to customize services	364	4.17	.697	.037	.000
Open to off-peak services	364	4.01	.733	.038	.000
Provide qualified personnel	364	4.29	.695	.036	.000
Provide spare parts	364	4.30	.725	.038	.000

vii. B7 - ICT

ICT is measured by six different items. From Table 4.54, it is observed that participants considered B7.1 - “collaborative technologies” (M = 3.70, SD = .790), B7.2 - “transaction processing system” (M = 3.63, SD = .780), B7.3 - “EDI” (M = 3.65, SD =

.824), B7.4 - “advanced tracking system” (M = 3.82, SD = .834), B7.5 - “ERP” (M = 3.70 , SD = .799) and B7.6 - “helpline” (M = 3.95, SD = .838) as very important. The results also confirm that the significance levels of all the items in the one sample t-test are less than 0.05 indicating that they are all statistically significant.

**Table 4.54 Results of t-test showing one sample statistics (ICT)**

	<b>N</b>	<b>M</b>	<b>SD</b>	<b>SE</b>	<b>Sig.</b>
Collaborative technologies	364	3.70	.790	.041	.000
Transaction processing system	364	3.63	.780	.041	.002
EDI	364	3.65	.824	.043	.000
Advanced tracking system	364	3.82	.834	.044	.000
ERP	364	3.70	.799	.042	.000
Helpline	364	3.95	.838	.044	.000

viii. B8 - Financial performance

Financial performance is measured by six different items. From Table 4.55, it is observed that participants considered B8.1 - “average return on investment” (M = 3.79, SD = .833), B8.2 - “profit as percentage of sales” (M = 3.79, SD = .848), B8.3 - “net income before taxes” (M = 3.72, SD = .841), B8.4 - “present value” (M = 3.73, SD = .818), B8.5 - “cash flow” (M = 3.99 , SD = .836) and B8,6 - “liquidity” (M = 3.82, SD = .809) as very important. The results also confirm that the significance levels of all the items in the one sample t-test are less than 0.05 indicating that they are all statistically significant.

**Table 4.55 Results of t-test showing one sample statistics (financial performance)**

	<b>N</b>	<b>M</b>	<b>SD</b>	<b>SE</b>	<b>Sig.</b>
Average return on investment	364	3.79	.833	.044	.000
Profit as percentage of sales	364	3.79	.848	.044	.000
Net income before taxes	364	3.72	.841	.044	.000
Present value	364	3.73	.818	.043	.000
Cash flow	364	3.99	.836	.044	.000
Liquidity	364	3.82	.809	.042	.000

ix. B9 - Product innovation

Product innovation is measured by six different items. From Table 4.56, it is observed that participants considered B9.1 - “designs new products” (M = 3.77, SD = .767), B9.2



- “develops customized products” (M = 3.93, SD = .702), B9.3 - “develops new product functions” (M = 3.87, SD = .743), B9.4 - “quickly in introducing new products” (M = 3.63, SD = .794), B9.5 - “willing to share key technological information” (M = 4.06 , SD = .760) and B9.6 - “adopts new production technology” (M = 3.90, SD = .724) as very important. The results also confirm that the significance levels of all the items in the one sample t-test are less than 0.05 indicating that they are all statistically significant.

Table 4.56 Results of t-test showing one sample statistics (product innovation)

	N	M	SD	SE	Sig.
Designs new products	364	3.77	.767	.040	.000
Develops customized products	364	3.93	.702	.037	.000
Develops new product functions	364	3.87	.743	.039	.000
Quickly in introducing new products	364	3.63	.794	.042	.002
Willing to share key technological information	364	4.06	.760	.040	.000
Adopts new production technology	364	3.90	.724	.038	.000

x. B10 - QMS

QMS is measured by four different items. From Table 4.57, it is observed that participants considered B10.1 - “manual and procedure for its quality system” (M = 4.11, SD = .817), B10.2 - “improves quality assurance system” (M = 4.09, SD = .824), B10.3 - “effective product database” (M = 4.03, SD = .795) and B10.4 - “achieves various quality system certifications” (M = 4.05, SD = .806) as very important. The results also confirm that the significance levels of all the items in the one sample t-test are less than 0.05 indicating that they are all statistically significant.

Table 4.57 Results of t-test showing one sample statistics (QMS)

	N	M	SD	SE	Sig.
Manual and procedure for its quality system	364	4.11	.817	.043	.000
Improves quality assurance system	364	4.09	.824	.043	.000
Effective product database	364	4.03	.795	.042	.000
Achieves various quality system certifications	364	4.05	.806	.042	.000

xi. B11 - Management and organization

Management and organization is measured by six different items. From Table 4.58, it is observed that participants considered B11.1 - “complete organizational structure” (M =

3.85, SD = .827), B11.2 - “management policies” (M = 3.85, SD = .777), B11.3 - “management attitude” (M = 3.95, SD = .782), B11.4 - “degree of alignment with customer's future plans” (M = 3.91, SD = .768), B11.5 - “stable workforce employment” (M = 3.96, SD = .758) and B11.6 - “compatibility of ethical standards with the customer” (M = 3.96, SD = .740) as very important. The results also confirm that the significance levels of all the items in the one sample t-test are less than 0.05 indicating that they are all statistically significant.

Table 4.58 Results of t-test showing one sample statistics (management and organization)

	<b>N</b>	<b>M</b>	<b>SD</b>	<b>SE</b>	<b>Sig.</b>
Complete organizational structure	364	3.85	.827	.043	.000
Management policies	364	3.85	.777	.041	.000
Management attitude	364	3.95	.782	.041	.000
Degree of alignment with customer's future plans	364	3.91	.768	.040	.000
Stable workforce employment	364	3.96	.758	.040	.000
Compatibility of ethical standards with the customer	364	3.96	.740	.039	.000

xii. B12 - Customer’s training

Customer’s training is measured by four different items. From Table 4.59, it is observed that participants considered B12.1 - “competent instructors” (M = 4.28, SD = .710), B12.2 - “provides adequate training materials” (M = 4.23, SD = .725), B12.3 - “provides training tailored for different skill levels” (M = 4.18, SD = .699) and B12.4 - “provides training specific to the needs of the customer” (M = 4.28, SD = .719) as very important. The results also confirm that the significance levels of all the items in the one sample t-test are less than 0.05 indicating that they are all statistically significant.

Table 4.59 Results of t-test showing one sample statistics (customer’s training)

	<b>N</b>	<b>M</b>	<b>SD</b>	<b>SE</b>	<b>Sig.</b>
Competent instructors	364	4.28	.710	.037	.000
Provides adequate training materials	364	4.23	.725	.038	.000
Provides training tailored for different skill levels	364	4.18	.699	.037	.000
Provides training specific to the needs of the customer	364	4.28	.719	.038	.000

## xiii. B13 - Employee training and development

Employee training and development is measured by four different items. From Table 4.60, it is observed that participants considered B13.1 - “undergo occupational health tests” (M = 3.88, SD = .820), B13.2 - “provides career advancement and training development” (M = 3.77, SD = .820), B13.3 - “well-planned training module” (M = 3.84, SD = .800) and B13.4 - “sufficient funds for training” (M = 3.78, SD = .820) as very important. The results also confirm that the significance levels of all the items in the one sample t-test are less than 0.05 indicating that they are all statistically significant.

Table 4.60 Results of t-test showing one sample statistics (Employee training and development)

	<b>N</b>	<b>M</b>	<b>SD</b>	<b>SE</b>	<b>Sig.</b>
Undergo occupational health tests	364	3.88	.820	.043	.000
Provides career advancement and training development	364	3.77	.820	.043	.000
Well-planned training module	364	3.84	.800	.042	.000
Sufficient funds for training	364	3.78	.820	.043	.000

## xiv. B14 - Performance history

Performance history is measured by three different items. From Table 4.61, it is observed that participants considered B14.1 - “local/international track record” (M = 4.19, SD = .774), B14.2 - “number of completed jobs” (M = 4.11, SD = .761) and B14.3 - “pending or possible legal suits” (M = 3.98, SD = .792) as very important. The results also confirm that the significance levels of all the items in the one sample t-test are less than 0.05 indicating that they are all statistically significant.

Table 4.61 Results of t-test showing one sample statistics (performance history)

	<b>N</b>	<b>M</b>	<b>SD</b>	<b>SE</b>	<b>Sig.</b>
Local/international track record	364	4.19	.774	.041	.000
Number of completed jobs	364	4.11	.761	.040	.000
Pending or possible legal suits	364	3.98	.792	.042	.000

## xv. B15 - Customer focus

Customer focus is measured by nine different items. From Table 4.62, it is observed that

participants considered B15.1 - “strong sense of loyalty to its customers” (M = 4.13, SD = .716), B15.2 - “dedicates manpower and resources” (M = 4.18, SD = .740), B15.3 - “encourages visits to its facilities” (M = 3.93, SD = .764), B15.4 - “long term partnership” (M = 4.03, SD = .742), B15.5 - “keeps us informed” (M = 4.04, SD = .756), B15.6 - “willing to make a long-term investment” (M = 3.98, SD = .717), B15.7 - “provides information” (M = 4.04, SD = .747), B15.8 - “strengthening of warranties” (M = 4.13, SD = .737) and B15.9 - “handles complaints promptly” (M = 4.23, SD = .733) as very important. The results also confirm that the significance levels of all the items in the one sample t-test are less than 0.05 indicating that they are all statistically significant.

Table 4.62 Results of t-test showing one sample statistics (customer focus)

	<b>N</b>	<b>M</b>	<b>SD</b>	<b>SE</b>	<b>Sig.</b>
Strong sense of loyalty to its customers	364	4.13	.716	.038	.000
Dedicates manpower and resources	364	4.18	.740	.039	.000
Encourages visits to its facilities	364	3.93	.764	.040	.000
Long term partnership	364	4.03	.742	.039	.000
Keeps us informed	364	4.04	.756	.040	.000
Willing to make a long-term investment	364	3.98	.717	.038	.000
Provides information	364	4.04	.747	.039	.000
Strengthening of warranties	364	4.13	.737	.039	.000
Handles complaints promptly	364	4.23	.733	.038	.000

xvi. B16 - CSR

CSR is measured by four different items. From Table 4.63, it is observed that participants considered B16.1 - “commitment to use a portion of its profits to help nonprofits” (M = 3.48, SD = .838), B16.2 - “corporate giving to community programmes” (M = 3.47, SD = .797), B16.3 - “code of ethics is published and distributed to employees” (M = 3.59, SD = .830) and B16.4 - “encouragement in recycling and use of recycled products” (M = 3.54, SD = .840) as very important. The results also confirm that only one item has significance level is less than 0.05 indicating that the rest of the items are all statistically insignificant.

Table 4.63 Results of t-test showing one sample statistics (CSR)

	<b>N</b>	<b>M</b>	<b>SD</b>	<b>SE</b>	<b>Sig.</b>
Commitment to use a portion of its profits to help nonprofits	364	3.48	.838	.044	.662
Corporate giving to community programmes	364	3.47	.797	.042	.511
Code of ethics is published and distributed to employees	364	3.59	.830	.044	.044
Encouragement in recycling and use of recycled products	364	3.54	.840	.044	.350

xvii. B17 - Safety awareness

Safety awareness is measured by nine different items. From Table 4.64, it is observed that participants considered B17.1 - “zero number of lost times from accidents” (M = 4.10, SD = .770), B17.2 - “provides adequate personal protection equipment” (M = 4.24, SD = .778), B17.3 - “provides adequate safety instructions” (M = 4.20, SD = .806), B17.4 - “has an emergency plan and evacuation procedure” (M = 4.19, SD = .774), B17.5 - “has periodic safety audit” (M = 4.10, SD = .845), B17.6 - “provides safety training for employees” (M = 4.15, SD = .759), B17.7 - “has certifications for safety practices” (M = 4.18, SD = .802), B17.8 - “has a safety officer” (M = 4.20, SD = .758) and B17.9 - “satisfy safety requirements at customer's premise” (M = 4.28, SD = .737) as very important. The results also confirm that the significance levels of all the items in the one sample t-test are less than 0.05 indicating that they are all statistically significant.

Table 4.64 Results of t-test showing one sample statistics (safety awareness)

	<b>N</b>	<b>M</b>	<b>SD</b>	<b>SE</b>	<b>Sig.</b>
Zero number of lost times from accidents	364	4.10	.770	.040	.000
Provides adequate personal protection equipment	364	4.24	.778	.041	.000
Provides adequate safety instructions	364	4.20	.806	.042	.000
Has an emergency plan and evacuation procedure	364	4.19	.774	.041	.000
Has periodic safety audit	364	4.10	.845	.044	.000
Provides safety training for employees	364	4.15	.759	.040	.000
Has certifications for safety practices	364	4.18	.802	.042	.000
Has a safety officer	364	4.20	.758	.040	.000
Satisfy safety requirements at customer's premise	364	4.28	.737	.039	.000

xviii. B18 - Environmental attributes

Environmental attributes is measured by ten different items. From Table 4.65, it is observed that participants considered B18.1 - “reduced consumption of material” (M = 3.79, SD = .750), B18.2 - “reduced consumption of energy” (M = 3.88, SD = .788), B18.3 - “reuse, recycle, recovery of material, and component parts” (M = 3.75, SD = .814), B18.4 - “avoid/reduce usage of hazardous products” (M = 3.97, SD = .806), B18.5 - “EMS” (M = 3.92, SD = .819), B18.6 - “ISO 14001 certification” (M = 3.93, SD = .807), B18.7 - “total quality environmental management” (M = 3.95, SD = .791), B18.8 - “environment friendly product design” (M = 3.89, SD = .788), B18.9 - “cleaner production” (M = 3.88, SD = .770) and B18.10 - “green packaging” (M = 3.81, SD = .853) as very important. The results also confirm that the significance levels of all the items in the one sample t-test are less than 0.05 indicating that they are all statistically significant.

Table 4.65 Results of t-test showing one sample statistics (environmental attributes)

	N	M	SD	SE	Sig.
Reduced consumption of material	364	3.79	.750	.039	.000
Reduced consumption of energy	364	3.88	.788	.041	.000
Reuse, recycle, recovery of material, and component parts	364	3.75	.814	.043	.000
Avoid/reduce usage of hazardous products	364	3.97	.806	.042	.000
EMS	364	3.92	.819	.043	.000
ISO 14001 certification	364	3.93	.807	.042	.000
Total quality environmental management	364	3.95	.791	.041	.000
Environment friendly product design	364	3.89	.788	.041	.000
Cleaner production	364	3.88	.770	.040	.000
Green packaging	364	3.81	.853	.045	.000

#### 4.2.11 Difference of Perceptions between Key Stakeholders

Since the participants were composed of five groups namely the “initiator”, “influencer”, “decision-maker”, “buyer” and “user”, the group mean comparison were conducted as illustrated in Table 4.66.

Table 4.66 Comparison of means of overall dependent variables

	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Product quality	1	4.45	1	4.59	1	4.73	1	4.79	1	4.59
Price	3	4.22	3	4.33	3	4.46	6	4.21	4	4.14
Delivery	4	4.17	2	4.33	2	4.48	2	4.58	2	4.28
Support services	5	4.12	7	4.10	5	4.23	3	4.48	3	4.16
Production system	14	3.81	14	3.86	10	3.90	14	3.91	13	3.70
Flexibility	13	3.81	15	3.76	13	3.79	13	3.94	11	3.78
ICT	15	3.78	16	3.71	16	3.56	17	3.79	17	3.55
Financial performance	8	4.05	12	3.90	8	3.94	10	4.15	10	3.83
Product innovation	16	3.74	9	3.98	17	3.46	16	3.85	16	3.61
QMS	10	3.96	10	3.94	9	3.94	8	4.18	14	3.70
Management and organization	17	3.72	17	3.69	15	3.69	11	4.00	15	3.63
Customer training	11	3.92	8	3.98	12	3.85	9	4.15	8	3.95
Employee training and development	12	3.90	13	3.86	14	3.73	12	3.94	12	3.73
Performance history	7	4.05	4	4.24	6	4.15	4	4.42	7	3.97
Customer focus	9	3.98	5	4.18	7	4.02	7	4.21	6	3.98
CSR	18	3.50	18	3.29	18	3.42	18	3.27	18	3.17
Safety awareness	2	4.30	6	4.16	4	4.23	5	4.24	5	3.98
Environmental attributes	6	4.06	11	3.90	11	3.90	15	3.88	9	3.83

Table 4.67 Comparison of means of independent variables (product quality)

Product quality	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Meets specification	1	4.44	1	4.53	1	4.48	1	4.79	1	4.50
Improve conformance	4	4.24	3	4.35	2	4.35	4	4.48	3	4.29
Reduce defective rates	3	4.26	4	4.33	4	4.15	3	4.58	4	4.29
Reduces breakdowns	2	4.28	2	4.41	3	4.27	2	4.67	2	4.45

Table 4.68 Comparison of means of independent variables (price)

Price	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Reasonable price	1	4.36	1	4.53	1	4.46	1	4.55	1	4.48
Allows space for price negotiations	3	4.22	4	4.08	2	4.10	4	4.30	2	4.23
Estimates cost accurately	4	4.18	2	4.14	4	4.06	2	4.42	3	4.17
Willing to show breakdown of unit price	2	4.31	3	4.10	3	4.10	3	4.33	4	4.09



Table 4.69 Comparison of means of independent variables (delivery)

Delivery	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Deliver on time	2	4.31	1	4.65	1	4.60	1	4.76	2	4.45
Correct quantity	1	4.44	2	4.51	2	4.52	2	4.73	1	4.48
Reduces manufacturing lead time	4	4.10	3	4.24	4	4.29	4	4.30	4	3.98
Accurate information	3	4.22	4	4.20	3	4.40	3	4.42	3	4.19
Geographical location	5	3.66	5	3.49	5	3.77	5	3.70	5	3.31

Table 4.70 Comparison of means of independent variables (production system)

Production system	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Optimum arrangement of plant layout	3	3.82	1	3.90	2	3.85	6	3.73	1	3.67
Accepts orders in small quantity	5	3.79	2	3.86	1	3.94	4	3.76	4	3.62
Uses MRP	2	3.83	3	3.76	5	3.75	5	3.73	6	3.55
Reduces production setup time	6	3.74	4	3.73	3	3.83	3	3.76	3	3.66
Adopts TPM	1	3.84	6	3.57	6	3.54	1	3.88	2	3.67
Continuously produce same product	4	3.80	5	3.59	4	3.77	2	3.79	5	3.60

Table 4.71 Comparison of means of independent variables (flexibility)

Flexibility	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Solving conflict resolution	3	4.01	1	4.16	1	4.23	2	4.03	1	4.08
Willing to change order volumes	4	3.90	4	3.88	4	3.92	3	3.94	2	4.03
Able to make design changes	2	4.04	3	4.08	3	4.21	4	3.85	4	3.98
Responds to changes in planned delivery dates	1	4.10	2	4.10	2	4.23	1	4.18	3	3.98
Rapidly changes the mix of different products	5	3.84	5	3.73	5	3.83	5	3.76	5	3.68

Table 4.72 Comparison of means of independent variables (support services)

Support services	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Performs the service right the first time	4	4.10	2	4.31	1	4.52	1	4.61	2	4.44
Provides services at the promised/due time	1	4.28	1	4.39	2	4.50	2	4.58	1	4.48
Willing to customize services	5	4.10	5	4.06	5	4.29	5	4.39	5	4.19
Open to off-peak services	6	3.94	6	3.92	6	4.15	6	4.24	6	3.99
Provide qualified personnel	3	4.15	4	4.27	3	4.38	3	4.55	3	4.36
Provide spare parts	2	4.19	3	4.29	4	4.37	4	4.48	4	4.35

Table 4.73 Comparison of means of independent variables (ICT)

ICT	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Collaborative technologies	5	3.74	4	3.67	4	3.67	3	3.85	3	3.63
Transaction processing system	6	3.67	5	3.57	3	3.69	5	3.64	5	3.58
EDI	4	3.74	3	3.71	5	3.62	6	3.55	6	3.57
Advanced tracking system	2	3.86	2	3.82	2	3.73	2	4.00	2	3.74
ERP	3	3.86	5	3.67	6	3.56	4	3.76	4	3.59
Helpline	1	3.95	1	4.02	1	3.96	1	4.03	1	3.87

Table 4.74 Comparison of means of independent variables (financial performance)

Financial performance	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Average return on investment	2	3.85	4	3.76	3	3.81	2	3.97	6	3.68
Profit as percentage of sales	4	3.84	3	3.84	4	3.79	5	3.79	4	3.70
Net income before taxes	6	3.74	5	3.73	6	3.63	4	3.85	2	3.70
Present value	5	3.82	6	3.65	5	3.67	6	3.79	5	3.68
Cash flow	1	4.05	2	3.92	1	4.00	1	4.18	1	3.91
Liquidity	3	3.84	1	3.98	2	3.81	3	3.94	3	3.70

Table 4.75 Comparison of means of independent variables (product innovation)

Product innovation	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Designs new products	6	3.68	5	3.94	3	3.81	5	4.03	5	3.72
Develops customized products	3	3.93	4	4.02	2	3.92	3	4.09	2	3.83
Develops new product functions	4	3.86	3	4.04	5	3.75	2	4.12	3	3.79
Quickly in introducing new products	5	3.68	6	3.69	6	3.65	6	3.76	6	3.50
Willing to share key technological information	1	4.03	1	4.22	1	3.98	1	4.30	1	3.97
Adopts new production technology	2	3.95	2	4.04	4	3.79	4	4.09	4	3.77

Table 4.76 Comparison of means of independent variables (QMS)

QMS	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Manual and procedure for its quality system	2	4.02	1	4.22	1	4.23	1	4.39	2	4.04
Improves quality assurance system	4	3.97	2	4.14	2	4.13	2	4.30	1	4.11
Effective product database	3	3.98	3	4.10	3	4.10	4	4.24	4	3.97
Achieves various quality system certifications	1	4.04	4	4.02	4	4.08	3	4.27	3	4.00

Table 4.77 Comparison of means of independent variables (management and organization)

Management and organization	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Complete organizational structure	3	3.90	4	3.88	5	3.85	1	4.12	6	3.70
Management policies	5	3.90	6	3.71	3	3.90	6	3.91	5	3.80
Management attitude	2	4.00	3	3.88	4	3.88	5	3.91	1	3.96
Degree of alignment with customer's future plans	4	3.94	5	3.82	6	3.85	3	3.97	3	3.92
Stable workforce employment	1	4.02	2	3.92	1	3.96	2	4.09	4	3.87
Compatibility of ethical standards with the customer	3	3.98	1	4.02	2	3.92	4	3.94	2	3.95

Table 4.78 Comparison of means of independent variables (customer's training)

Customer's training	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Competent instructors	1	4.29	4	4.24	2	4.19	1	4.45	1	4.27
Provides adequate training materials	3	4.26	2	4.29	4	4.06	3	4.33	3	4.22
Provides training tailored for different skill levels	4	4.19	3	4.27	3	4.08	4	4.21	4	4.16
Provides training specific to the needs of the customer	2	4.26	1	4.39	1	4.25	2	4.33	2	4.25

Table 4.79 Comparison of means of independent variables (employee training and development)

Employee training and development	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Undergo occupational health tests	1	3.99	1	3.84	1	3.92	1	3.91	2	3.75
Provides career advancement and training development	4	3.85	4	3.71	4	3.77	4	3.73	3	3.72
Well-planned training module	2	3.91	2	3.82	2	3.83	2	3.79	1	3.77
Sufficient funds for training	3	3.85	3	3.76	3	3.83	3	3.76	4	3.71

Table 4.80 Comparison of means of independent variables (performance history)

Performance history	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Local/international track record	1	4.18	2	4.35	1	4.31	1	4.36	1	4.02
Number of completed jobs	2	4.00	1	4.37	2	4.25	2	4.33	2	4.00
Pending or possible legal suits	3	3.90	3	4.24	3	4.02	3	4.15	3	3.89

Table 4.81 Comparison of means of independent variables (customer focus)

Customer focus	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Strong sense of loyalty to its customers	4	4.07	3	4.29	3	4.21	8	4.09	4	4.09
Dedicates manpower and resources	3	4.08	2	4.31	1	4.31	4	4.21	2	4.18
Encourages visits to its facilities	8	3.97	9	3.96	8	3.90	9	4.03	9	3.85
Long term partnership	5	4.02	8	4.02	6	4.06	6	4.12	6	4.01
Keeps us informed	6	4.01	4	4.20	5	4.10	7	4.09	8	3.97
Willing to make a long-term investment	9	3.90	7	4.02	9	3.90	3	4.21	7	4.01
Provides information	7	4.00	6	4.10	7	3.94	5	4.18	5	4.05
Strengthening of warranties	2	4.11	5	4.16	4	4.10	2	4.24	3	4.11
Handles complaints promptly	1	4.15	1	4.33	2	4.29	1	4.24	1	4.26

Table 4.82 Comparison of means of independent variables (CSR)

CSR	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Commitment to use a portion of its profits to help nonprofits	2	3.62	4	3.45	3	3.52	3	3.45	4	3.33
Corporate giving to community programmes	4	3.57	2	3.53	4	3.42	2	3.45	3	3.37
Code of ethics is published and distributed to employees	1	3.66	1	3.61	1	3.71	1	3.67	2	3.41
Encouragement in recycling and use of recycled products	3	3.62	3	3.49	2	3.65	4	3.36	1	3.49

Table 4.83 Comparison of means of independent variables (safety awareness)

Safety awareness	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Zero number of lost times from accidents	8	4.19	9	4.00	6	4.17	6	4.39	8	3.93
Provides adequate personal protection equipment	2	4.30	4	4.22	2	4.31	2	4.55	5	4.05
Provides adequate safety instructions	5	4.26	3	4.24	3	4.19	3	4.45	6	4.03
Has an emergency plan and evacuation procedure	3	4.28	8	4.14	7	4.17	7	4.33	2	4.06
Has periodic safety audit	7	4.21	7	4.14	9	4.04	8	4.30	9	3.93
Provides safety training for employees	4	4.26	2	4.27	8	4.06	9	4.27	7	3.98
Has certifications for safety practices	9	4.17	6	4.22	4	4.19	1	4.55	4	4.06
Has a safety officer	6	4.22	5	4.22	5	4.19	5	4.42	1	4.11
Satisfy safety requirements at customer's premise	1	4.41	1	4.27	1	4.38	4	4.42	3	4.06



Table 4.84 Comparison of means of independent variables (environmental attributes)

Environmental attributes	Initiator (N = 125)		Influencer (N = 49)		Decision-maker (N = 48)		Buyer (N = 33)		User (N = 109)	
	Rank	M	Rank	M	Rank	M	Rank	M	Rank	M
Reduced consumption of material	10	3.75	6	3.84	9	3.79	9	3.79	7	3.82
Reduced consumption of energy	6	3.94	3	3.90	10	3.77	8	3.85	4	3.85
Reuse, recycle, recovery of material, and component parts	9	3.78	10	3.67	7	3.85	10	3.58	9	3.75
Avoid/reduce usage of hazardous products	1	4.03	2	3.90	1	4.02	6	3.97	2	3.92
EMS	2	4.01	1	3.94	6	3.88	2	4.03	8	3.79
ISO 14001 certification	8	3.93	5	3.84	2	3.98	1	4.06	1	3.93
Total quality environmental management	3	4.01	4	3.88	3	3.92	3	4.03	3	3.89
Environment friendly product design	4	3.96	9	3.78	4	3.90	5	4.00	5	3.83
Cleaner production	5	3.95	8	3.78	5	3.88	4	4.00	6	3.83
Green packaging	7	3.93	7	3.80	8	3.83	7	3.91	10	3.64

### 4.3 Qualitative Analysis

This section presents results from two separate data sets of the qualitative component of this study. With this in mind, this section is divided into two sub-sections. The first sub-section presents results from the semi-structured interviews, while the final sub-section provides results derived from document review.

#### 4.3.1 Semi-structured Interviews

In this qualitative phase of the research individual semi-structured interviews were conducted with seven men and three women from the sample for the qualitative phase. Due to privacy, the detailed information of about the participants is being withheld. Therefore participants are identified by codes from P1 to P12. Table 4.85 provides the summary of the attributes of all interview participants.

Table 4.85 **Summary of demographic background of the participants**

Attributes		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	Total
<b>Gender</b>	Men	x		x	x	X	x	x	x			x	x	<b>9</b>
	Women		x							x	x			<b>3</b>
<b>Line of Work (Division)</b>	Generation					X			x	x	x			<b>4</b>
	Transmission		x				x							<b>2</b>
	Distribution	x												<b>1</b>
<b>Current leadership level</b>	Others			x	x			x				x	x	<b>5</b>
	VP							x						<b>1</b>
<b>Years of service</b>	Head			x	x		x							<b>3</b>
	Manager	x	x			X			x	x	x	x	x	<b>8</b>
<b>Years of service</b>	20 & over			x	x			x						<b>3</b>
	10 - 19	x	x			X	x					x	x	<b>6</b>
	Under 10								x	x	x			<b>3</b>

As in the case of the questionnaire survey, participants self-selected for interviews. The interviews took place in respective interviewee's office at a time convenient to each interviewee. Interviews were approximately 45 minutes in length. Notes were taken during the interviews. As in questionnaire survey, no incentive was offered for

participation in semi-structured interviews. A synopsis of individual semi-structured interview responses is provided here. These responses are referenced also in Chapter 5 as a means to illustrate or otherwise augment points made in the interpretation of findings of the research.

#### **4.3.1.1 Question 1**

*In your opinion do you think that in the current TNB practices that all buyers, suppliers and end-users (engineers and managers) have the same understanding of each of the supplier selection metrics?*

Question 1 offered participants the opportunity to express their opinions whether the buyers, suppliers and end-users are in the same wave length whenever they talk about any supplier selection metrics. Among the twelve participants in the semi-structured interviews, only two women managers with experience less than 10 years indicated that all buyers, suppliers and end-users have the same understanding on each of the selection metrics. However, most participants were unanimous in stating that there are no proper guidelines on supplier selection metrics despite the availability of TNB Procurement Procedure and Policy manual. The manual outlines that evaluation committee should decide the suitable “mandatory metrics” and “preferred metrics”. The participants were adamant on the fact that the manual did not provide a list of common metrics in practice and it is totally left to the discretion of the DMU. Most reported that the executives have the latitude to decide the suitable evaluation metrics based on their previous experience. In terms of definition, the participants observed:

*The definition of price for procurement officer might be different from the end-user as the procurement officer is more interested in the lowest offer whereas the end-user doesn't care about pricing as long as the equipment is of high quality. (P1)*

*It is subject to individual interpretation. (P3)*

*Due to the nature of particular purchase, the definition could be different. (P12)*

A few participants acknowledged the existence of miscommunication and confusion due to irregularities in the definition for each metric. Some believed that the respective parties should refer to the custodian which is the Procurement Division for clarification of the decision-making metrics and their corresponding definitional dimensions. However, two indicated that buyers and suppliers are in accord in their understanding, since suppliers need to comply with whatever is being stated in the tender documentation. The only concern would be addressing the gap between end-users and buyers, which is prevalent and worrying as both parties are working for the same organization. According to one participant:

*By right the input from managers and end-users should be considered by the buyer in forming the decision-making metrics and the definitional dimensions. (P11)*

Another participant clearly stated that:

*There is no sharing of information within the organization as Generation, Transmission and Distribution divisions are operating in silos. (P5)*

These responses further justify the need for this research work. Nearly all participants reported that all buyers, suppliers and end-users must have a common understanding of each of the supplier selection metrics. The researcher highlights the extracted quotes from five of the participants as the remaining participants saying much of the same.

#### **4.3.1.2 Question 2**

*Do you think that having a standard supplier decision model with clear descriptions of each metric and a ranking of importance for each can improve the supplier selection process in TNB. Give reasons for your answers.*

All participants indicated that having a standard supplier selection decision model with clear descriptions of each metric and a ranking of importance for each can improve the supplier selection process in TNB. Responses to this question yielded a consensus between participants that a standard decision model will reduce the procurement lead time, thus expediting the supplier selection process. Some participants agreed that:

*Any department or division in TNB is facing the same problem regarding supplier selection. Thus, having this standard will ensure the DMU understands the expectation for each set metrics. (P12)*

*All three parties will have a clear guideline on the supplier selection process. They will be able to decide the level of importance for each metric. (P1)*

*The model will eliminate non-compliant supplier. (P11)*

From the perspective of DMU, two participants reported that this initiative could guide the team to reach a consensus as all of them might have different perceptions on metrics coupled with different background and work experience. One participant reported that this model would help to evaluate suppliers with due diligence. Nearly all participants reported that having a good supplier selection metrics will help to select the right supplier for the right job. One participant cited that:

*It will ensure that we do not select the lowest bid and focus on fulfilment of our [real] requirements. (P8)*

This observation was echoed by several other few participants in that:

*This will drive the market and pressure the supplier to what we want. It will help to enhance manufacturing quality. (P4)*

*TNB will have better quality products due to process improvement for supplier selection. (P1)*

*It will help to study who is best for what. It may reduce unwanted expenses as we never focus on high-value projects where we lost a lot. (P5)*

Some of the participants did agree that this model could help the organization to trim down its large supply base to increase manageability. One participant shared his

experience that:

*TNB should not be portrayed as a large retail outlet where there could be too many brands on the shelves. As a major service provider, it deals with specialized equipment and spare parts. Overlooking this aspect would cause the technicians to face problem in the field. (P7)*

The same participant agreed that TNB should be bold in implementing a standard supplier selection model to avoid any decision-making mistakes by both new and old staff.

#### **4.3.1.3 Question 3**

***TNB's existing practices for supplier selection are based on four basic metrics: price, quality, delivery and service. What is your understanding of each of these metrics?***

Question 3 was designed to discover participants understanding of the definition of each aforementioned metric. Most participants defined the metrics in broad terms as they construe them using their own expectations. Nearly all participants reported that when it comes to price, the only concern would be the lowest offer. Some of the participants stressed that:

*Frequently, lowest possible price will be at the expense of product quality. (P7)*

*There is no consideration for Total Cost of Ownership or Life Cycle Cost. (P2)*

*At the moment, the way we look at the price does not reflect value for money. (P1)*

However, when talking about quality, there were mixed responses from the participants. Some participants reported that it refers to reliability and durability of the products in service. Others construe it as being fit for specific purpose. However, one participant reported that quality relates to right culture and right management of the supplier. Some participants relate quality to:

*How [do] we want the product to [perform] as we set the specifications? (P1)*

*How the particular products perform and how it was manufactured? (P4)*

*Supply of product as per required in the specifications but with some acceptable tolerance. (P2)*

The participants seemed to have a common understanding of delivery which is meeting original delivery date. Finally, support services is viewed by most of the participants as response from supplier after sales. However, some of the participants feel that service relates to:

*Delivery of products to the acceptable condition. (P5)*

*The supplier's competence level. (P2)*

*What value the suppliers add to the buying organization? (P4)*

These are all very interesting comments that will make one continue to wonder why it should be so. It also explains the inconsistency in the responses from participants from even the same organization that have different understanding on how their organization do certain things, simply because supplier selection metrics are never well specified, communicated and understood by all.

#### **4.3.1.4 Question 4**

***Do you think that TNB needs to expand on this list? What would you suggest as new metrics that must be added to the list? Give reasons for your answers.***

This question derived from supplier selection literature and has been utilized in the questionnaire survey. It will be used to validate the results obtained from the quantitative phase. Initially, the participants were allowed to voice their preferences. Then, the researcher guided the participants with a list of additional metrics and obtained the responses whether the highlighted metrics should be included or otherwise. All twelve participants reported that TNB should expand its supplier selection metrics list. Nearly all participants believed that expansion of business and stiff competition

between power producers require TNB to ensure its power supply is not interrupted. However, only six participants suggested the additional metrics which are already listed in the questionnaire survey. Whereas, the rest of the participants were guided using the same list to obtain their agreement on the suggested metrics. However, among the twelve participants there was a roughly even split between those suggesting differentiating mandatory and preferred metrics and those accepting all these metrics to be lumped in a single category. Table 4.86 summarizes the findings on participants' responses for this question. The participants were then requested to briefly explain the rationale behind their suggestion. Summary of their responses are shown below:

Production system:

Comply with technical specification. (P10)

Management and organization:

*Ensures good communication. (P12)*

Financial performance:

*Strong backup to sustain [on-going operations of TNB]. (P2)*

*Having strong fund means they would not withdraw. (P8)*

Customer training:

*Sharing of information and technology will help the buying organization understand the product better. (P1)*

Performance history:

*Track record of the company. (P2)*



*Good for filtering. (P9)*

*They don't have experience and give problems. Better to award the tender to the performers. (P10)*

Customer focus:

*Suppliers should give the best to the organization. They should be willing to go extra mile for the organization to achieve the best business results. (P1)*

*They have dedicated and specialized workforce for our needs. (P2)*

*Providing better customized service to TNB. (P8)*

*Best result in future. (P9)*

*How soon they can fix the problem. (P10)*

*How they are willing to commit to TNB? (P12)*

Safety awareness:

*Most important as it involves human life. (P1)*

Table 4.86 Participants' responses for additional supplier selection metrics

Additional metrics	Level of Agreement (/ - Important, X - Not important)											
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
Production system	X	/	/	/	/	/	/	/	/	/*	/	/
Flexibility	/	/	/	/	/	/	/	/	/	/	/	/
ICT	X	X	/	/	/	/	/	/	/	/	/	/
Financial performance	/	/*	/	/	/	/	/	/*	/	/	/	/
Product innovation	/	X	/	X	/	/	/	/	/	/	/	/
QMS	X	/	/	/	/	/	/	/	/	/	/	/
Management and organization	X	/	X	/	/	/	/	/	/	/	X	/*
Customer training	/*	/	/	/	/	/	/	/	/	/	/	/
Employee training and development	/	X	X	/	/	/	/	/	/	/	X	/
Performance history	/	/*	/	/	/	/	/	/	/*	/*	/	/
Customer focus	/*	/*	/	/	/	/	/	/*	/*	/*	/	/*
CSR	/	X	X	/	X	X	X	X	/	X	/	/
Safety awareness	/*	/	/	/	/	/	/	/	/	/	/	/
Environmental attributes	/	X	/	/	/	/	/	/	/	/	/	/

\* - metrics suggested by the participants

#### **4.3.1.5 Question 5**

*How would you rank each of the metric you proposed in order of importance with number 1 being the most important and number 18 being the least important? Give reasons for your ranking.*

This question endeavours to identify participants' preference in adopting the relevant metrics for supplier selection. Although in Question 4 the participants have been asked whether the suggested metrics are suitable or not, no ranking exercise has taken place. This is to enable the participants' to voice their preferences without being influenced and overloaded with the list suggested by the researcher. In this question, the participants were requested to rank the metrics that they have suggested including with the ones listed by the researcher. However, there were mixed responses as only six participants gave their own additional metrics. The rest remained with the standard metrics outlined by the organization (product quality, price, delivery and support services). However, two participants reported that the ranking of the four aforementioned metrics could only be decided after finalizing the types of products need to be purchased. Details of the responses are shown in Table 4.87.

Table 4.87 Participants' responses for ranking of supplier selection metrics

Metrics	Ranking											
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
Product quality	2	2	1,2,3,4	1,2,3,4	1	1	1	1	1	2	2	1
Price	3	4	1,2,3,4	1,2,3,4	3	2	4	2	4	4	1	3
Delivery	4	5	1,2,3,4	1,2,3,4	2	3	2	4	3	5	3	2
Support services	5	1	1,2,3,4	1,2,3,4	4	4	3	6	5	6	4	4
Production system	X	NR	NR	NR	NR	NR	NR	NR	NR	1	NR	NR
Flexibility	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
ICT	X	X	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Financial performance	NR	7	NR	NR	NR	NR	NR	3	NR	NR	NR	NR
Product innovation	NR	X	NR	X	NR	NR	NR	NR	NR	NR	NR	NR
QMS	X	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Management and organization	X	NR	X	NR	NR	NR	NR	NR	NR	NR	X	6
Customer training	6	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Employee training and development	NR	X	X	NR	NR	NR	NR	NR	NR	NR	X	NR
Performance history	NR	6	NR	NR	NR	NR	NR	NR	2	3	NR	NR
Customer focus	7	3	NR	NR	NR	NR	NR	5	6	7	NR	5
CSR	NR	X	X	NR	X	X	X	X	NR	X	NR	NR
Safety awareness	1	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Environmental attributes	NR	X	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

NR – accepted but not ranked by the participants

### 4.3.1.6 Question 6

*What other information do you think a supplier decision model should have? Give reasons for your answers.*

Only two participants answered this question as the remaining mentioned that nothing further to be added to a decision-making framework. Summary of the given responses are shown below:

*Should be fool-proof against manipulation. (P7)*

*Must have reward and penalty scheme. (P1)*

### 4.3.2 Document Review

As shown in Table 4-88, nine sample working papers from Generation, Transmission and Distribution Divisions were reviewed. Due to confidentiality nature of these documents, no further descriptions of the particular purchase (capital equipment) would be revealed in this thesis. The researcher reviewed the metrics selected for each working paper. In brief, the documents reviewed do not show the consistency of applying standard supplier selection metrics within the divisions and across the organization.

Table 4.88 Comparison of supplier selection metrics within divisions and across organization

	Generation			Transmission			Distribution		
	G1	G2	G3	T1	T2	T3	D1	D2	D3
Price	/	/	/	/	/	/	/	/	/
Quality	/	/	/	/	/	/	/	/	/
Delivery	/	/	/	/	/	/	/	/	/
Support service	X	/	/	X	X	/	/	/	/
Past experience	/	X	X	X	/	/	X	X	X
Customer training	/	/	X	X	X	/	/	/	X
Safety awareness	X	X	X	X	X	X	X	/	X

## **4.4 Chapter Summary**

Chapter 4 has presented the results of the research phase of this study, as organized by the six research questions investigating the appropriate supplier selection metrics for electricity supply industry. In Chapter 5 the researcher will discuss the findings of the study. Both quantitative and qualitative findings will be integrated into the discussions in order to develop insights into current procurement practice as well as to make recommendations for the future.

# Chapter 5

## Discussion of Findings

### 5.1 Introduction

Chapter 4 presented an analysis of the data generated through the research phase of the project. Chapter 5 utilizes the findings of this chapter in order to discuss the objectives of the study as these were stated in chapter 1. The discussion aims to put the analysis findings into the context of existing literature. From the findings it is intended to establish a better understanding of supplier selection practices in the ESI. The integrated summary of results and discussions below is a deliberate mixture of two sets of results emergent from both data sources (quantitative and qualitative). Synthesis of results through discussion is a principal mechanism that mixes the findings as implied by the mixed methods research tradition (Creswell & Plano-Clark, 2007).

### 5.2 Exposure of Participants to Structured Decision-Making

Before discussing the main findings, it is important to mention one finding that is indirectly related to this study. This observation has implications for the strategic sourcing supplier selection in TNB. This finding is the exposure of participants to structured decision-making. The descriptive statistics indicate that executives in TNB are likely to use “pros and cons analysis” as well as CBA, as the common decision-making methods in their supplier selection process. According to descriptive analysis, this study found that the mean score for participants evaluation on pros and cons analysis ( $M = 3.40$ ,  $SD = .696$ ,  $n = 364$ ) is closer to 3, which represents somewhere between neither effective nor ineffective. This result means that adoption of pros and

cons analysis in supplier selection decision-making is generally rated as average by the study participants. Pros and cons analysis is more to resembling the categorical method as discussed in Section 2.3.3.5.1. The participants might find pros and cons analysis simple to use, inexpensive and quick. However, the participants could be dissatisfied with this method as all metrics are assumed to have equal importance (Humphreys et al., 1998) and it heavily relies upon the experience of the evaluating executives (Ordoobadi, 2009). On the other hand, descriptive statistics indicate that the mean score for participants evaluation on cost benefit analysis ( $M = 3.60$ ,  $SD = .822$ ,  $n = 364$ ) is closer to 4, which represents effective performance for supplier selection decision-making. This result means that adoption of CBA in supplier selection decision-making is generally rated as effective by the study participants. Cost benefit analysis is similar to the total cost of ownership (TCO) method as discussed in Section 2.3.3.5.7. Participants are more inclined to utilize this method as it attempts to include all quantifiable costs that are incurred throughout the purchased product's life cycle (De Boer et al., 2001). In hindsight, however this approach is expensive to implement due to its complexity and being more time consuming in its execution (Degraeve & Roodhooft, 1999a).

Judging from the descriptive statistics, approximately 22% of participants have used both commercial and in-house software for supplier selection. The remaining participants have not used any supplier selection software indicating there is no widely implemented scientific decision-making technique across the host organization. The next step was to examine the reasons why the host organization still refrains from implementing such practice at the corporate level. The main reason for not implementing supplier selection software was that 28.8% of the participants believed the effort was unnecessary. About 14.8% of participants believed that supplier selection software was unable to realize any benefit for their organization. Only 13.7% of participants highlighted that the host organization could not find a suitable solution in the market. In addition, 6.3% expected the implementation process to be too costly, and finally, 4.7% of participants named high software cost as being one of principal reason for not using it. However, 31.9% of participants gave mixed responses for this question. These results accentuate a well-known and hard-to-solve problem: usually, it is difficult to convince and change the mindset of executives to embrace a systematic decision-making using information technology (Poon & Wagner, 2001). However, if such reform



were implemented by the host organization at a corporate level, the executives have to follow the prescribed initiative.

Although this insight does not directly speak to the research questions, the researcher felt it is too important to ignore, because these aforementioned evidences indicates the host organization does not employ any standardized structured decision-making technique in its supplier selection decision-making. Executives were given the freedom to decide the best method to adopt during any supplier selection or appraisal process as there is no standard guideline on this particular issue.

### **5.3 Restatement of the Objectives**

For purposes of making fully explicit the research findings from this study, it is necessary to correlate the findings of the study with the objectives that were originally laid out to guide the study process. Consequently, the following sections address each objective in turn. The summary of all of these findings is given in tabular form in section 5.10.

### **5.4 Objective 1**

*To understand the supplier selection process in TNB. This will involve an in-depth analysis on the current practices of strategic sourcing evaluation and decision-making process stretching from strategic sourcing opportunity identification and appraisal to decision making and implementation of strategic sourcing supplier selection decisions..*

The first research objective addressed the supplier selection practices in TNB. This objective has been achieved using both quantitative and qualitative methods. According to descriptive statistics, this study found that the mean score for TNB's judgment on supplier selection ( $M = 3.39$ ,  $SD = .717$ ,  $n = 364$ ) is closer to 3, which represents *somewhere between neither effective nor ineffective*. This result means that TNB's performance in supplier selection decision-making is generally rated as *average* by the study participants.

Qualitative findings corroborated this quantitative result. According to the qualitative results:

- i. There is no proper guideline on supplier selection metrics;
- ii. Each proposed metric is subject to individual interpretation;
- iii. There is no consistency in applying standard metrics within the divisions and across the organization; and
- iv. The document review validated this finding by revealing the lack of current policy to promote corporate governance which has to be bounded by rational and unbiased decision-making for strategic sourcing supplier selection.

The quantitative study shows TNB's judgment on supplier selection to be rated as an 'average'. In the commercial point of view, this may be considered to be somewhat negative (or at least inadequate) as a judgement. This is a common phenomenon in questionnaire survey where the psychology of the participants influences the given response whereby they knew that the organization is not doing well when it comes to the supplier selection judgment. However at the same time they are afraid that they could be traced as being the individual pin-pointing the weakness of the organization. Therefore, the non-committal attitude (possibly related to issues related to racial or national culture) of the participants would encourage them to tick the neutral point which is somewhere between neither effective nor-ineffective. As supported by the qualitative findings, there is no clear standard on supplier selection metrics for strategic sourcing of capital equipment. That is why people standing on the borderline. This signals something is vital, therefore a framework for supplier selection decision-making is important for TNB.

Indeed, qualitative data help to clarify and bring to life the *average* rating on organizational judgment of supplier selection decision-making as suggested by quantitative data. For instance, as mentioned above, qualitative data show that absence of a proper guideline on supplier selection metrics is an issue observed in this study. Executives can hardly make fact-based decision-making without a set of standard metrics. Moreover, it appears that the participants felt that the definitions for each metric might be different between the key stakeholders. This is exemplified by participants' acknowledging the existence of miscommunication and confusion due to

irregularities of the definition for each metric. Nevertheless, only one participant argued that:

*Due to the nature of particular purchase, the definitions could [or should] be different. (P12)*

By far the most important input into decision-making is a robust and reliable set of data or information (Shim et al., 2002). Having standard metrics with a level of structure and rigour will enable the collection of appropriate data. This is echoed by the philosophy of rational decision-making which encourages the use of a consistent rational approach which provides a trail of how the decision was reached and what was considered (Cervone, 2005). The application of a structured supplier selection decision-making approach is even more important, not only for quality decisions but also for consistency. However, views of employees should not be neglected in the formulation of a standard supplier selection metrics as they are concerned with the strategic direction of the organization (McDonald, 1996). This stance is exemplified by one participant saying that:

*By right the input from managers and end-users should be considered by the buyer in forming the decision-making criteria and the definitions. (P11)*

Also, according to the qualitative data, since there is no standard supplier selection metrics in existence at the organization wide level, currently the adopted metrics are subject to individual interpretation and vary from purchase to purchase. One participant mentions that:

*It is subject to individual interpretation. (P3)*

It is cause for alarm, then, that executives themselves come up with their own metrics for a particular purchase which could lead to inconsistent decision-making culture throughout the organization. To serve as an illustration, one participant mentions that:

*Any department or division in TNB is facing the same problem regarding supplier selection. Thus, having this standard will ensure the decision-making team understands the expectation for each set criteria. (P12)*

Another participant reflects that:

*The definition of “price” for a procurement officer might be different from the end-user as the procurement officer is more interested in the lowest offer whereas the end-user doesn’t care about pricing as long as the equipment is of high quality. (P1)*

While the typical DMU is highly intelligent and highly educated, their decisions are nevertheless susceptible to many common judgement and decision errors (Kardes, 2001). Decision-making are often confounded by various assumptions and biases held by the members of DMU (Korte, 2003). Translated to this study, when the definition of each metric is left in the hands of an individual, it could create ambiguous meanings which might not be in favour of the host organization’s procurement policy.

Qualitative data show that there is no consistency in applying standard metrics within the divisions and across the organization. The document review discloses that three main divisions in TNB have applied different supplier selection metrics within divisions. This would suggest its contention that these entities belonging to the same organization are not on the “same wavelength” when it comes to supplier selection protocols. This stance is exemplified by one participant saying that:

*There is no sharing of information within the organization as Generation, Transmission and Distribution divisions are operating in silos. (P5)*

The document review also reveals that currently TNB’s strategic sourcing supplier selection process is governed by 2011 Procurement Policy and Procedures (TNB, 2011). In the current manual, executives are given the latitude to decide suitable strategic sourcing supplier selection metrics. However, executives are required to decide the components of two categories of metrics. These include “mandatory metrics” and “preferred metrics”. This is a significant departure from the 2004 manual which clearly states any supplier selection should be evaluated using four main metrics namely product quality, price, delivery and support services. This change in procurement policy has created confusion among key stakeholders involved in the supplier selection decision-making as they have to come up with suitable “mandatory metrics” and

“preferred metrics” based on their experience. The specific metrics and their relative importance are likely to vary substantially between individuals in the DMUs and across evaluation sub-stages. This particularly the case when there is a change in the composition of selection committee members. If there is a change in the members of a DMU, often so do the selected metrics. Metrics are a consequence both of corporate and individual goals (Kotler & Bloom, 1984). The variation in the level of experience among the members of DMU regarding the products being purchased can complicate the purchasing process. Day et al. (1994) highlighted that it is reasonable to assume that novice executives would be likely to use somewhat different metrics than those used by experienced executives. Expectations and perceptions regarding the quality of the decision-making process will depend on the experience of the buying organization. It would seem apparent that the metrics may differ with novice or experienced executives; the consequences would be more significant and can cause long lasting damage if the members of the DMU are replaced with new members as there would not be any consistency in future decision-making.

The absence of a standard supplier selection metrics in the host organization could undermine the organization’s standard of corporate governance. This might be tainted by unethical conduct which is more inclined to the decision-maker’s self-interest (Barnett & Vaicys, 2000). The issue of transparency and integrity could arise here as members of DMU are responsible to make decisions with the sole intention to maximize the stakeholder’s wealth (Stovall et al., 2004). Regarding how the organization could be impacted by formulation of a standard supplier selection metrics and definitions, an example can be drawn from statements of one respondent, who posits:

*[The standard supplier selection metrics and definitions] should be fool-proof against manipulation. (P7)*

The goals of selection are best served when selection metric and corresponding definitions are made explicit in a structured process. Therefore the selection of appropriate decision-making metrics and corresponding definitions is crucial for identifying the right supplier. To a great extent, the choice of decision-making metrics could be identified correctly if TNB has a structured procurement model in place. In the absence of a structured and systematic decision-making framework, the great diversity

of executives' personal perceptions and objectives will make it hard to achieve the organization's procurement objectives. Hence it is critical for TNB to adopt a structured and systematic decision-making framework to ensure its corporate and business strategic objectives are aligned and achieved.

Hence realizing the need for an appropriate strategic sourcing supplier selection metrics and corresponding definitional dimensions highlights the potential for improvement in TNB's procurement system achieving objective 1.

## **5.5 Objective 2**

*To establish that the two proposed constructs (Supplier Competitiveness and Supplier Attractiveness) statistically distinct from one another as determined by an unconstrained factor analysis. The nature of the situation particularly in TNB where is no clear standard metrics for strategic sourcing supplier selection necessitated a need to figure out a constructive way of representing the identified eighteen metrics in a multiple perspective format.*

The second research objective addresses the way in which the two theorized constructs (Supplier Competitiveness and Supplier Attractiveness) were statistically distinct from one another and investigates the relationships among them. An unconstrained factor analysis was conducted on the eighteen dependent variables, which yielded two factors that statistically explained by 50.18% of the variance explained by the total number of items. Upon close inspection of the specific items loaded into each factor, it was found that the two factors that emerged configured the executives' responses to the survey items similarly in the two theorized constructs. The factor analysis unveiled a new conceptualization of strategic sourcing supplier selection metrics for ESI as configured by executives' perceptions. This new conceptualization led the researcher to seek a greater understanding of the way executives perceives the strategic sourcing supplier selection metrics. Following is the discussion and interpretation of the factor analysis:

i. Factor 1 (Supplier Attractiveness)

As were seen in Table 4.7, the fourteen extracted supplier selection metrics for component 1 were QMS (82.3%), CSR (82.0%), management and organization (81.1%), employee training and development (77.6%), product innovation (74.9%), environmental attributes (74.1%), ICT (73.6%), financial performance (63.4%), production system (58.7%), safety awareness (58.6%), customer training (54.9%), customer focus (54.0%), flexibility (51.7%) and performance history (43.6%). The number in parenthesis indicates the respective factor loadings. This cluster accounted for 43.18% of the variance. These metrics share a common link to supplier attractiveness which is governed by a supplier's organizational capability and as argued by Ulrich and Wiersema (1989), the response of employees, system and processes within an organization towards global competitiveness is of critical importance in the current turbulent business environment. Being a supplier for specialized products meant for power utilities, increasing competitions from other suppliers force the company to strive for continuous business excellence. Hence organizations that are able to accrue resources and capabilities that are exceptional, important, non-substitutable and difficult to duplicate will achieve a competitive advantage over competing organizations (Dyer & Singh, 1998).

It seems that executives in TNB are particular about supplier's QMS level. Engineers usually will be responsible for measuring quality after a product has been received. As supplier's QMS is an on-going quality management process, it may appear to the executives that exemplary QMS level would reduce the likelihood of receiving faulty products. Executives in TNB seem to be aware of CSR as they have to follow the organization's requirement in becoming a good corporate citizen. They might view that the harmonization of CSR policies and practices between the suppliers and TNB is imperative for a sustainable SCM which may increase TNB's customers' loyalty, improve quality and productivity and the avoidance of possible reputational risks from environmental incidents. However, this is a new finding in the Malaysian context. Another area that receives attention from the participants was supplier's management and organization. TNB executives may perceive that suppliers who are able to demonstrate compatibility in management styles, strategic objectives and organization

cultures would establish a close collaborative relationship with TNB. It would appear that TNB executives realize the importance of supplier's employee training and development activities. They may believe that well-trained employees would contribute to fewer product defects.

It seems that executives in TNB emphasize on product innovation. Although capital equipment in the ESI are relatively standard and had not undergone much design changes, the executives may believe that having a newly developed product would improve the stability of power network. As increasing environmental regulation is one of the most critical issues facing power utilities today, the executives tend to consider environmental attributes in selecting their suppliers. They may the contention that supplier's compliance with this metric would reduce the environmental impact of TNB's operations across power generation, transmission and distribution facilities. The participants believe that effective communication processes and information sharing are essential in building successful buyer-supplier relationships. In their perspective, suppliers' readiness to invest in information and communications technology infrastructure would reduce the transaction processing costs and gain a better understanding of the TNB's requirements. Furthermore, they might think of the bigger picture as real-time information on the product orders may lead to efficient operational decision-making to minimize downtime during a power failure.

It would appear that TNB's executives also look into the supplier's financial performance. They may perceive that supplier's with sound financial position is not only indicating the supplier's stability but assures the continuous availability of quality products. Purchasing of reliable products to be used for equipping power plants and building transmission and distribution lines and substations frequently involves engineer's critical evaluation of the supplier's production system. For an organization that experiences irregular demand, the supplier's production system has to be adequate to meet a specified production plan (Chan, 2007; Jayaraman & Srivastava, 1999), i.e., when the need for electricity is highest. The statutory requirements on safety operations and other occupational health and safety areas in Malaysia drive power utilities to adopt safety management practices. To support this effort, the executives tend to include supplier's safety awareness as a risk assessment measure to reduce the likelihood of



potential losses in production. What is also quite clear is that supplier's commendable performance in safety may reflect its excellence in other areas (Pun & Hui, 2002).

Power utilities have a wide range of equipment that necessitates training by the supplier which is vital to face a power outage. Therefore, the executives may perceive that restoration of power supply depends on the adequate operating personnel training in performing the necessary installation, service or maintenance procedures. It is therefore significant that customer training emerged as one the most critical factor in this grouping. Here, customer focus refers to supplier's commitment to satisfy the buyers' needs which is the focal purpose of any business (Doyle, 1994). Facing the competition from the IPPs make the executives to realize with creation of unique individualized value through investments in the production process and the product provides a measure of the commitment of the supplier to TNB. In this study, flexibility refers to the supplier's agility in changing production attributes, responding to unexpected demand, allowing variety in orders and reaching conflict resolutions (Chan et al., 2008; Choi & Hartley, 1996). Executives in TNB may believe that supplier's flexibility would help to cater organizational need during emergency times. The executives realize that sustainability of a power utility depends on the performance of its suppliers. Therefore, they pay attention on supplier's performance which would eliminate those who could be a potential threat to TNB's business performance.

ii. Factor 2 (Supplier Competitiveness)

Component 2 consists of product quality (72.6 %), delivery (72.5%), price (56.6%) and support services (47.8%) and was labelled supplier competitiveness accounting for 7.01% of the total variance. Product quality emerged as the highest factor in this grouping. The executives may believe that a supplier can greatly influence the final quality of a buyer's product. This may be supported by the reliance of TNB on high product quality to minimise the power outages which may influence its financial position and the lives of customers. Another metric that is considered a principal requirement for supplier selection was delivery. TNB executives' may have strong believed that regular supplier performance in the area of delivery minimizes interruptions in the TNB's business operations. Price emerged the third highest factor in this grouping and conforms to the empirical evidence that price influences the selection

and evaluation of suppliers to certain extent (Xia & Wu, 2007). The executives may believe that having a slight discount in purchasing price helps to increase the profit of TNB. The executives' pay attention to support services rendered to TNB which might be able to reduce downtime.

In summary, the factor analysis found a better organization for the eighteen dependent variables. The grouping of two constructs that emerged from the factor analysis can be used as conceptualization of constructs of strategic sourcing supplier selection metrics. They represent a perspective in the way the executives' in TNB view strategic sourcing supplier selection metrics. This important finding reflects differences from prior studies that used factor analysis to investigate executives' perceptions of supplier selection metrics. The factor analysis by Dempsey (1978) identified five factors based on 20 variables, although some of these factors are similar to Factor 1 and 2 in the current study in their clear differentiation of supplier stability, economic value, geographical suitability, support services and communications. However, this study incorporated new metrics which are relevant to current business requirements and is more specific to strategic sourcing of capital equipment. The results of the this research indicates that executives in TNB may have a different way of prioritizing and conceptually organizing metrics relevant to strategic sourcing of capital equipment in the ESI. At present, TNB Procurement Policy and Procedures left a gap by not outlining the suggested components for the generally written "mandatory metrics" and "preferred metrics". The finding from this factor analysis could be suited to fill this gap. The supplier competitiveness construct could be addressing the "mandatory metrics" while the supplier attractiveness construct addressing the "preferred metrics". Therefore, objective 2 has been achieved.

### **5.6 Objective 3**

*To measure the degree of importance the key stakeholders' (initiators, influencers, decision-makers, buyers and users) place on each metric for decision support in strategic sourcing supplier selection. The researcher sought to explore if and to what extent, the shortlisted eighteen metrics influence or determine the strategic sourcing*

*supplier selection. Therefore this research will help to understand the successful ingredients of strategic sourcing supplier selection practices and decision-making process in the electricity supply industry with primary focus on the factors that influence the process of decision making to purchase capital equipment.*

Metrics in their most basic form are measurements. In industry, metrics allow the choice of a given process, item, or information to be used as a quantification of success or failure as defined by that industry (Stork & Morgan, 1999). Metrics as part of supply management are easy to accept and understand; however, it must be realized that a metric can be unique to a given organization based on individual requirements such as quality that can have different definitions for different companies (Duffy, 2006, p. 34).

The study's third research objective addressed the degree of importance that the key stakeholders placed on the dependent variables. Both quantitative and qualitative methods have been utilized to achieve this objective. Results of the this study indicate that the way in which executives in TNB rated the importance of the dependent variables is consistent with prior studies conducted in non-power related industries. Eighteen hypotheses were tested and all null hypotheses were rejected except for CSR. Executives in TNB acknowledge the importance of the seventeen listed metrics and accepted that CSR is not important in their consideration during supplier selection practices. For the purpose of this study, any metric with a mean of above 4.0 was considered to be highly favourable by the executives in TNB. Prior research has indicated that members of DMU believe that product quality, delivery, price and support services were far more important for supplier selection than other metrics (Dempsey, 1978; Lehmann & O'Shaughnessy, 1982; Weber et al., 1991; Wilson, 1994), however the rank order of importance in these studies might be different. It is interesting to note that the executives in TNB view another set of three decision metrics in their top 7 decision metrics. Those are safety awareness, performance history and customers focus.

“Product quality” was ranked first by the participants ( $M = 4.58$ ,  $SD = .632$ ,  $n = 364$ ), indicating that they agreed that operations in TNB are highly dependent on the quality of equipment being used for power generation, transmission and distribution purposes. This quantitative result is corroborated by the findings of the qualitative result. Approximately 50% of the study participants agreed that product quality should be

given the first priority when appraising a supplier. This could be related to the stiff competition from IPPs and the liberalization of electricity industry in Malaysia which is currently being planned. Furthermore, the aftermath of a substantial national blackout on 29<sup>th</sup> September 1992 might have influenced executives in TNB to place a priority on product quality. Right product quality would raise power generating, transmitting and distributing efficiency and reduces the probability of power failure, thereby contributing to better reputation building and customer retention. By contrast, poor product quality results in power supply interruption, depletion in profit and reduction in the number of customer base (Nicolas & Estava, 2011). Poor product quality was also identified as a critical factor that negatively affects the performance of power producers in various countries or regions (Williams & Ghanadan, 2006; Yunos & Hawdon, 1997).

“Delivery” was identified as the second most important metric for strategic sourcing supplier selection ( $M = 4.30$ ,  $SD = .732$ ,  $n = 364$ ). However, qualitative result indicates that 50% of the participants were having split responses of placing delivery in the second or third ranking. These participants have the common understanding that delivery means meeting original delivery date. Overall, this implies that the success of any new electricity infrastructure projects or on-going maintenance works rely on the supplier’s ability to timely deliver the purchased product. Like any other industries, suppliers for the ESI with a short lead time would have higher degree of control over their value chain and the suppliers are probably more cost efficient. However, the consequences of poor delivery are very costly, commonly as an effect of delays in the electricity supply chain. This could hamper the target of having Malaysia 100% fully electrified by the year 2013 (Haris et al., 2010b). Therefore, consistent supplier performance in the area of delivery minimizes interruptions in the buyer's business operations thereby ensuring uninterrupted production (Cheraghi et al., 2004).

“Price” was ranked third by the survey participants ( $M = 4.24$ ,  $SD = .747$ ,  $n = 364$ ) and 25% of the interview participants which clearly proves that TNB executives do not agree that price is the primary metric for strategic sourcing supplier selection at the expense of other metrics despite the current cost pressure in the ESI. This implies that the executives are aware of the consequences in selecting a supplier based on price is a risky route for the host organization. This stance is exemplified by one participant

saying that:

*Frequently, lowest possible price will be at the expense of product quality. (P7)*

There are many suppliers in the market supplying capital equipment for power utilities. However, it is imperative for the DMU to select a supplier who will be able to provide products which are value for money. This is reinforced by a participant who mentioned that:

*TNB should not be portrayed as a large retail outlet where there could be too many brands on the shelves. As a major service provider, it deals with specialized equipment and spare parts. Overlooking this aspect would cause the technicians to face problem in the fields. (P7)*

Another participant reflects that:

*At the moment, the way we look at the price does not reflect value for money. (P1)*

However, there is awareness about total cost of ownership as one participant mentions that:

*There is no consideration for Total Cost of Ownership or Life Cycle Cost. (P2)*

“Support services” was identified as the fourth most favourable metric by TNB executives ( $M = 4.18$ ,  $SD = .721$ ,  $n = 364$ ) which was corroborated by nearly 33% of the interview participants. This implies that executives in TNB are more concerned and sensitive towards after sales services which mirror the overall competence of a supplier (Dempsey, 1978; Donaldson, 1994). Reliable support throughout the entire operations of a power utility may contribute to enhance the value of purchased equipment and to reduce any possible downtime. From qualitative findings, the participants mention that support services are associated with:

*The supplier's competence level. (P2)*

*What value the supplier's add to the buying organization? (P4)*

These stances tend to reinforce the position of Kahraman et al. (2003), highlighting that buying organizations measure support services performance in terms of reliability, how responsive the supplier is and what value does the supplier add to the organization.

As ESI continues to play a major role in the Malaysian economy, the industry has faced a wide range of challenges, one of which is the frequent occurrences of accidents at the workplace. In parallel with that the “safety awareness” metric was ranked by TNB executives as fifth most important criteria in awarding any supplier to be under strategic sourcing program ( $M = 4.17$ ,  $SD = .826$ ,  $n = 364$ ). This is validated by qualitative findings that indicate participants agree this metric is of importance, but didn’t provide any ranking. Suppliers’ effort in raising awareness of safety as well as building a culture of safe working is something that a power utility cannot afford to overlook. One of the participants reflects that:

*[Safety awareness should be treated as] most important as it involves human life. (P1)*

As the suppliers may try to lower their tender prices, it causes the sum payable for the safety related items not to be measured and identified in the tender rates and prices. Therefore suppliers are likely to cut the budgets under the safety items to put in other necessary items (Choi et al., 2011). Poor safety awareness by suppliers could incur huge costs and may result in delays (Fong & Choi, 2000).

The “performance history” ( $M = 4.10$ ,  $SD = .786$ ,  $n = 364$ ) was ranked 6<sup>th</sup>, suggesting that engineers tended to value the “high performance” suppliers. Again this finding is validated by qualitative findings which indicate that the participants agree that this metric is of importance but didn’t provide any ranking. This corroborated finding implies that TNB executives acknowledge past screening failure of the performance history of suppliers. Ideally this screening should eliminate those who could be a potential threat to TNB’s business performance. However this has historically not happened. This stance is exemplified by one participant saying that:

*[If] they don’t have experience and [would probably] give problems, [it is] better to award the tender to the performers. (P10)*

The performance history of suppliers could be used as a yardstick to determine whether suppliers are capable of maintaining a high quality performance or improving their current inadequate performance. This is reinforced by a participant who mentions that:

*[Performance history of suppliers is a good mechanism] for filtering. (P9)*

Suppliers having good reputation and sound performance history should stand a better chance in winning tenders (Chan et al., 2008), especially when facing severe competition and reduced demand.

“Customer focus” was identified as the seventh most important metric for strategic sourcing supplier selection ( $M = 4.03$ ,  $SD = .753$ ,  $n = 364$ ). Again this finding is validated by qualitative findings which indicate that participants agree this metric is of importance but didn’t provide any ranking. This supported finding implies that TNB executives recognize the importance of suppliers becoming more transparent towards their buyer. It can be seen as the suppliers’ effort to meet the buyers’ expectations in the purchase of capital equipment. This is reinforced by participants mentioning:

*Suppliers should give the best to [TNB]. They should be willing to go extra mile for [TNB] to achieve the best business results. (P1)*

*[Supplier should be able in] providing better customized service to TNB [which shows TNB is their priority customer]. (P8)*

Another participant reflects that customer focus by suppliers should be measured on:

*How are they willing to commit to TNB? (P12)*

Due to the dynamic nature of expectations of purchasing organizations, suppliers need to continually survey and identify their customers' expectations in order to deliver high quality products (Rosenthal, 1992).

Besides these seven top metrics, other metrics taken into consideration are financial performance, customer training, environmental attributes, QMS, employee training and development, production systems, flexibility, management and organization as well as product innovation. It should be noted, however, that while the supplier’s ICT level are

generally believed to be a powerful mechanism in coordinating suppliers and their activities (Paulraj & Chen, 2007), in the context of TNB, the executives do not consider it as important as other metrics and was ranked seventeenth. Another point worth noting is that CSR was considered not important and was ranked eighteenth. Executives seemed to be unconcerned with this metric during supplier selection decision-making. This might be due to the concept of CSR which is only focussing on the obligations towards the natural environment and social dimensions. These dimensions are considered important from the perspective of an organization (Björklund, 2010) more so than the considerations given by the executives involved in strategic sourcing supplier selection decision-making.

The test results addressing Objective 3 suggest that by employing appropriate strategic sourcing supplier selection decision-making metrics, the quality of supplier selection decisions by TNB could be improved.

## **5.7 Objective 4**

*To identify whether the metrics differ among initiators, influencers, decision-makers, buyers and users since there is limited knowledge available on this subject area and no baseline of current use of these metrics, as well as evaluation of their impacts on intended decision outcomes exist.*

Doing business today increasingly mean being effective in a group and team environment. The modern organization depends on participation, and increasingly on the consensus, of its principals, employees, and interested others, all of whom are potential stakeholders in the innumerable business processes and decisions that create success. Similarly, in the case of TNB, decision-making without knowing the actual key stakeholders could be indistinct and may produce ambiguous results with lack of integrity.

An element of this research was also to determine if the metrics for strategic sourcing supplier selection were the same among key stakeholders. Quantitative findings



supported by qualitative results indicate that the list of metrics for initiators, influencers, decision-makers, buyers and users would be the same; however their prioritization of these metrics was stakeholder specific based on each stakeholder's view and the requirements of their job. The outstanding patterns observed from this study are the case of product quality is the most favourable metric and CSR falls as the least favourable metric across the five significant stakeholders.

In this study, as identified in section 5.3, there are seven favourable metrics suitable for the appraisal of strategic sourcing suppliers. However, it seems that influencer, decision-maker, buyer and user share the same opinion on the selected seven metrics with different ranking order. It is interesting to note that the initiator has a slight difference as customer focus was not listed as their main concern, but environmental attributes were chosen to be one of the seven favourable metrics. This could be possibly due to the nature of their job as initiators are the one who request a particular product purchase to be made. During the preparation of capital equipment tender documentation, the initiator might be concerned of product quality, price, delivery, support services, safety awareness and performance history. However, they are inclined to list environmental attributes next to the aforementioned metrics compared to customer focus. This might be due to their tendency to be environmentally conscious when preparing the required specifications for a particular capital equipment purchase.

The results addressing Objective 4 suggest that by employing appropriate strategic sourcing supplier selection decision-making metrics, whenever the significant stakeholders sit in a decision-making committee they could be on the "same wavelength" in terms of metrics and their corresponding definitional dimensions.

## **5.8 Objective 5**

*To provide the key stakeholders' perceptions on the definitional dimensions of each of the top metric for strategic sourcing supplier selection. In this exploratory study, the researcher will take a holistic view of the subject area, gathering as much information as possible before deciding which definitional dimension is important and which*

*definitional dimension can be discarded concerning each of the top metric.*

Supplier selection is a part of SCM and strategic sourcing. A part of supplier selection comes from an understanding of the buyer's knowledge that collaboration in competition must be applied by all parties involved (Cavinato et al., 2006; Spekman et al., 1998). Trent and Monczka (1998) assert that increasing cost for both the suppliers and buyers in response to a global demand for limited resources has made supplier selection a key priority for SCM. The SCM function is required to consider all areas of the supply chain, and how each impacts the equipment or product requirements, and how each can add value to the end-user in making the supplier selection (Davis, 1993; Mabert & Venkataramanan, 1998). One approach to collaboration is using a clear method of supplier selection, such as defining what metrics are to be used in supplier selection. Precise metric definitions allow all key stakeholders to have clear expectations for requirements of capital equipment prior to strategic sourcing supplier selection. This method does allow for greater accountability for key stakeholders. Having a clear method for supplier selection also helps the buying organization to meet the requirements of corporate governance.

As discussed in Section 5.3, seven most favourable metrics being considered for strategic sourcing supplier selection are product quality, delivery, price, support services, safety awareness, performance history and customer focus. For the purpose of this study, any definitional dimension with a mean of above 4.0 was considered to be appropriate for strategic sourcing supplier selection decision-making in TNB. The first definitional dimensions reviewed by the survey participants were those assigned to the product quality metric; there were a total of four definitional dimensions used by the key stakeholders to define the metric:

- i. The supplier meets the required product specifications (international standards);
- ii. The supplier improves conformance to design specifications;
- iii. The supplier reduces defective rates; and
- iv. The supplier reduces probability of product breakdowns.

For the product quality metric, there was a 100% match in ranking among two groups: initiator and buyer as well as influencer and user. This indicates there might be a closer relationship between initiator and buyer when it comes to the issue of product quality.

However, there might be a high probability that the influencer and user are on the same page because the influencer could be ranking the definitional dimensions from the perspective as a previous user.

The next metric reviewed was the delivery metric. The delivery metric had a total of five definitional dimensions. One of the dimension (the supplier is geographically located nearby to the customer) was dropped due to its statistical insignificance. The remaining four accepted dimensions are:

- i. The supplier delivers the kind of products needed on time;
- ii. The supplier delivers the correct quantity of products;
- iii. The supplier is able to reduce manufacturing lead time; and
- iv. The supplier provides accurate information concerning an order.

For the delivery metric, there was a 100% match in ranking among two groups: initiator and user as well as decision-maker and buyer. This indicates there might be a closer relationship between initiator and user when it comes to the issue of delivery as they might be the ones dealing with the installation and commissioning of the purchased capital equipment. However, there might be a high probability that the decision-maker and buyer are on the same page because these two groups are in the authority position which deals with releasing of payment of the purchased product.

The next metric reviewed was the price metric. There were a total of four definitional dimensions used by the key stakeholders to define the price metric:

- i. The supplier offers a reasonable price;
- ii. The supplier allows space for price negotiations;
- iii. The supplier estimates cost accurately; and
- iv. The supplier is willing to show the breakdown of unit price.

For the price metric, there was a 100% match in ranking among influencer and buyer. This indicates there might be a closer relationship between influencer and buyer when it comes to the issue of price.

The next metric reviewed was the support services metric. There were a total of six definitional dimensions used by the key stakeholders to define the support services

metric:

- i. The supplier performs the service right the first time (correct operation);
- ii. The supplier provides services at the promised/due time;
- iii. The supplier is willing to customize services;
- iv. The supplier is open to off-peak services;
- v. The supplier is able to provide qualified personnel for support services; and
- vi. The supplier is able to provide spare parts.

For the support services metric, there was a 100% match in ranking among decision-maker and buyer. This indicates there might be a closer relationship between decision-maker and buyer when it comes to the issue of support services as their role might require them to think of the after sales support required by the organization for a particular capital equipment purchase.

The following metric reviewed was the safety awareness metric. There were a total of nine definitional dimensions used by the key stakeholders to define the safety awareness metric:

- i. The supplier has zero number of lost times from accidents;
- ii. The supplier provides adequate personal protection equipment (PPE) to employees;
- iii. The supplier provides adequate safety instructions in the plant;
- iv. The supplier has an emergency plan and evacuation procedure;
- v. The supplier has periodic safety audit;
- vi. The supplier provides safety training for employees;
- vii. The supplier has certifications for safety practices;
- viii. The supplier has a safety officer; and
- ix. The supplier is able to satisfy safety requirements at customer's premise.

For the safety awareness metric, there was no any 100% match in ranking among the key stakeholders. This indicates that the role assumed by each category of stakeholder influences the definitional dimensions of safety awareness to be perceived differently.

The next metric reviewed was the performance history metric. There were a total of three definitional dimensions used by the key stakeholders to define the performance

history metric:

- i. The supplier's local/international track record (position in industry);
- ii. The supplier's number of completed jobs with renowned customers; and
- iii. The supplier's pending or possible legal suits.

For the performance history metric, there was a 100% match in ranking among initiator, decision-maker, buyer and user. This indicates there might be a closer relationship between the four stakeholders when it comes to the issue of performance history.

The final metric reviewed was the customer focus metric. There were a total of nine definitional dimensions used by the key stakeholders to define the customer focus metric:

- i. The supplier has a strong sense of loyalty to its customers;
- ii. The supplier dedicates whatever manpower and resources it takes to meet the given contract expectations;
- iii. The supplier encourages visits to its facilities on a regular basis;
- iv. The supplier treats each relationship with its customers as an alliance to seek long term partnership;
- v. The supplier keeps us informed about events or changes that may affect us;
- vi. The supplier is willing to make a long-term investment in helping us;
- vii. The supplier provides information that might be of help;
- viii. The supplier is committed through strengthening of warranties; and
- ix. The supplier handles complaints promptly.

For the customer focus metric, there was no any 100% match in ranking among the key stakeholders. This indicates that the role assumed by each category of stakeholder influences the definitional dimensions of customer focus to be perceived differently.

The comparison of ranking done across the key stakeholders identifies the seven top metrics with their definitional dimensions for the appraisal of suppliers under strategic sourcing programme. With the application of a structured decision-making technique, the standard of quality decision-making would increase and equally important is consistency across the buying organization, especially under the complex condition that involves a list of metrics and large number of bidders.

## 5.9 Objective 6

*To develop a framework for a strategic sourcing supplier selection for capital equipment decision making. The current goal is to expose and solve the current problem so as to help key stakeholders improve the strategic sourcing supplier selection practices and decision making process within their organization.*

Business decisions require the facts, options, outcomes and consequences to be carefully considered. Therefore having a decision-making framework to assist in such exercise in supplier selection would provide a structured format for executives' thought. The proposed decision-making framework is quite generic since it is not possible to specifically use a single solution for all the business environments. Although the current study initially departs from eighteen identified metrics, finally the proposed framework only accounted seven top metrics and their corresponding definitional dimensions. This outcome is an effort to reduce large number of consequences which derails the focus of DMU members, therefore avoiding the occurrences of "paralysis of analysis". As a result of this doctoral research, the researcher came up with a decision-making framework bespoke for the strategic sourcing supplier selection of capital equipment in the ESI. The framework as illustrated in Figure 5.1 is to be referred as  $S^4 - \text{CapEq}$  hereafter.

The selection of strategic sourcing suppliers is a complex process. Therefore,  $S^4 - \text{CapEq}$  has been developed for enhancing strategic relationship with reliable suppliers to ensure the operational and financial sustainability of TNB.  $S^4 - \text{CapEq}$  is made up of supplier competitiveness and supplier attractiveness components. The supplier competitiveness component is the major criteria comprising product quality, delivery, price and support services. However, supplier attractiveness measures the safety awareness, performance history and customer focus demonstrated by the supplier. The  $S^4 - \text{CapEq}$  has two distinctions. First, it delineates the supplier competitiveness metrics and supplier attractiveness metrics. Second, it suggests various definitional dimensions for each metric which has been accepted by key stakeholders in TNB.

The framework is constructed using seven top metrics and their corresponding definitions. All metrics under supplier competitiveness have been accepted into the

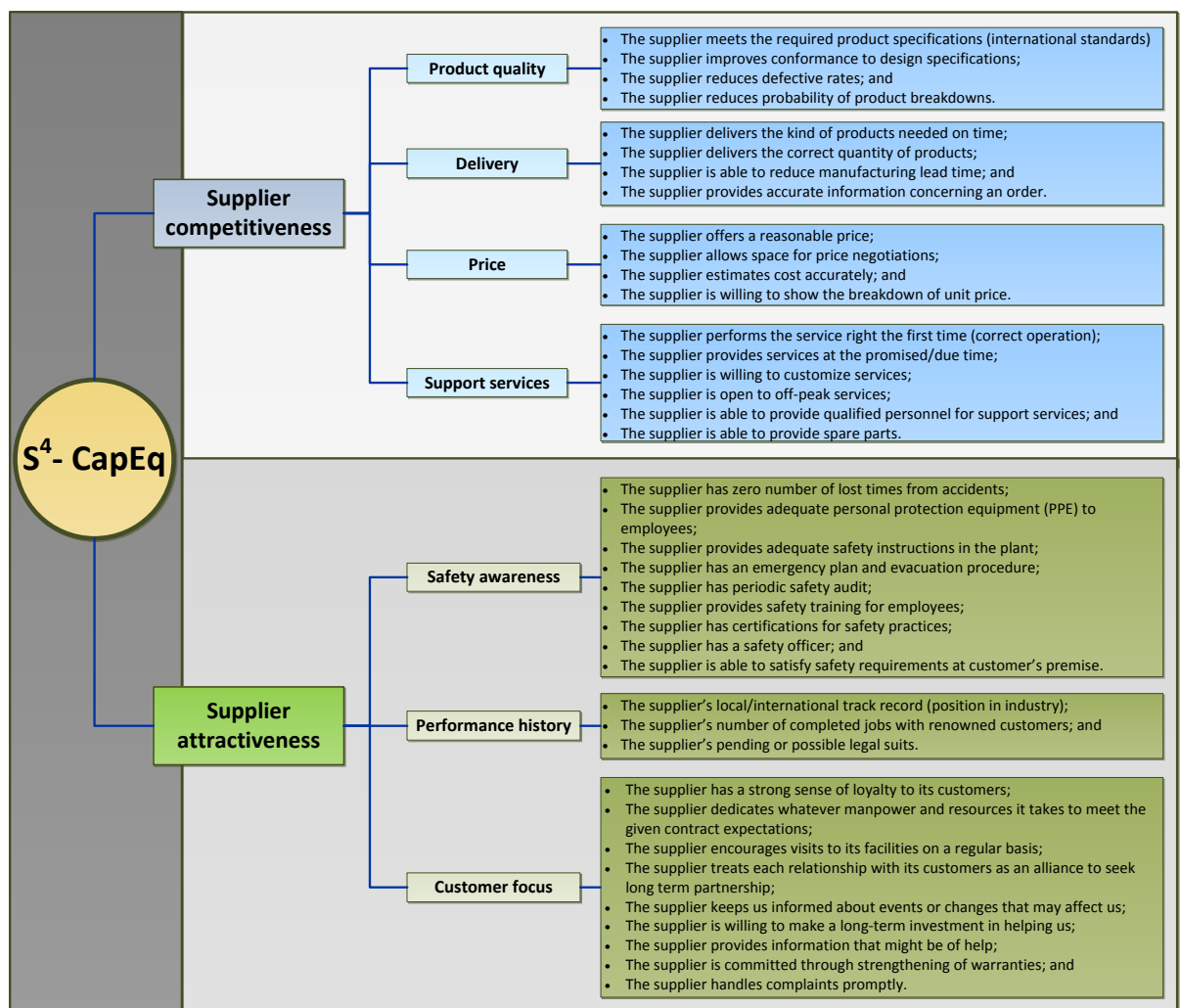
framework based on the feedback received through quantitative and qualitative approaches. However, only three metrics from supplier attractiveness have been incorporated into the framework. Although quantitative data might support the inclusion of the remaining metrics under supplier attractiveness, the viewpoints received from the qualitative approaches reflect that only safety awareness, performance history and customer focus are fit to be included in the framework. Safety awareness has been a critical issue in the electricity supply industry. Equipment which does not comply with safety requirements poses danger to human lives (employees of the power utility and consumers). Most participants expressed their frustration over the absence of tracking the suppliers past performance. This is due to the non-performers could not be penalized as they may enter bidding by registering as a new company. Therefore, due diligence is mandatory in investigating the performance history of a prospective supplier. Another metric found as vital by the participants due to equipment sustainability issues is pertaining to the element of customer focus. End users are the most affected group when suppliers neglect the after sales service. Most participants' complain that suppliers are very enthusiastic during the bidding process by promising good after sales service. However this turns out to be unimpressive following the after the award of contract. Therefore, incorporation of customer focus into the framework is essential to select an optimal supplier who could be reliable in delivering necessary assistance after commissioning of the purchased equipment.

The S<sup>4</sup> – CapEq is intended to:

- i. Provide members of DMU with a framework for making consistent strategic sourcing supplier selection decisions;
- ii. Help superiors monitor the fairness and consistency of decisions being made by DMU in line with TNB's procurement policy; and
- iii. Assist less experienced executives in making strategic sourcing supplier selection decisions.

The S<sup>4</sup> – CapEq decision-making framework could be treated as a manifestation of the rising importance for strong corporate governance in TNB. Having a set of standard organizational wide implemented metrics with corresponding definitional dimensions would promote transparency or opaqueness of supplier selection decision-making. This

in turn could increase the integrity in public procurement process which is one of the seven main agendas in the recently launched Malaysian Government Transformation Plan (GTP): fighting corruption. The  $S^4$  – CapEq would help the members of DMU to make better ethical choice through a systematic approach. More importantly, the  $S^4$  – CapEq will enable the decision-making teams to defend their decision whenever issues of integrity arise.



**Figure 5.1** Strategic Sourcing Supplier Selection for Capital Equipment ( $S^4$  – CapEq) Decision-Making Framework

Members of DMU would be able to improve the quality of their supplier selection decision-making by adopting  $S^4$  – CapEq decision-making framework. The quality of their decision will be decided by the accuracy and consistency of the decision being made. The  $S^4$  – CapEq as a set of clear, specific and comprehensive metrics and



definitional dimensions would assist to avoid any ambiguities between the members of DMU. Echoing the principles of rational decision-making, the S<sup>4</sup> – CapEq could proffer an adequate guide to effective decision-making for selecting suppliers. The S<sup>4</sup> – CapEq could minimize the complexity of selection problem as its consistent structure provides a trail how the decision was reached and what was considered. This trail is crucial if the particular decision has to be justified to the general public, stakeholders and outside interested parties. Finally, the S<sup>4</sup> – CapEq would assist a rational decision-maker to move through the dynamic process of decision-making in an orderly and disciplined manner.

Another additional feature of S<sup>4</sup> – CapEq that members of DMU can rely on when facing trade-off situation is the pair-wise comparison. The S<sup>4</sup> – CapEq decompose the strategic sourcing supplier selection decision-making problem into a hierarchy. Members of DMU could make pair-wise comparisons and establish priority among the elements in the hierarchy as illustrated from Tables 5.1 to 5.8.

i. Main metrics

Table 5.1 **Pair-wise comparison matrix for main metrics**

	a	b	c	d	e	f	g	Geometric Mean	Normalized Relative Weight
Metrics	PQ	D	P	SS	SA	PH	CF	$\sqrt[n]{a + \dots + n}$	$Wi = Gmi/Gmt$
<b>a PQ</b>	1	1.07	1.08	1.10	1.10	1.12	1.14	1.29	0.140
<b>b D</b>	0.93	1	1.01	1.03	1.03	1.05	1.07	1.31	0.142
<b>c P</b>	0.93	0.99	1	1.01	1.02	1.03	1.05	1.32	0.143
<b>d SS</b>	0.91	0.97	0.99	1	1.01	1.02	1.04	1.32	0.143
<b>e SA</b>	0.91	0.97	0.98	0.99	1	1.02	1.03	1.33	0.144
<b>f PH</b>	0.89	0.95	0.97	0.98	0.98	1	1.02	1.33	0.144
<b>g CF</b>	0.88	0.93	0.95	0.96	0.97	0.98	1	1.34	0.145
							<b>Total</b>	<b>GMt = 9.24</b>	<b>1.000</b>

Where:

PQ: Product quality

D: Delivery

P: Price

SS: Support services

SA: Safety awareness

PH: Performance history

CF: Customer focus

ii. Definitional dimensions

Table 5.2 Pair-wise comparison matrix for product quality definitional dimensions

	a	b	c	d	Geometric Mean	Normalized Relative Weight
<b>Metrics</b>	<b>PQ<sub>1</sub></b>	<b>PQ<sub>2</sub></b>	<b>PQ<sub>3</sub></b>	<b>PQ<sub>4</sub></b>	$\sqrt[4]{a + \dots + n}$	$Wi = Gmi/Gmt$
<b>a PQ<sub>1</sub></b>	1	1.03	1.05	1.05	1.40	0.248
<b>b PQ<sub>2</sub></b>	0.97	1	1.02	1.02	1.41	0.250
<b>c PQ<sub>3</sub></b>	0.95	0.98	1	1.01	1.42	0.251
<b>d PQ<sub>4</sub></b>	0.95	0.98	0.99	1	1.42	0.251
					<b>GMt = 5.65</b>	<b>1.000</b>

Where:

PQ<sub>1</sub>: The supplier meets the required product specifications (international standards)

PQ<sub>2</sub>: The supplier reduces probability of product breakdowns

PQ<sub>3</sub>: The supplier improves conformance to design specifications

PQ<sub>4</sub>: The supplier reduces defective rates

Table 5.3 Pair-wise comparison matrix for delivery definitional dimensions

	a	b	c	d	Geometric Mean	Normalized Relative Weight
<b>Metrics</b>	<b>D<sub>1</sub></b>	<b>D<sub>2</sub></b>	<b>D<sub>3</sub></b>	<b>D<sub>4</sub></b>	$\sqrt[7]{a + \dots + n}$	$Wi = Gmi/Gmt$
<b>a D<sub>1</sub></b>	1	1.01	1.06	1.09	1.40	0.247
<b>b D<sub>2</sub></b>	0.99	1	1.05	1.08	1.40	0.247
<b>c D<sub>3</sub></b>	0.94	0.95	1	1.03	1.42	0.251
<b>d D<sub>4</sub></b>	0.92	0.93	0.97	1	1.44	0.254
					<b>GMt = 5.66</b>	<b>1.000</b>

Where:

D<sub>1</sub>: The supplier delivers the correct quantity of products

D<sub>2</sub>: The supplier delivers the kind of products needed on time

D<sub>3</sub>: The supplier provides accurate information concerning an order

D<sub>4</sub>: The supplier is able to reduce manufacturing lead time

Table 5.4 Pair-wise comparison matrix for price definitional dimensions

	a	b	c	d	Geometric Mean	Normalized Relative Weight
<b>Metrics</b>	<b>P<sub>1</sub></b>	<b>P<sub>2</sub></b>	<b>P<sub>3</sub></b>	<b>P<sub>4</sub></b>	$\sqrt[4]{a + \dots + n}$	$Wi = Gmi/Gmt$
<b>a P<sub>1</sub></b>	1	1.06	1.06	1.06	1.39	0.246
<b>b P<sub>2</sub></b>	0.94	1	1.01	1.01	1.42	0.251
<b>c P<sub>3</sub></b>	0.94	0.99	1	1.01	1.42	0.251
<b>d P<sub>4</sub></b>	0.94	0.99	0.99	1	1.42	0.251
					<b>GMt = 5.65</b>	<b>1.000</b>

Where:

P<sub>1</sub>: The supplier offers a reasonable price

P<sub>2</sub>: The supplier allows space for price negotiations

P<sub>3</sub>: The supplier willing to show the breakdown of unit price

P<sub>4</sub>: The supplier estimates cost accurately

Table 5.5 Pair-wise comparison matrix for support services definitional dimensions

	a	b	c	d	e	f	Geometric Mean	Normalized Relative Weight	
Metrics	$SS_1$	$SS_2$	$SS_3$	$SS_4$	$SS_5$	$SS_6$	$\sqrt[6]{a + \dots + n}$	$Wi = Gmi/Gmt$	
<b>a</b>	$SS_1$	1	1.02	1.03	1.03	1.06	1.10	1.33	0.164
<b>b</b>	$SS_2$	0.98	1	1.01	1.01	1.04	1.08	1.34	0.166
<b>c</b>	$SS_3$	0.97	0.99	1	1.01	1.03	1.07	1.34	0.166
<b>d</b>	$SS_4$	0.97	0.99	0.99	1	1.03	1.07	1.35	0.167
<b>e</b>	$SS_5$	0.94	0.96	0.97	0.97	1	1.04	1.36	0.168
<b>f</b>	$SS_6$	0.91	0.93	0.93	0.93	0.96	1	1.37	0.169
							<b>GMt = 8.09</b>	<b>1.000</b>	

Where:

- $SS_1$ : The supplier provides services at the promised/due time  
 $SS_2$ : The supplier performs the service right the first time (correct operation)  
 $SS_3$ : The supplier is able to provide spare parts  
 $SS_4$ : The supplier is able to provide qualified personnel for support services  
 $SS_5$ : The supplier is willing to customize services  
 $SS_6$ : the supplier is open to off-peak services

Table 5.6 Pair-wise comparison matrix for safety awareness definitional dimensions

Metrics	a	b	c	d	e	f	g	h	i	Geometric Mean	Normalized Relative Weight
	SA <sub>1</sub>	SA <sub>2</sub>	SA <sub>3</sub>	SA <sub>4</sub>	SA <sub>5</sub>	SA <sub>6</sub>	SA <sub>7</sub>	SA <sub>8</sub>	SA <sub>9</sub>	$\sqrt[n]{a + \dots + n}$	$Wi = Gmi / Gmt$
<b>a SA<sub>1</sub></b>	1	1.01	1.02	1.02	1.02	1.02	1.03	1.04	1.04	1.27	0.110
<b>b SA<sub>2</sub></b>	0.99	1	1.01	1.01	1.01	1.01	1.02	1.03	1.03	1.27	0.110
<b>c SA<sub>3</sub></b>	0.98	0.99	1	1.00	1.00	1.00	1.01	1.02	1.02	1.28	0.111
<b>d SA<sub>4</sub></b>	0.98	0.99	1.00	1	1.00	1.00	1.01	1.02	1.02	1.28	0.111
<b>e SA<sub>5</sub></b>	0.98	0.99	1.00	1.00	1	1.00	1.01	1.02	1.02	1.28	0.111
<b>f SA<sub>6</sub></b>	0.98	0.99	1.00	1.00	1.00	1	1.01	1.02	1.02	1.28	0.111
<b>g SA<sub>7</sub></b>	0.97	0.98	0.99	0.99	0.99	0.99	1	1.01	1.01	1.28	0.111
<b>h SA<sub>8</sub></b>	0.96	0.97	0.98	0.98	0.98	0.98	0.99	1	1.00	1.28	0.111
<b>i SA<sub>9</sub></b>	0.96	0.97	0.98	0.98	0.98	0.98	0.99	1.00	1	1.28	0.111
<b>Total</b>										<b>GMt =</b> 11.50	1.000

Where:

SA<sub>1</sub>: The supplier is able to satisfy safety requirements at customer's premise

SA<sub>2</sub>: The supplier provides adequate personal protection equipment (PPE) to employees

SA<sub>3</sub>: The supplier has a safety officer

SA<sub>4</sub>: The supplier provides adequate safety instructions in the plant

SA<sub>5</sub>: The supplier has an emergency plan and evacuation procedure

SA<sub>6</sub>: The supplier has certifications for safety practices

SA<sub>7</sub>: The supplier provides safety training for employees

SA<sub>8</sub>: The supplier has zero number of lost times from accidents

SA<sub>9</sub>: The supplier has periodic safety audit

Table 5.7 Pair-wise comparison matrix for performance history definitional dimensions

	a	b	c	Geometric Mean	Normalized Relative Weight
Metrics	PH <sub>1</sub>	PH <sub>2</sub>	PH <sub>3</sub>	$\sqrt[3]{a + \dots + n}$	$Wi = Gmi/Gmt$
a PH <sub>1</sub>	1	1.02	1.05	1.43	0.330
b PH <sub>2</sub>	0.98	1	1.03	1.44	0.333
c PH <sub>3</sub>	0.95	0.97	1	1.46	0.337
<b>GMt = 4.33</b>					1.000

Where:

PH<sub>1</sub>: The supplier's local/international track record (position in industry)

PH<sub>2</sub>: The supplier's number of completed jobs with renowned customers

PH<sub>3</sub>: The supplier's pending or possible legal suits

Table 5.8 Pair-wise comparison matrix for customer focus definitional dimensions

	a	b	c	d	e	f	g	h	i	Geometric Mean	Normalized Relative Weight
Metrics	CF <sub>1</sub>	CF <sub>2</sub>	CF <sub>3</sub>	CF <sub>4</sub>	CF <sub>5</sub>	CF <sub>6</sub>	CF <sub>7</sub>	CF <sub>8</sub>	CF <sub>9</sub>	$\sqrt[9]{a + \dots + n}$	$Wi = Gmi/Gmt$
a CF <sub>1</sub>	1	1.01	1.02	1.02	1.05	1.05	1.05	1.06	1.08	1.27	0.110
b CF <sub>2</sub>	0.99	1	1.01	1.01	1.03	1.03	1.04	1.05	1.06	1.27	0.110
c CF <sub>3</sub>	0.98	0.99	1	1.00	1.02	1.02	1.03	1.04	1.05	1.27	0.110
d CF <sub>4</sub>	0.98	0.99	1.00	1	1.02	1.02	1.03	1.04	1.05	1.27	0.110
e CF <sub>5</sub>	0.95	0.97	0.98	0.98	1	1.00	1.00	1.02	1.03	1.28	0.111
f CF <sub>6</sub>	0.95	0.97	0.98	0.98	1.00	1	1.00	1.02	1.03	1.28	0.111
g CF <sub>7</sub>	0.95	0.96	0.97	0.97	1.00	1.00	1	1.01	1.03	1.28	0.111
h CF <sub>8</sub>	0.94	0.95	0.96	0.96	0.98	0.98	0.99	1	1.01	1.28	0.111
i CF <sub>9</sub>	0.93	0.94	0.95	0.95	0.97	0.97	0.97	0.99	1	1.33	0.115
<b>Total</b>										<b>GMt = 11.53</b>	1.000

Where:

CF<sub>1</sub>: The supplier handles complaints promptly

CF<sub>2</sub>: the supplier dedicates whatever manpower and resources it takes to meet the

given contract expectations

CF<sub>3</sub>: the supplier has a strong sense of loyalty to its customers

CF<sub>4</sub>: the supplier is committed through strengthening of warranties

CF<sub>5</sub>: the supplier provides information that might be of help

CF<sub>6</sub>: the supplier keeps us informed about events or changes that may affect us

CF<sub>7</sub>: the supplier treats each relationship with its customers as an alliance to seek long term partnership

CF<sub>8</sub>: the supplier is willing to make a long-term investment in helping us

CF<sub>9</sub>: the supplier encourages visits to its facilities on a regular basis

## 5.10 An Outline of the Response to the Research Objectives

Sections 5.4 to 5.9 discussed the research objectives individually. To obtain a clear and unambiguous view of how these objectives were addressed in this thesis an overview is particularly useful. Table 5.9 provides an outline of the response and overall evaluation of the research objectives.

**Table 5.9 Review and evaluation of research objectives**

	Objectives	Response
1	<i>To understand the supplier selection process in TNB. This will involve an in-depth analysis on the current practices of strategic sourcing evaluation and decision-making process stretching from strategic sourcing opportunity identification and appraisal to decision making and implementation of strategic sourcing supplier selection decisions.</i>	The thesis examined and established the need to have standard strategic sourcing supplier selection metrics and corresponding definitional dimensions in TNB.
2	<i>To establish that the two proposed constructs (Supplier Competitiveness and Supplier Attractiveness) statistically distinct from one another as determined by an unconstrained factor analysis. The nature of the situation particularly in TNB where is no clear standard metrics for strategic sourcing</i>	The thesis verified the strategic sourcing supplier selection metrics could be categorized into two separate constructs namely supplier competitiveness and supplier attractiveness.

	<i>supplier selection necessitated a need to figure out a constructive way of representing the identified eighteen metrics in a multiple perspective format.</i>	
3	<i>To measure the degree of importance the key stakeholders' (initiators, influencers, decision-makers, buyers and users) place on each metric for decision support in strategic sourcing supplier selection. The researcher sought to explore if and to what extent, the shortlisted eighteen metrics influence or determine the strategic sourcing supplier selection. Therefore this research will help to understand the successful ingredients of strategic sourcing supplier selection practices and decision-making process in the electricity supply industry with primary focus on the factors that influence the process of decision making to purchase capital equipment.</i>	The thesis measured the degree of importance the key stakeholders place on each metric for strategic sourcing supplier selection.
4	<i>To identify whether the metrics differ among initiators, influencers, decision-makers, buyers and users since there is limited knowledge available on this subject area and no baseline of current use of these metrics, as well as evaluation of their impacts on intended decision outcomes exist.</i>	The thesis identified the differences in the metrics among the key stakeholders.
5	<i>To provide the key stakeholders' perceptions on the definitional dimensions of each of the top metric for strategic sourcing supplier selection. In this exploratory study, the researcher will take a holistic view of the subject area, gathering as much information as possible before deciding which definitional dimension is important and which definitional dimension can be discarded concerning each of the top metric.</i>	The thesis provided the definitional dimensions for each of the important metric for strategic sourcing supplier selection.



6	<i>To develop a framework for a strategic sourcing supplier selection for capital equipment decision making. The current goal is to expose and solve the current problem so as to help key stakeholders improve the strategic sourcing supplier selection practices and decision making process within their organization.</i>	This thesis developed a decision-making framework bespoke for the strategic sourcing supplier selection of capital equipment in the ESI.
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### 5.11 Summary

Chapter 5 discussed the findings of the study in accordance with the research objectives. This facilitated the incorporation of quantitative and qualitative information obtained throughout the conduct of this research. The chapter concluded with a review and evaluation of the research objectives which demonstrated that these have been addressed sufficiently. A summary of key findings will be provided in the following chapter which will also draw the conclusions and recommendations of this research.

# Chapter 6

## Conclusions and Recommendations

### 6.1 Introduction

The aim of this chapter is to conclude the study on strategic sourcing supplier selection for capital equipment within the context of the ESI. The chapter begins with a critical overview of the research elements. This is followed by a summary of the research findings and the study's contribution to knowledge. The thesis finishes by considering recommendations for the ESI and suggestions for further research.

### 6.2 Research Overview

The Malaysian ESI plays an indispensable role both directly and indirectly in the nation's economic growth. While the ESI has a huge contribution to make to the Malaysian aspiration of becoming a developed country by 2020, the industry is going through a major transformation. Deregulation as being practiced by developed countries is taking place gradually in Malaysia. The restructuring of the electricity industry leads to the unbundling of existing vertically integrated electricity utility companies. Therefore the major business player in the ESI, Tenaga Nasional Berhad is in a transition phase. TNB is facing a significant challenge from IPPs, and no longer has the monopoly it has held for almost half a century.

Notwithstanding the current situation of being in a competitive market, TNB is also the power purchasing agency appointed by the government. TNB is bound by the PPA to buy electricity from IPPs at a fixed price based on separate capacity and energy rates.

This has been seen as bleeding TNB financially due to the nature of the agreement being endorsed which favour the IPPs. TNB has to comply with the “take or pay” conditions for 21 years. The creation of huge power reserves from the operations of IPPs has been a great disadvantage to TNB as it has to pay for something which is not needed. Apart from that, the escalation of fuel prices worsened the financial situation of TNB. Since TNB is constrained by statute, it is unable to pass any additional costs incurred to its consumers because of government fixing the selling price of electricity.

Given that Malaysia is currently undergoing reformation of its ESI into more effective, transparent and competitive electricity trading market, it would seem apparent that TNB is forced to take advantage of any opportunity to optimize its business processes. Efforts must be made from within the organization to provide cost savings which can offset the aforementioned perceived detrimental effects. Moreover, with the intense competition from new players in ESI, TNB as a Government-Linked Company (GLC) is expected by the government to provide continuous and efficient power supply for the whole nation. Revisiting TNB’s strategic sourcing supplier selection process could provide an avenue to improve its operational and financial performance.

### **6.3 Research Problems, Questions and Objectives**

Despite the pivotal role of strategic sourcing within SCM, until the research detailed in this thesis little work has been conducted to determine the appropriate strategic sourcing supplier selection metrics in the electricity industry supply chain. The actual underlying constructs of strategic sourcing supplier selection for ESI capital equipment has rarely been addressed and little is understood.

- i. Currently, there is an absence of defined metrics and definitional dimensions for strategic sourcing supplier selection for TNB.
- ii. Currently, there is an absence of an appropriate decision-making framework for strategic sourcing supplier selection in TNB.

From the problems stated above, the following research questions arose:

- i. What is the supplier selection process in TNB?
- ii. To what extent are the two proposed constructs (Supplier Competitiveness and Supplier Attractiveness) statistically distinct from one another as determined by factor analysis?
- iii. What degree of importance do the key stakeholders' (initiators, influencers, decision-makers, buyers and users) place on each metric for decision support in strategic sourcing supplier selection?
- iv. How do the metrics differ among initiators, influencers, decision-makers, buyers and users?
- v. What are the key stakeholders' perceptions on definitional dimensions of each of the top metric for strategic sourcing supplier selection?
- vi. What is the appropriate tool to assist a strategic sourcing supplier selection for capital equipment decision making?

The aim of this research was to investigate the perceptions of key stakeholders' within one company in the ESI in terms of appropriate strategic sourcing supplier selection metrics and corresponding definitional dimensions, and therefore is intended to develop a suitable strategic sourcing supplier selection decision-making framework so as to enable supply chain performance improvement. To achieve this, and to give direction to the research, the objectives were formulated. The formulated objectives for this thesis were stated as follows:

- i. To understand the supplier selection process in TNB. This will involve an in-depth analysis on the current practices of strategic sourcing evaluation and decision-making process stretching from strategic sourcing opportunity identification and appraisal to decision making and implementation of strategic sourcing supplier selection decisions.
- ii. To establish that the two proposed constructs (Supplier Competitiveness and Supplier Attractiveness) statistically distinct from one another as determined by an unconstrained factor analysis. The nature of the situation particularly in TNB where is no clear standard metrics for strategic sourcing supplier selection necessitated a need to figure out a constructive way of representing the identified eighteen metrics in a multiple perspective format.

- iii. To measure the degree of importance the key stakeholders' (initiators, influencers, decision-makers, buyers and users) place on each metric for decision support in strategic sourcing supplier selection. The researcher sought to explore if and to what extent, the shortlisted eighteen metrics influence or determine the strategic sourcing supplier selection. Therefore this research will help to understand the successful ingredients of strategic sourcing supplier selection practices and decision-making process in the electricity supply industry with primary focus on the factors that influence the process of decision making to purchase capital equipment.
- iv. To identify whether the metrics differ among initiators, influencers, decision-makers, buyers and users since there is limited knowledge available on this subject area and no baseline of current use of these metrics, as well as evaluation of their impacts on intended decision outcomes exist.
- v. To provide the key stakeholders' perceptions on the definitional dimensions of each of the top metric for strategic sourcing supplier selection. In this exploratory study, the researcher will take a holistic view of the subject area, gathering as much information as possible before deciding which definitional dimension is important and which definitional dimension can be discarded concerning each of the top metric.
- vi. To develop a framework for a strategic sourcing supplier selection for capital equipment decision making. The current goal is to expose and solve the current problem so as to help key stakeholders improve the strategic sourcing supplier selection practices and decision making process within their organization

## **6.4 Methodological Framework**

The methodological approach adopted in this thesis was determined by the nature of the research problem and objectives of the study. Thus, chapter 3 included an analysis of the issue of strategic sourcing supplier selection in the ESI can be described as generic, quantifiable and complex. This was followed by a philosophical analysis of the problem according to epistemological, ontological, axiological and rhetorical beliefs that underlie the adopted approach. The outcome established the objectives of the research supported by a mixed-methods approach which in turn, called for the collection of both quantitative-qualitative data. However, it was also established that the research methods

to be employed should allow for a deep understanding the behaviours and attitudes of individuals when they are faced with decision-making that might be applicable to strategic sourcing decision-making process especially in the ESI. These requirements, together with the research objectives, dictated the data collection and analysis methods which could enable to capture the perceptions of executives' in TNB on appropriate strategic sourcing supplier selection metrics and their corresponding definitional dimensions. Respectively, these were facilitated by a concurrent qualitative-quantitative triangulation approach to the research study was considered the most appropriate method: a type of design in which different but complementary data were collected on the same subject.

In order to satisfy the requirement for an objective understanding of reality, the quantitative portion, in the form of a questionnaire, addressed key stakeholders' perceptions of the supplier selection metrics and definitions. Concurrent with this data collection, the qualitative portion of the study facilitates the study in greater depth. The data collection method provided information related to:

- i. Current supplier selection practice in TNB.
- ii. Perceived importance of appropriate strategic sourcing supplier selection metrics.
- iii. Perceived importance of appropriate definitional dimensions to accompany the suggested strategic sourcing supplier selection metrics.

The required data was collected following a purposive sampling strategy. This strategy was adopted as it selects especially informative participants that are representative of the wider phenomenon being studied. Purposive sampling was appropriate in the context of this study, since it fits the purpose, budget and timeframe of this study. The research participants were able to supply information on their perceptions of suitable supplier selection metrics and corresponding definitional dimensions for capital equipment purchase under strategic sourcing initiatives.

The above framework defined an overall approach that this study utilized in order to address the research problem – according to the researcher – most effectively. However, to facilitate a better insight into the quality and significance of the research findings, it would be appropriate not to neglect the limitations of this approach as noted in section 3.13.

## 6.5 Summary of Key Research Findings

Sections 6.5.1 to 6.5.6 list the key findings of this research in accordance with the thesis response to the research objectives.

### 6.5.1 Research Objective 1

*To understand the supplier selection process in TNB. This will involve an in-depth analysis on the current practices of strategic sourcing evaluation and decision-making process stretching from strategic sourcing opportunity identification and appraisal to decision making and implementation of strategic sourcing supplier selection decisions.*

Key findings included:

- i. TNB's performance in strategic sourcing supplier selection decision-making has been rated as *average* by its executives. This can be perceived as a negative perception on the organizational judgment in supplier selection;
- ii. There is no proper guideline on supplier selection metrics;
- iii. Each proposed metric is subject to individual interpretation;
- iv. There is no consistency in applying standard metrics within the divisions and across the organization; and
- v. The lacking of current policy to promote corporate governance which has to be bounded by rational and unbiased decision-making for strategic sourcing supplier selection.

### 6.5.2 Research Objective 2

*To establish that the two proposed constructs (Supplier Competitiveness and Supplier Attractiveness) statistically distinct from one another as determined by an unconstrained factor analysis. The nature of the situation particularly in TNB where is no clear standard metrics for strategic sourcing supplier selection necessitated a need to figure out a constructive way of representing the identified eighteen metrics in a multiple perspective format.*

The unconstrained factor analysis revealed the following key findings:

- i. The current study group's strategic sourcing supplier selection metrics together in a different way than has been done in other non-electricity related industries.
- ii. The executives in TNB tend to categorize QMS, CSR, management and organization, employee training and development, product innovation, environmental attributes, ICT, financial performance, production system, safety awareness, customer training, customer focus, flexibility and performance history under one component which resembles supplier attractiveness. This component could be aligned to TNB's undefined "preferred metrics".
- iii. The executives in TNB tend to categorize product quality, delivery, price and support services under one component which resembles supplier competitiveness. This component could be aligned to TNB's undefined "mandatory metrics".

### **6.5.3 Research Objective 3**

*To measure the degree of importance the key stakeholders' (initiators, influencers, decision-makers, buyers and users) place on each metric for decision support in strategic sourcing supplier selection. The researcher sought to explore if and to what extent, the shortlisted eighteen metrics influence or determine the strategic sourcing supplier selection. Therefore this research will help to understand the successful ingredients of strategic sourcing supplier selection practices and decision-making process in the electricity supply industry with primary focus on the factors that influence the process of decision making to purchase capital equipment.*

The principal findings can be stated as follows:

- i. The nature of strategic sourcing supplier selection for capital equipment in the ESI was found to be highly influenced by seven top metrics: product quality, delivery, price, support services, safety awareness, performance history and customers focus (listed in order of importance).
- ii. Other metrics taken into consideration when assessing suppliers under strategic sourcing initiatives: financial performance, customer training, environmental attributes, QMS, employee training and development, production system, flexibility, management and organization as well as product innovation and ICT listed in order of importance.
- iii. The executives in TNB do not consider CSR as important as other metrics and was



ranked the last.

#### **6.5.4 Research Objective 4**

*To identify whether the metrics differ among initiators, influencers, decision-makers, buyers and users since there is limited knowledge available on this subject area and no baseline of current use of these metrics, as well as evaluation of their impacts on intended decision outcomes exist.*

The findings included:

- i. The list of metrics for initiators, influencers, decision-makers, buyers and users would be the same.
- ii. Their prioritization of these metrics on that list was stakeholder specific based on each stakeholder's view and the requirements of their job.
- iii. Influencer, decision-maker, buyer and user share the same opinion on the selected seven top metrics with different ranking order.
- iv. Initiator has a slight different preference as customer focus was not chosen to be one of the seven top metrics. However, priority was given to environmental attributes.

#### **6.5.5 Research Objective 5**

*To provide the key stakeholders' perceptions on the definitional dimensions of each of the top metric for strategic sourcing supplier selection. In this exploratory study, the researcher will take a holistic view of the subject area, gathering as much information as possible before deciding which definitional dimension is important and which definitional dimension can be discarded concerning each of the top metric.*

The principal findings can be stated as follows:

- i. The accepted four definitional dimensions used by the key stakeholders to define the product quality metric:
  - The supplier meets the required product specifications (international standards);
  - The supplier improves conformance to design specifications;
  - The supplier reduces defective rates; and
  - The supplier reduces probability of product breakdowns.
- ii. The four accepted definitional dimensions to define delivery metric are:

- The supplier delivers the kind of products needed on time;
  - The supplier delivers the correct quantity of products;
  - The supplier is able to reduce manufacturing lead time; and
  - The supplier provides accurate information concerning an order.
- iii. The four accepted definitional dimensions used by the key stakeholders to define the price metric are:
- The supplier offers a reasonable price;
  - The supplier allows space for price negotiations;
  - The supplier estimates cost accurately; and
  - The supplier is willing to show the breakdown of unit price.
- iv. The six accepted definitional dimensions used by the key stakeholders to define the support services metric are:
- The supplier performs the service right the first time (correct operation);
  - The supplier provides services at the promised/due time;
  - The supplier is willing to customize services;
  - The supplier is open to off-peak services;
  - The supplier is able to provide qualified personnel for support services; and
  - The supplier is able to provide spare parts.
- v. The nine accepted definitional dimensions used by the key stakeholders to define the safety awareness metric are:
- The supplier has zero number of lost times from accidents;
  - The supplier provides adequate personal protection equipment (PPE) to employees;
  - The supplier provides adequate safety instructions in the plant;
  - The supplier has an emergency plan and evacuation procedure;
  - The supplier has periodic safety audit;
  - The supplier provides safety training for employees;
  - The supplier has certifications for safety practices;
  - The supplier has a safety officer; and
  - The supplier is able to satisfy safety requirements at customer's premise.
- vi. The three accepted definitional dimensions used by the key stakeholders to define the performance history metric are:

- The supplier's local/international track record (position in industry);
  - The supplier's number of completed jobs with renowned customers; and
  - The supplier's pending or possible legal suits.
- vii. The nine accepted definitional dimensions used by the key stakeholders to define the customer focus metric are:
- The supplier has a strong sense of loyalty to its customers;
  - The supplier dedicates whatever manpower and resources it takes to meet the given contract expectations;
  - The supplier encourages visits to its facilities on a regular basis;
  - The supplier treats each relationship with its customers as an alliance to seek long term partnership;
  - The supplier keeps us informed about events or changes that may affect us;
  - The supplier is willing to make a long-term investment in helping us;
  - The supplier provides information that might be of help;
  - The supplier is committed through strengthening of warranties; and
  - The supplier handles complaints promptly.

### **6.5.6 Research Objective 6**

*To develop a framework for a strategic sourcing supplier selection for capital equipment decision making. The current goal is to expose and solve the current problem so as to help key stakeholders improve the strategic sourcing supplier selection practices and decision making process within their organization.*

The framework:

- i. Considers seven top metrics (four metrics from supplier competitiveness component and three metrics from supplier attractiveness component).
- ii. Allows members of DMU to make consistent strategic sourcing supplier selection decisions.
- iii. Assist top management in monitoring the fairness and consistency of decisions being made by DMU in line with TNB's procurement policy.
- iv. Help less experienced executives in making strategic sourcing supplier selection decisions.

## **6.6 Contributions of the Research**

Bearing in mind the identified practical dimensions of the problem, as well as the existing gap in the literature in terms of strategic sourcing supplier selection in the ESI, this research has made the contributions described in section 6.6.1 to 6.6.2.

### **6.6.1 Research Contribution to Practice**

The research results contributed to the body of knowledge related to supplier selection and therefore practice in the following manner:

- i. The research results provided a general overview of strategic sourcing supplier selection evaluation practices and decision-making within the host organization, TNB.
- ii. The results provided a better understanding of the appropriate determinants in strategic sourcing supplier selection decision-making process for capital equipment in the ESI.
- iii. The results provided insights into the interactions between key stakeholders during strategic sourcing supplier selection decision-making process for capital equipment in the ESI.
- iv. It also identifies a framework or process for better strategic sourcing supplier selection decision-making process for capital equipment in the ESI.

### **6.6.2 Research Contribution to Knowledge**

The results of this research contribute to the SCM body of knowledge in the following ways:

- i. The results identified gaps in existing literature regarding the systematic approach in strategic sourcing supplier selection decision-making for capital equipment in the ESI.
- ii. The research also exposed the behaviour of key stakeholders during strategic sourcing supplier selection decision-making process for capital equipment in the ESI.
- iii. The research proposed a framework or process for better strategic sourcing supplier selection decision-making process for capital equipment in the ESI.

## 6.7 Recommendations

The process of the research and its findings has been substantial for the researcher. Extensive findings and recommendations for the Malaysian ESI have been developed. Their impact in the country is expected to be significant. It is anticipated that the research detailed herein will significantly inform policy formulation in the Malaysian ESI – in particular with TNB. The specific recommendations are embodied in both procedural and research based recommendations. In particular:-

- i. The primary focus of this research work was on influences of appropriate supplier selection metrics and definitional dimensions with respect to the initiators, influencers, decision-makers, buyers and users. Further research efforts can investigate the influences with respect to the between company board members and management executives.
- ii. It was recognized from this research work that key stakeholders play important role in strategic sourcing supplier selection decision-making. The key stakeholders composed of three main different ethnics in Malaysia, namely Malay, Chinese and Indian. Therefore the decision-making process could be highly influenced by strong cultural biases. Future research can investigate in-depth, to establish to what extent cultural biases are involved in strategic sourcing supplier selection decision-making.
- iii. Players in the Malaysian ESI have to develop and implement procurement policies which incorporate the selection of suppliers under strategic sourcing based on supplier competitiveness and supplier attractiveness components. The implications of this would incur an additional provision of organizational operating budget to support such initiatives.
- iv. There is an opportunity to develop a propriety piece of software or web-based interface based on the proposed framework. The selection metrics, definitional dimensions and pair-wise matrices can be implemented as an integrated, yet customizable software package. This would make it easier to use and could be instrumental in bringing the framework to a wider audience.
- v. To test and implement the proposed strategic sourcing supplier selection decision-making framework in different industries other than ESI as well as testing and implementing it in different countries and cultural setting.

- vi. Current study looked at only one side of the buyer-supplier dyad, i.e. buying organization's participants' perceptions. A dyadic study of TNB as the buying organization and its suppliers would provide balance and insight into how suppliers perceive strategic sourcing supplier selection metrics and corresponding definitional dimensions.

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# Appendix 1

## Breakdown of supplier selection attributes considered between 2001-2012

Criteria	Number of articles	Authors
Quality	47	Krause et al. (2001); Lee et al. (2001); Narasimhan et al. (2001); Bhutta and Huq (2002); Kannan and Tan (2002); Simpson et al. (2002); Bharadwaj (2003); Chan (2003); Choy and Lee (2003); Humphreys et al. (2003a); Shahadat (2003); Chan and Chan (2004); Hong et al. (2005); Kumar et al. (2005); Lasch and Janker (2005); Ndubisi et al. (2005); Pi and Low (2005); Teng and Jaramillo (2005); Hsu et al. (2006); Kannan and Tan (2006); Sarkar and Mohapatra (2006); El-Sawalhi et al. (2007); Florez-Lopez (2007); Ho et al. (2007); Wadhwa and Ravindran (2007); Xia and Wu (2007); Tahriri et al. (2008); Vahdani et al. (2008); Aretoulis et al. (2009); Inemek and Tuna (2009); Kasirian and Yusuff (2009); Kumar et al. (2009); Ordoobadi (2009); Thanaraksakul and Phruksaphanrat (2009); Ho et al. (2010); Kang and Lee (2010); Park et al. (2010); Azadnia et al. (2011); Dogan and Aydin (2011); Labib (2011); Chen (2012); Soroor et al. (2012); Lin (2012); Golmohammadi and Mellat-Parast (2012); Kermani et al. (2012); Khaleie et al. (2012); Chen and Chao (2012);
Delivery	47	Krause et al. (2001); Lee et al. (2001); Narasimhan et al. (2001); Kannan and Tan (2002); Simpson et al. (2002); Barla (2003); Bharadwaj (2003); Choy and Lee (2003); Humphreys et al. (2003a); Shahadat (2003); Chan and Chan (2004); Hong et al. (2005); Kumar et al. (2005); Lasch and Janker (2005); Ndubisi et al. (2005); Pi and Low (2005); Teng and Jaramillo (2005); Hsu et al. (2006); Kannan and Tan (2006); Sarkar and Mohapatra (2006); Florez-Lopez (2007); Ho et al. (2007); Huang and Keskar (2007); Wadhwa and Ravindran (2007); Xia and Wu (2007); Tahriri et al. (2008); Aretoulis et al. (2009); Inemek and Tuna

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		(2009); Kasirian and Yusuff (2009); Kumar et al. (2009); Ordoobadi (2009); Thanaraksakul and Phruksaphanrat (2009); Ho et al. (2010); Kang and Lee (2010); Park et al. (2010); Wu and Weng (2010); Azadnia et al. (2011); Chen (2011); Dogan and Aydin (2011); Ertay et al. (2011); Labib (2011); Soroor et al. (2012); Lin (2012); Golmohammadi and Mellat-Parast (2012); Kermani et al. (2012); Khaleie et al. (2012); Chen and Chao (2012);
<b>Performance history</b>	10	Kannan and Tan (2002); Chan (2003); Shahadat (2003); Hsu et al. (2006); El-Sawalhi et al. (2007); Tahriri et al. (2008); Kasirian and Yusuff (2009); Kumar et al. (2009); Thanaraksakul and Phruksaphanrat (2009); Watt et al. (2010)
<b>Warranties and claim policies</b>	5	Simpson et al. (2002); Shahadat (2003); Xia and Wu (2007); Tahriri et al. (2008); Thanaraksakul and Phruksaphanrat (2009)
<b>Production facilities and capacity</b>	25	Humphreys et al. (2001); Lee et al. (2001); Bhutta and Huq (2002); Simpson et al. (2002); Chan (2003); Choy and Lee (2003); Humphreys et al. (2003b); Hsu et al. (2006); Kannan and Tan (2006); Sarkar and Mohapatra (2006); El-Sawalhi et al. (2007); Ho et al. (2007); Huang and Keskar (2007); Xia and Wu (2007); Tahriri et al. (2008); Inemek and Tuna (2009); Kasirian and Yusuff (2009); Thanaraksakul and Phruksaphanrat (2009); Ho et al. (2010); Kang and Lee (2010); Ertay et al. (2011); Chen (2012); Soroor et al. (2012); Vahdani et al. (2012); Chen and Chao (2012)
<b>Price</b>	47	Humphreys et al. (2001); Krause et al. (2001); Bevilacqua and Petroni (2002); Kannan and Tan (2002); Simpson et al. (2002); Barla (2003); Bharadwaj (2003); Chan (2003); Choy and Lee (2003); Humphreys et al. (2003b); Shahadat (2003); Chan and Chan (2004); Hong et al. (2005); Lasch and Janker (2005); Ndubisi et al. (2005); Pi and Low (2005); Teng and Jaramillo (2005); Hsu et al. (2006); Sarkar and Mohapatra (2006); Florez-Lopez (2007); Ho et al. (2007); Huang and Keskar (2007); Wadhwa and Ravindran (2007); Xia and Wu (2007); Tahriri et al. (2008); Vahdani et al. (2008); Aretoulis et al. (2009); Inemek and Tuna (2009); Kasirian and Yusuff (2009); Kumar et al. (2009); Ordoobadi (2009); Thanaraksakul and Phruksaphanrat (2009); Ho et al. (2010); Kang and Lee (2010); Park et al. (2010); Watt et al. (2010); Wu and Weng (2010); Azadnia et al. (2011); Dogan and Aydin (2011); Ertay et al. (2011); Labib (2011); Chen (2012); Soroor et al. (2012); Lin (2012); Golmohammadi and Mellat-Parast (2012); Kermani et al. (2012); Khaleie et al. (2012); Chen and Chao (2012);
<b>Technical capability</b>	32	Lee et al. (2001); Narasimhan et al. (2001); Bevilacqua and Petroni (2002); Kannan and Tan (2002); Simpson et al.

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		(2002); Barla (2003); Chan (2003); Humphreys et al. (2003b); Shahadat (2003); Ndubisi et al. (2005); Kannan and Tan (2006); El-Sawalhi et al. (2007); Ho et al. (2007); Xia and Wu (2007); Tahriri et al. (2008); Vahdani et al. (2008); Aretoulis et al. (2009); Inemek and Tuna (2009); Thanaraksakul and Phruksaphanrat (2009); Ho et al. (2010); Kang and Lee (2010); Park et al. (2010); Watt et al. (2010); Wu and Weng (2010); Azadnia et al. (2011); Dogan and Aydin (2011); Büyüközkan & Çifçi (2012); Chen (2012); Soroor et al. (2012); Vahdani et al. (2012); Khaleie et al. (2012); Chen and Chao (2012)
<b>Financial position</b>	23	Humphreys et al. (2001); Lee et al. (2001); Bevilacqua and Petroni (2002); Kannan and Tan (2002); Simpson et al. (2002); Barla (2003); Chan (2003); Choy and Lee (2003); Humphreys et al. (2003b); Hong et al. (2005); Hsu et al. (2006); Sarkar and Mohapatra (2006); El-Sawalhi et al. (2007); Inemek and Tuna (2009); Thanaraksakul and Phruksaphanrat (2009); Ho et al. (2010); Wu and Weng (2010); Büyüközkan & Çifçi (2012); Dogan and Aydin (2011); Ertay et al. (2011); Vahdani et al. (2012); Li et al. (2012); Chen and Chao (2012)
<b>Procedural compliance</b>	Nil	-
<b>Communication system</b>	7	Humphreys et al. (2001); Kannan and Tan (2002); Humphreys et al. (2003b); Shahadat (2003); Sarkar and Mohapatra (2006); Ho et al. (2007); Thanaraksakul and Phruksaphanrat (2009)
<b>Reputation and position in industry</b>	8	Shahadat (2003); Hsu et al. (2006); Sarkar and Mohapatra (2006); Ho et al. (2007); Kasirian and Yusuff (2009); Thanaraksakul and Phruksaphanrat (2009); Ho et al. (2010); Watt et al. (2010)
<b>Desire for business</b>	3	Shahadat (2003); Thanaraksakul and Phruksaphanrat (2009); Li et al. (2012)
<b>Management and organization</b>	30	Humphreys et al. (2001); Narasimhan et al. (2001); Bevilacqua and Petroni (2002); Kannan and Tan (2002); Simpson et al. (2002); Barla (2003); Chan (2003); Choy and Lee (2003); Humphreys et al. (2003b); Shahadat (2003); Hsu et al. (2006); Sarkar and Mohapatra (2006); El-Sawalhi et al. (2007); Ho et al. (2007); Tahriri et al. (2008); Aretoulis et al. (2009); Inemek and Tuna (2009); Thanaraksakul and Phruksaphanrat (2009); Ho et al. (2010); Park et al. (2010); Watt et al. (2010); Wu and Weng (2010); Dogan and Aydin (2011); Ertay et al. (2011); Büyüközkan & Çifçi (2012); Chen (2012); Soroor et al. (2012); Li et al. (2012); Khaleie et al. (2012); Chen and Chao (2012)
<b>Operating controls</b>	Nil	-
<b>Repair service</b>	17	Bevilacqua and Petroni (2002); Bhutta and Huq (2002);

		Kannan and Tan (2002); Bharadwaj (2003); Choy and Lee (2003); Florez-Lopez (2007); Xia and Wu (2007); Ho et al. (2007); Kasirian and Yusuff (2009); Thanaraksakul and Phruksaphanrat (2009); Ho et al. (2010); Labib (2011); Büyüközkan & Çifçi (2012); Chen (2012); Soroor et al. (2012); Vahdani et al. (2012); Li et al. (2012)
<b>Attitude</b>	6	Shahadat (2003); Sarkar and Mohapatra (2006); Ho et al. (2007); Vahdani et al. (2008); Kumar et al. (2009); Thanaraksakul and Phruksaphanrat (2009)
<b>Impression</b>	4	Hong et al. (2005); Ho et al. (2007); Thanaraksakul and Phruksaphanrat (2009); Wu and Weng (2010)
<b>Packaging ability</b>	5	Humphreys et al. (2001); Simpson et al. (2002); Humphreys et al. (2003b); Thanaraksakul and Phruksaphanrat (2009); Vahdani et al. (2012)
<b>Labour relations record</b>	6	Humphreys et al. (2001); Simpson et al. (2002); Choy and Lee (2003); Humphreys et al. (2003b); Sarkar and Mohapatra (2006); Thanaraksakul and Phruksaphanrat (2009)
<b>Geographical location</b>	12	Humphreys et al. (2001); Bevilacqua and Petroni (2002); Kannan and Tan (2002); Simpson et al. (2002); Barla (2003); Humphreys et al. (2003b); Hsu et al. (2006); Sarkar and Mohapatra (2006); Ho et al. (2007); Kasirian and Yusuff (2009); Kumar et al. (2009); Thanaraksakul and Phruksaphanrat (2009)
<b>Amount of past business</b>	2	El-Sawalhi et al. (2007); Thanaraksakul and Phruksaphanrat (2009)
<b>Training aids</b>	Nil	-
<b>Reciprocal arrangements</b>	Nil	-
<b>Reliability</b>	13	Shahadat (2003); Teng and Jaramillo (2005); Florez-Lopez (2007); Xia and Wu (2007); Aretoulis et al. (2009); Inemek and Tuna (2009); Kasirian and Yusuff (2009); Kumar et al. (2009); Ordoobadi (2009); Thanaraksakul and Phruksaphanrat (2009); Ertay et al. (2011); Chen and Chao (2012)
<b>Flexibility</b>	23	Humphreys et al. (2001); Krause et al. (2001); Narasimhan et al. (2001); Bevilacqua and Petroni (2002); Kannan and Tan (2002); Humphreys et al. (2003b); Shahadat (2003); Chan and Chan (2004); Teng and Jaramillo (2005); Hsu et al. (2006); Ho et al. (2007); Huang and Keskar (2007); Vahdani et al. (2008); Kasirian and Yusuff (2009); Kumar et al. (2009); Thanaraksakul and Phruksaphanrat (2009); Ho et al. (2010); Kang and Lee (2010); Wu and Weng (2010); Dogan and Aydin (2011); Ertay et al. (2011); Lin (2012);




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		Chen and Chao (2012)
<b>Process improvement</b>	15	Humphreys et al. (2001); Narasimhan et al. (2001); Bevilacqua and Petroni (2002); Kannan and Tan (2002); Simpson et al. (2002); Kumar et al. (2005); Sarkar and Mohapatra (2006); Ho et al. (2007); Inemek and Tuna (2009); Kumar et al. (2009); Thanaraksakul and Phruksaphanrat (2009); Wu and Weng (2010); Ertay et al. (2011); Vahdani et al. (2012); Chen and Chao (2012)
<b>Product development</b>	19	Humphreys et al. (2001); Krause et al. (2001); Lee et al. (2001); Narasimhan et al. (2001); Bhutta and Huq (2002); Simpson et al. (2002); Kannan and Tan (2002); Bharadwaj (2003); Chan (2003); Choy and Lee (2003); Shahadat (2003); Chan and Chan (2004); Hsu et al. (2006); Kannan and Tan (2006); Florez-Lopez (2007); Ho et al. (2007); Ordoobadi (2009); Thanaraksakul and Phruksaphanrat (2009); Ho et al. (2010)
<b>Environmental and social responsibility</b>	11	Humphreys et al. (2001); Humphreys et al. (2003a); Humphreys et al. (2003b); Ho et al. (2007); Huang and Keskar (2007); Tahriri et al. (2008); Thanaraksakul and Phruksaphanrat (2009); Bai and Sarkis (2010); Ho et al. (2010); Ertay et al. (2011); Büyüközkan & Çifçi (2012)
<b>Occupational safety and health</b>	4	El-Sawalhi et al. (2007); Huang and Keskar (2007); Thanaraksakul and Phruksaphanrat (2009); Ho et al. (2010)
<b>Integrity</b>	5	Kannan and Tan (2002); Hsu et al. (2006); Ho et al. (2007); Tahriri et al. (2008); Inemek and Tuna (2009); Thanaraksakul and Phruksaphanrat (2009)
<b>Professionalism</b>	4	Simpson et al. (2002); Pi and Low (2005); Kasirian and Yusuff (2009); Thanaraksakul and Phruksaphanrat (2009)
<b>JIT</b>	4	Humphreys et al. (2001); Bevilacqua and Petroni (2002); Kannan and Tan (2002); Ho et al. (2007)
<b>Commitment</b>	9	Lee et al. (2001); Kannan and Tan (2002); Chan (2003); Chan and Chan (2004); Hsu et al. (2006); Ho et al. (2007); Aretoulis et al. (2009); Inemek and Tuna (2009); Park et al. (2010)
<b>Economic situation</b>	1	Thanaraksakul and Phruksaphanrat (2009)
<b>Long-term relationship</b>	6	Simpson et al. (2002); Kasirian and Yusuff (2009); Thanaraksakul and Phruksaphanrat (2009); Ho et al. (2010); Kang and Lee (2010); Dogan and Aydin (2011)
<b>Political situation</b>	2	Inemek and Tuna (2009); Thanaraksakul and Phruksaphanrat (2009)

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# Appendix 2

	<b>Auckland University of Technology</b> New Zealand	<b>Call to Participate in a Research Study...</b>	
<p>The following research activity has been reviewed via AUT arrangements for the conduct of research involving human participation. If you choose to participate, you will be provided with more detailed participant information, including who you can contact if you have any concerns.</p>			
<b>Improving Supplier Selection Criteria Using a Decision Support Model: A Case Study of a Government Linked Company in Malaysia</b>			
<b>Research Team Contacts</b>			
Associate Professor Dr. John E. Tookey School of Engineering, AUT University 0064-9-921 9512 (NZ) <a href="mailto:jtookey@aut.ac.nz">jtookey@aut.ac.nz</a>		Sivadass Thiruchelvam School of Engineering, AUT University 03-89212020 ext: 6276 <a href="mailto:sivadass@uniten.edu.my">sivadass@uniten.edu.my</a>	
Please contact the researcher team members to have any questions answered or if you require further information about the project.			
<b>What is the purpose of the research?</b>			
The purpose of this research is to design a supplier decision model that can reflect TNB staff's orientations and preferences about supplier selection. The research will ask standard questions on the existing supply chain model of TNB as well as participants' suggestion of new criteria that they think may be useful.			
<b>Are you looking for people like me?</b>			
The research team is looking for TNB engineers or senior executives in purchasing with the following criteria for semi-structured interviews and questionnaire survey.			
Semi-structured interviews:			
<ul style="list-style-type: none"> <li>• Senior executives serving Tenaga Nasional Berhad, and</li> <li>• Senior executives who have been involved in formulation of Group Procurement policy and procedures.</li> <li>• Executives (Grade E15 and above).</li> </ul>			
Questionnaire survey:			
<ul style="list-style-type: none"> <li>• Engineers serving Tenaga Nasional Berhad, and</li> <li>• Experienced in dealing with procurement of generation, transmission and distribution infrastructure.</li> <li>• Executives (Grade E14 and below).</li> </ul>			
<b>What will you ask me to do?</b>			
According to the above listed criteria, your participation will involve either 90 minutes of your time for a semi-structured interview or 30 minutes of your time for completing a questionnaire survey.			
<b>Are there any risks for me in taking part?</b>			
Participants are not required to divulge any personal feelings about their work or their organization and therefore there should be no emotional or psychological risks to the participants in this research. Participants' privacy and confidentiality are assured as the questionnaires are anonymous and no personal information that may divulge a participant's identity. If we use any extracts from your interview they will not contain your name or anything that identifies you as an individual. Any reporting of findings will have no names or details of demographics that will permit identification of participants.			
<b>Are there any benefits for me in taking part?</b>			
It is unlikely that this project will benefit you directly. However, this study will improve understanding about supplier selection process in the Malaysian electricity supply industry			
<b>Will I be compensated for my time?</b>			
There is no compensation or fee to be paid to any participant in this study. Participation is voluntary.			
<b>Who is funding this research?</b>			
The project is funded by Universiti Tenaga Nasional. This fact-finding mission is only for academic purposes and is not carried out on behalf of TNB to assess its employees on the supplier selection issues. Therefore, the outcome of this study has no financial interest to the researcher, UNITEN or TNB.			
<b>I am interested – what should I do next?</b>			
If you would like to participate in this study, please contact Sivadass Thiruchelvam at (03) 8921 2020 ext: 6276 or e-mail <a href="mailto:sivadass@uniten.edu.my">sivadass@uniten.edu.my</a> for details of the next step. You will be provided with further information to ensure that your decision and consent to participate are fully informed.			
<b>Thank You!</b>		AUTEK Reference Number:	<b>11/111</b>

# Appendix 3

27 August 2012

## Consent Form (Semi-structured Interviews)



**Project title:** Improving Supplier Selection Criteria Using a Decision Support Model: A Case Study of a Government Linked Company in Malaysia.

**Project Supervisor:** Associate Professor Dr. John E. Tookey

**Researcher:** Sivadass Thiruchelvam

- I have read and understood the information provided about this research project in the Information Sheet dated 30 May 2011.
- I have had an opportunity to ask questions and to have them answered.
- I understand that notes will be taken during the interviews.
- I understand that I may withdraw myself or any information that I have provided for this project at any time prior to completion of data collection, without being disadvantaged in any way.
- If I withdraw, I understand that all relevant information will be destroyed.
- I agree to take part in this research.
- I wish to receive a copy of the report from the research (please tick one): Yes  No

Participant's signature: .....

Participant's name: .....

Participant's Contact Details (if appropriate):

.....  
.....  
.....  
.....

Date:

**Approved by the Auckland University of Technology Ethics Committee on *type the date on which the final approval was granted* AUTEK Reference number *type the AUTEK reference number***

*Note: The Participant should retain a copy of this form.*

# Appendix 4

## Participant Information Sheet (Semi-structured Interviews)



### Date Information Sheet Produced:

30 May 2011

### Project Title

Improving Supplier Selection Criteria Using a Decision Support Model: A Case Study of a Government Linked Company in Malaysia.

### An Invitation

Hello, my name is Sivadass Thiruchelvam. I am a sponsored staff member by Universiti Tenaga Nasional, pursuing a doctoral program in Engineering at Auckland University of Technology (AUT). My research is about understanding supplier selection practices in the Malaysian electricity supply industry. As you are directly involved in the purchasing process in Tenaga Nasional Berhad (TNB), I would like to invite you to participate in this research project. Your participation in this project is entirely voluntary. You may choose to withdraw at any time without providing an explanation and this will not affect you in any way.

### What is the purpose of this research?

The purpose of this research is to design a supplier decision model that can reflect TNB staff's orientations and preferences about supplier selection. However, this research study is carried out with the sole intention for the completion of my doctoral study at AUT. This fact-finding mission is only for academic purposes and is not carried out on behalf of TNB to assess its employees on the supplier selection issues. Therefore, the outcome of this study has no financial interest to the researcher, UNITEN or TNB. I also plan to employ the findings for conference proceedings and other refereed publications.

### How was I identified and why am I being invited to participate in this research?

My main participants of this research are TNB engineers and senior executives experienced in purchasing. You will probably come across about this study from emails and online adverts.

### What will happen in this research?

It is important to understand that your involvement in this study is voluntary. While I would be pleased to have you participate, I respect your right to decline. If you agree to participate in this project, I will invite you to participate in an individual interview. The interview should not exceed 90 minutes. It will be arranged at your preferred time in a public meeting place that is convenient to you. It will be conducted in English. The research will ask standard questions on the existing supply chain model of TNB as well as participants' suggestion of new criteria that they think may be useful.

### What are the discomforts and risks?

Participants are not required to divulge any personal feelings about their work or their organisation and therefore there should be no emotional or psychological risks to the participants in this research. Participants' privacy and confidentiality are assured. When the study is written up and published we will use some quotes from the discussion as examples of what people have said. If we use any extracts from your interview they will not contain your name or anything that identifies you as an individual.

**How will these discomforts and risks be alleviated?**

The interview will be conducted in ways that you are comfortable with. At any time during the interview you may choose not to describe subjects that you find distressing. You may also withdraw from the interview and/or the study at any time and request your data be destroyed. Your identity, job position and other important personal information will not be disclosed in the final thesis. Where it is necessary for me to use names, I will use pseudonyms instead of real names to ensure the privacy of my participants. I will also ensure that all identifiable personal information is omitted from the findings. You may also request for a copy of my final thesis when this is available. It is most unlikely that any discomfort of any type will be felt since the research involved is the discussion of professional practice within a professional organization by recognized professionals in their field. Consequently, given that anonymity can be guaranteed using the protocol explained, there is minimal likelihood of discomfort.

**What are the benefits?**

You will be assisting me in completing my PhD thesis. You will also be contributing to information that could provide insights to supplier selection in the Malaysian electricity supply industry. In addition, some people find that being interviewed about what they have been through is an enjoyable and/or interesting experience.

**How will my privacy be protected?**

Your anonymity, privacy and confidentiality will be protected at all times during this research. I will not use any real names and will delete any other identifiable personal information from my final thesis. The only individual who will have access to your personal information will be me and my main supervisor. TNB as the participating organisation will only be given a summary of the findings at the end of the research, but no any information on the identity of the respondents will be given to TNB. All data and consent forms will be stored separately in locked cabinets at the Construction Management premises of Auckland University of Technology City Campus for six years. All original data will be destroyed after six years.

**What are the costs of participating in this research?**

I understand that you will give up some of your precious time in order to contribute to this research. I will ensure that this interview is conducted at a time that is agreeable to you and at your convenience with as little interruption to your daily duties as possible. There will be no financial costs anticipated in this project.

**What opportunity do I have to consider this invitation?**

Your participation is voluntary. It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason. Please take one week to consider your possible involvement as a research participant. If you are willing to participate in this research or have questions about it, please email me at [sivadass@unitek.ac.nz](mailto:sivadass@unitek.ac.nz) or call Malaysian office number 03-89212020 ext: 6276.

**How do I agree to participate in this research?**

If you agree to participate in this research, please complete, sign and return your consent form to me any time before 01/07/2011.

**Will I receive feedback on the results of this research?**

All participants are entitled to feedback from this study. I will send you an electronic version of the summary of my research findings at an email address provided by you in the consent form. Summary results of this research will be available on TNB's online news bulletin board in July 2012. If you are interested, I will also inform you of any imminent publications concerning the findings of this project.

**What do I do if I have concerns about this research?**

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor, Associate Professor Dr. John E. Tookey (email: [jtookey@aut.ac.nz](mailto:jtookey@aut.ac.nz) or office telephone: 0064-9-921 9512 (NZ)).

Concerns regarding the conduct of the research should be notified to the Executive Secretary, ATEC, Madeline Banda, *madeline.banda@aut.ac.nz* , 0064-9-921 9999 ext 8044 (NZ).

Whom do I contact for further information about this research?

***Researcher Contact Details:***

Sivadass Thiruchelvam (email: *sivadass@uniten.edu.my* or office telephone: 03-89212020 ext: 6276 (M'sia)).

***Project Supervisor Contact Details:***

Associate Professor Dr. John E. Tookey (email: *jtookey@aut.ac.nz* or office telephone: 0064-9-921 9512 (NZ)).

Approved by the Auckland University of Technology Ethics Committee on *type the date final ethics approval was granted*,  
ATEC Reference number *type the reference number*.

# Appendix 5

By completing this questionnaire you are indicating your consent to participate

**QUESTIONNAIRE**  
**Improving Supplier Selection Criteria Using a Decision Support Model: A Case Study of a Government Linked Company in Malaysia**



Dear Sir/Madam,

This survey is a part of research which is aimed at gaining insight into procurement practices of the electricity supply industry in Malaysia. The results of this survey will be used to analyse various aspects of selecting supplier practices, particularly in identifying the order of importance of the criteria and sub-criteria in use.

This questionnaire comprises of 3 sections:

**Section A:** Personal background

**Section B:** Investigation of supplier selection practices in Malaysian Electricity Supply Industry

**Section C:** Assessment of supplier selection metrics and definitions

It will take you not more than 30 minutes to complete the questionnaire.

**ALL RESPONSES WILL BE TREATED IN THE STRICTEST CONFIDENCE.**

Your kind cooperation is highly appreciated.

Any inquiries regarding this questionnaire please contact:

**Researcher Contact Details:**

Sivadass Thiruchelvam (email: [sivadass@uniten.edu.my](mailto:sivadass@uniten.edu.my) or office phone: 03-89212020 ext. 6276 (M'sia)).

**Research Supervisor Contact Details:**

Associate Professor Dr. John E. Tookey (email: [jtookey@aut.ac.nz](mailto:jtookey@aut.ac.nz) or telephone: 0064-9-921 9512 (NZ))

**Section A: Personal background**

**Direction: Please tick (/) your answer in the respective boxes.**

**A1. Division/Department/Section**

Generation

Transmission

Distribution

Others

If others, please specify: \_\_\_\_\_

**A2. Number of years working at Malaysian Electricity Supply Industry**

Less than 5 years

6 – 10 years

11 – 15 years

16 – 20 years

More than 20 years

**A3. How many times you have been involved in supplier selection process?**

Never

1 – 10 times

11 – 20 times

More than 20 times



**Section B: Investigation of supplier selection practices in Malaysian Electricity Supply Industry**

**Direction:** Please tick (/) your answer in the respective boxes.

**B1. Your organization's supplier selection decisions are mainly based on:**

- |  |   |
|--|---|
| <input type="checkbox"/> Company to company relationship | <input type="checkbox"/> Buyer-seller personal relationship |
| <input type="checkbox"/> Buyer's intuition               | <input type="checkbox"/> Instruction from top management    |
| <input type="checkbox"/> Best value for money            |   |

**B2. Has your organization utilized any systematic decision-making technique in your supplier selection process?**

- |                              |                             |
|------------------------------|-----------------------------|
| <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|------------------------------|-----------------------------|

If yes, please state/explain the technique(s) employed:

\_\_\_\_\_

**B3. Is the systematic decision-making for the supplier selection based on computer software?**

- |                              |                             |
|------------------------------|-----------------------------|
| <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|------------------------------|-----------------------------|

**B4. Based on past suppliers' performance, how do you rate your organization's purchasing judgment?**

Always not optimal	Sometimes not optimal	Seldom optimal	Sometimes optimal	Always optimal
←-----→				
1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**B5. As an initiative to improve effectiveness of strategic procurement in your organization, how do you rate the importance of having a systematic supplier selection process and technique?**

Not important	Least important	Neutral	Important	Very important
←-----→				
1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
				3

**B6. From your experience, could you please indicate the following major criteria according to their levels of importance in your supplier selection?**

Criterion	Degree of importance							Most Important
	Least Important	1	2	3	4	5	6	
<b>Quality achievement</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Price	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Delivery capability</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Production facility and capacity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Flexibility</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Technical capacity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Repair services and follow-up</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Information and communication technology (ICT)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Financial status</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Innovation, research and development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Quality management systems</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Management and organization	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Support services experience</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Subcontracting experience	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Customer satisfaction and business relations experience</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reputation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Commitment</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Training experience	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Employee training and development</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Performance history	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Safety awareness</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Environmental attributes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**B7. Are there other criteria apart from the ones mentioned in sub-section B6, which you consider important in supplier selection? Could you please state the criteria and indicate the corresponding levels of importance in your supplier selection?**

Criterion	Least Important	Degree of importance							Most Important
		1	2	3	4	5	6	7	
_____		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
_____		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
_____		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
_____		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
_____		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Section C: Assessment of supplier selection metrics and definitions**

With reference to the major criteria stated in sub-section B6, could you please assess the levels of importance for each accompanying sub-criteria in your supplier selection.

Direction: Please tick (/) your answer according to the following scale:  
 1 – Unimportant    2 – Of Little Importance    3 – Moderately Important  
 4 – Important    5 – Very important

**C1 Quality achievement**

		1	2	3	4	5
C1.1	Supplier's ability in conforming to the supplied product quality.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C1.2	Supplier's capability to provide continuous quality improvement of the supplied product.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C1.3	Supplier's promptness in substituting any rejected product.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C1.4	Supplier's effectiveness in reporting on non-conformities of raw materials.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C1.5	Supplier capable to find remedies to quality problems.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C1.6	If others, please specify					
	_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	_____					

**Direction: Please tick (/) your answer according to the following scale:**  
**1 – Unimportant 2 – Of Little Importance 3 – Moderately Important**  
**4 – Important 5 – Very important**

**C2 Price**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C2.1	Supplier's credit period is negotiable.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C2.2	Supplier allows for price negotiations.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C2.3	Supplier's capability in accurately estimating cost.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C2.4	Supplier's initiatives to cooperate in cost reduction.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C2.5	Supplier's price offer is frequently competitive.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C2.6	Supplier's keenness of revealing the breakdown of unit price.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C2.7	If others, please specify	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	.....					
	.....					

**C3 Delivery capability**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C3.1	Supplier's capability to deliver expected product requirements.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C3.2	Supplier's ability to ensure compliance of delivered product's quantity.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C3.3	Supplier is capable of delivering orders on time.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C3.4	Supplier strives to reduce lead time.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C3.5	Supplier's ability to provide real-time updates to enquiries of order processing status.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C3.6	If others, please specify	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	.....					
	.....					

**Direction: Please tick (/) your answer according to the following scale:**  
*1 – Unimportant 2 – Of Little Importance 3 – Moderately Important*  
*4 – Important 5 – Very important*

**C4 Production facility and capacity**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C4.1	Supplier's flexibility in production capacity.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4.2	Supplier's willingness to change productivity on demand.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C4.3	Supplier able to perform in planning, providing and controlling production capacity to satisfy heavy ordering volume.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4.4	Supplier's willingness to accept order changes.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C4.5	Supplier's ability to react quickly towards order change.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4.6	If others, please specify	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	.....					
	.....					

**C5 Flexibility**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C5.1	Supplier's ability in obtaining quick conflict resolution.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C5.2	Supplier is able to respond to unanticipated demand.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C5.3	Supplier's ability to have flexible production systems.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C5.4	Supplier's flexibility of contract terms and conditions.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C5.5	Supplier's willingness to change products or services to meet changing needs of customer.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C5.6	If others, please specify	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	.....					
	.....					

**Direction: Please tick (/) your answer according to the following scale:**  
**1 – Unimportant 2 – Of Little Importance 3 – Moderately Important**  
**4 – Important 5 – Very important**

**C6 Technical capacity**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C6.1	Supplier has professional technical capability in production process.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C6.2	Supplier adopts new technology to improve performance and deliver new services.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C6.3	Supplier's capability in process improvement.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C6.4	Supplier's effectiveness in providing necessary technical expertise required by the customer.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C6.5	Supplier has the capability to update technological support.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C6.6	If others, please specify	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	.....					
	.....					

**C7 Repair services and follow-up**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C7.1	Supplier's ability to maintain supplied products.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C7.2	Supplier's ability to meet response times.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C7.3	Supplier's ability to manage and resolve problems.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C7.4	Supplier's excellence in providing service satisfaction.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C7.5	Supplier's capability in obtaining spare parts on a timely basis.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C7.6	Supplier's capability in providing replacement components on a timely basis.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C7.7	Supplier's ability to respond to customer driven changes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C7.8	If others, please specify	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	.....					
	.....					

**Direction: Please tick (/) your answer according to the following scale:**  
**1 – Unimportant 2 – Of Little Importance 3 – Moderately Important**  
**4 – Important 5 – Very important**

**C8 Information and communication technology (ICT)**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C8.1	Supplier has compatible ICT system with the customer.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C8.2	Supplier's effectiveness in ease of communication.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C8.3	Supplier's ability to share information with the customer and other stakeholders.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C8.4	Supplier has latest IT facility in its business establishment.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C8.5	Supplier's effectiveness in protecting customer's sensitive information from being accessed by unauthorized parties.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C8.6	If others, please specify	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	.....					
	.....					

**C9 Financial status**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C9.1	Supplier's ability to perform accurate costing on product/services.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C9.2	Supplier's liquidity status.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C9.3	Supplier's strength on balance sheet.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C9.4	Supplier's ability to use different financial instruments and choose appropriate methods to lower overall costs.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C9.5	Supplier's ability to identify hidden cost drivers and wastes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C9.6	If others, please specify	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	.....					
	.....					

**Direction: Please tick (/) your answer according to the following scale:**  
*1 – Unimportant 2 – Of Little Importance 3 – Moderately Important*  
*4 – Important 5 – Very important*

**C10 Innovation, research and development**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C10.1 Supplier has the required design capability.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C10.2 Supplier's level of investment in new technology.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C10.3 Supplier's ability to provide timely innovative idea.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C10.4 Supplier's achievement of relevant industry certifications.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C10.5 Supplier's ability to provide technical support.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C10.6 If others, please specify ..... .....	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

**C11 Quality management systems**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C11.1 Supplier has a procedure for all employees to be committed to quality improvement.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C11.2 Supplier's ability to provide a comprehensive quality control programme.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C11.3 Supplier's ability to provide a comprehensive quality assurance programme.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C11.4 Supplier has effective products database and traceability of product records.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C11.5 Supplier achieves various quality system certifications (e.g. ISO).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C11.6 If others, please specify ..... .....	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>



**Direction: Please tick (/) your answer according to the following scale:**

*1 – Unimportant 2 – Of Little Importance 3 – Moderately Important*

*4 – Important 5 – Very important*

**C12 Management and organization**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C12.1 Supplier has complete and sound organizational structure.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C12.2 Supplier has clear vision, mission and philosophy.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C12.3 Supplier's level of command and compatibility with employees.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C12.4 Supplier has low employee turnover rate.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C12.5 Compatibility of buyer's and supplier's corporate cultures.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C12.6 If others, please specify	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
.....					
.....					

**C13 Support services experience**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C13.1 Effectiveness of supplier's personnel.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C13.2 Reliability of supplier's personnel.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C13.3 Supplier's ability to provide qualified personnel for support services.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C13.4 Supplier's ability and responsiveness in meeting quick turnaround requirements.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C13.5 Supplier's ability to satisfy security requirements and obtain clearances for personnel in a prompt fashion.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C13.6 Performance in planning, scheduling, controlling, monitoring and reporting on deliverables.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C13.7 If others, please specify	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.....					
.....					

**Direction: Please tick (/) your answer according to the following scale:**

**1 – Unimportant    2 – Of Little Importance    3 – Moderately Important  
4 – Important    5 – Very important**

**C14 Subcontracting experience**

	1	2	3	4	5
C14.1 Supplier's effectiveness in monitoring and controlling the performance of subcontractors.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C14.2 Supplier's promptness in making payments to subcontractors.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C14.3 Supplier's effectiveness in managing and resolving problems with subcontractors.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C14.4 Supplier's effectiveness in choosing capable subcontractors and teaming partners.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C14.5 Supplier's effectiveness in solving contract performance problems without extensive guidance from customers.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C14.6 If others, please specify ----- -----	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

**C15 Customer Satisfaction and business relations experience**

	1	2	3	4	5
C15.1 Supplier's ability to perform in responding questions/technical/service/administrative issues.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C15.2 Supplier's capability in resolving problems that arise which involve customers and affect their applications.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C15.3 Supplier's ability to coordinate the efforts of subcontractors and customer personnel to resolve customer problems.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C15.4 Supplier's ability to communicate the status of customer-related issues back to the customer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C15.5 Supplier's understanding of the importance of customer-related issues.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C15.6 If others, please specify ----- -----	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

**Direction: Please tick (/) your answer according to the following scale:**

**1 – Unimportant    2 – Of Little Importance    3 – Moderately Important  
4 – Important    5 – Very important**

**C16 Reputation**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C16.1 Supplier has a good process of dealing with customer complaints.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C16.2 Supplier is able to quickly process customer complaints.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C16.3 Supplier demonstrates performance in providing exemplary service.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C16.4 Supplier's firm is often benchmarked by other customers.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C16.5 Supplier's firm has attained a leading position in the industry.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C16.6 If others, please specify ----- -----	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

**C17 Commitment**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C17.1 Customer has special access to new developments within the supplier's research and development activities.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C17.2 Supplier demonstrates commitment by allocating full resources for given contract.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C17.3 Supplier provides tour around its facility whenever requested by customer.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C17.4 Supplier's prompt response to operational issues.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C17.5 Customer has appropriate access to supplier's sensitive information.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C17.6 Customer has access to supplier's subject matter expert for further advice on technical matters.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C17.7 Project delivered within conditions of supply.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C17.8 Supplier demonstrates performance in keeping promises with the customer.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C17.9 If others, please specify ----- -----	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Direction: Please tick (/) your answer according to the following scale:**

**1 – Unimportant    2 – Of Little Importance    3 – Moderately Important  
4 – Important    5 – Very important**

**C18 Customer’s training experience**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C18.1 Quality and thoroughness of supplier’s training materials.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C18.2 Competency and effectiveness of supplier’s instructors.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C18.3 Supplier demonstrates performance in providing training tailored for different skill levels (e.g., novice, experienced, advanced).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C18.4 Supplier demonstrates performance in providing training for different levels of understanding (e.g., conceptual versus practical).	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C18.5 Supplier’s ability to provide training specific to the needs of the customer.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C18.6 If others, please specify ----- -----	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

**C19 Employee training and development**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C19.1 Supplier ensures employees undergo necessary occupational tests.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C19.2 There are provisions for employee to continue professional education.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C19.3 Supplier demonstrated performance in providing exemplary service a well-planned training activity for the employees.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C19.4 Supplier demonstrated performance in allocating sufficient funds for annual training expenses.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C19.5 Employees are exposed to the state-of-the-art technology related to their jobs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C19.6 If others, please specify ----- -----	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

**Direction: Please tick (/) your answer according to the following scale:**  
**1 – Unimportant 2 – Of Little Importance 3 – Moderately Important**  
**4 – Important 5 – Very important**

**C20 Performance history**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C20.1 Supplier received awards for its competence.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C20.2 Supplier has proven commercial ability.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C20.3 Supplier has a track record of timely completion.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C20.4 Supplier has good number of customers.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C20.5 Supplier has evident number of jobs completed with renowned customers.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C20.6 If others, please specify	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
.....					
.....					

**C21 Safety awareness**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C21.1 Supplier demonstrates performance in having low or almost zero number of lost times from accidents.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C21.2 Supplier provides adequate personal protection equipment to employees.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C21.3 Supplier has procedures and practices regarding safety training and level of awareness for its employees.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C21.4 Supplier has an emergency plan for anticipating any untoward industrial mishaps in its premises or on-site.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C21.5 Supplier obtains feedback on safety procedures through audit review.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C21.6 If others, please specify	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
.....					
.....					

**Direction: Please tick (/) your answer according to the following scale:**

***1 – Unimportant   2 – Of Little Importance   3 – Moderately Important  
4 – Important   5 – Very important***

**C22 Environmental attributes**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
C22.1 Supplier has awareness for environmental requirements.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C22.2 Supplier avoids the usage of substances which cause pollution.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C22.3 Supplier demonstrates environmental awareness through environmental data sheets and categorization.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C22.4 Minimal or almost zero usage of toxic or hazardous substances at any time during the life cycle of the good or service.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C22.5 Goods comply with current regulations that govern the content of environmentally hazardous substances.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C22.6 If others, please specify	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
.....					
.....					

**End of Questionnaire**

**Thank you very much for taking your time to fill in the questionnaire**

# Appendix 6

*By completing this questionnaire you are indicating your consent to participate*



## QUESTIONNAIRE

### **Improving Supplier Selection Criteria Using a Decision Support Model: A Case Study of a Government Linked Company in Malaysia**

Dear Sir/Madam,

This survey is part of a research, aimed at examining equipment procurement practices in the Malaysian electricity supply industry. The survey analyses various aspects of supplier selection practices and identifies the order of importance of each selection criteria and sub-criteria.

This questionnaire comprises of 3 sections:

**Section A:** Investigation of supplier selection practices

**Section B:** Assessment of supplier selection metrics and definitions

**Section C:** Demographic details

It will take you not more than 30 minutes to complete the questionnaire.

**ALL RESPONSES WILL BE TREATED IN THE STRICTEST CONFIDENCE.**

Your kind cooperation is highly appreciated.

For any inquiries regarding this questionnaire, please contact:

**Researcher:**

Sivadass Thiruchelvam (email: [sivadass@uniten.edu.my](mailto:sivadass@uniten.edu.my) or mobile phone: 016-333 44 80 (M'sia)).

**Research Supervisor:**

Associate Professor Dr. John E. Tookey (email: [jtookey@aut.ac.nz](mailto:jtookey@aut.ac.nz) or telephone: 0064-9-921 9512 (NZ))

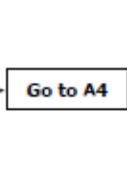
<b>Section A: Investigation of supplier selection practices</b>
---

- A1. Which of the following decision-making method(s) are being used in your supplier selection process? (More than one box may be ticked) Please indicate the level of effectiveness for the selected method(s).**

Decision-making methods	Totally ineffective ← → Very effective				
	1	2	3	4	5
<input type="checkbox"/> Pros and cons analysis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Cost-benefit analysis (CBA)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Maximin and maximax methods	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Conjunctive and disjunctive methods	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Lexicographic method	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Simple multi-attribute rating technique (SMART)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Generalized means	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Analytic Hierarchy Process (AHP)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> ELECTRE method	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> PROMETHEE method	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- A2. What kind of decision-making software is being used in your supplier selection process? If applicable, please indicate the level of effectiveness for the selected software. (Tick the best answer that applies)**

Decision-making software	Totally ineffective ← → Very effective				
	1	2	3	4	5
<input type="checkbox"/> Commercial software	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Please specify: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> In-house software	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Please specify: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Never used any					







- A5. Based on your professional view in order to enhance the strategic importance of procurement, to what degree should your organization rate the importance of the following supplier selection criteria?

Criteria	Not at all important	Degree of importance					Extremely important
		1	2	3	4	5	
Product quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Price	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Delivery	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Production system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Flexibility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Support services	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Information and communication technology (ICT)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Financial performance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Product innovation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Quality management systems (QMS)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Management and organization	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Customer training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Employee training and development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Performance history	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Customer focus	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Corporate social responsibility (CSR)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Safety awareness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Environmental attributes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	


<b>Section B: Assessment of supplier selection metrics and definitions</b>
--

Based on your professional view in order to enhance the strategic importance of procurement, to what degree should your organization rate the importance of the following supplier selection sub-criteria?

Direction: Please tick (✓) your answer according to the following scale:

- 1 – *Not at all important*
- 2 – *Unimportant*
- 3 – *Neither important nor unimportant*
- 4 – *Very important*
- 5 – *Extremely important*

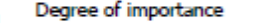

**B1 Product quality**

Not at all important  Extremely important  
1 2 3 4 5

The supplier:

- |      |   |                          |                          |                          |                          |                          |
|------|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| B1.1 | meets the required product specifications (international standards) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B1.2 | improves conformance to design specifications                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B1.3 | reduces defective rates   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B1.4 | reduces probability of product breakdowns                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**B2 Price**

Not at all important  Degree of importance  Extremely important  
1 2 3 4 5

The supplier:

- |      |  |                          |                          |                          |                          |                          |
|------|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| B2.1 | offers a reasonable price                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B2.2 | allows space for price negotiations            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B2.3 | estimates cost accurately                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B2.4 | is willing to show the breakdown of unit price | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Direction: Please tick (✓) your answer according to the following scale:

- 1 – Not at all important  
 2 – Unimportant  
 3 – Neither important nor unimportant  
 4 – Very important  
 5 – Extremely important

**B3 Delivery**

Not at all Degree of importance Extremly  
 important 1 2 3 4 5 important

The supplier:

- B3.1 delivers the kind of products needed on time
- B3.2 delivers the correct quantity of products
- B3.3 is able to reduce manufacturing lead time
- B3.4 provides accurate information concerning an order
- B3.5 is geographically located nearby to the customer

**B4 Production system**

Not at all Degree of importance Extremly  
 important 1 2 3 4 5 important

The supplier:

- B4.1 has optimum arrangement of plant layout
- B4.2 accepts orders in a small quantity
- B4.3 uses materials requirement planning (MRP)
- B4.4 reduces production setup time
- B4.5 adopts Total Productive Maintenance (TPM)
- B4.6 shall continuously produce the same product in the future

Direction: Please tick (✓) your answer according to the following scale:

*1 – Not at all important*

*2 – Unimportant*

*3 – Neither important nor unimportant*

*4 – Very important*

*5 – Extremely important*

**B5 Flexibility**

Not at all important  $\xrightarrow{\text{Degree of importance}}$  1 2 3 4 5 Extremly important

The supplier:

- |      |   |                          |                          |                          |                          |                          |
|------|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| B5.1 | is successful in solving conflict resolution  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B5.2 | is willing to change order volumes            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B5.3 | is able to make design changes                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B5.4 | responds to changes in planned delivery dates | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B5.5 | rapidly changes the mix of different products | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**B6 Support services**

Not at all important  $\xrightarrow{\text{Degree of importance}}$  1 2 3 4 5 Extremly important

The supplier:

- |      |   |                          |                          |                          |                          |                          |
|------|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| B6.1 | performs the service right the first time (correct operation) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B6.2 | provides services at the promised/due time                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B6.3 | is willing to customize services                              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B6.4 | is open to off-peak services                                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B6.5 | is able to provide qualified personnel for support services   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B6.6 | is able to provide spare parts                                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**Direction: Please tick (✓) your answer according to the following scale:**

- 1 – Not at all important*
- 2 – Unimportant*
- 3 – Neither important nor unimportant*
- 4 – Very important*
- 5 – Extremely important*

**B7 Information and communication technology (ICT)**

Not at all      Degree of importance      Extremely  
important 1 2 3 4 5 important

The supplier uses:

- |      |   |  |
|------|---|--|
| B7.1 | collaborative technologies to achieve inter-organizational coordination and information sharing | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| B7.2 | transaction processing system   | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| B7.3 | electronic data interchange (EDI) for transfer of purchase orders, invoices and/or funds        | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| B7.4 | advanced tracking system for production, storage and delivery                                   | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| B7.5 | enterprise resource planning (ERP)  | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| B7.6 | helpline to provide necessary customer support  | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |

**B8 Financial performance**

Not at all      Degree of importance      Extremely  
important 1 2 3 4 5 important

The supplier's:

- |      |   |  |
|------|---|--|
| B8.1 | average return on investment                  | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| B8.2 | profit as percentage of sales (profit growth) | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| B8.3 | net income before taxes                       | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| B8.4 | present value                                 | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| B8.5 | cash flow                                     | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| B8.6 | liquidity                                     | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |

8

Direction: Please tick (✓) your answer according to the following scale:

- 1 – *Not at all important*  
 2 – *Unimportant*  
 3 – *Neither important nor unimportant*  
 4 – *Very important*  
 5 – *Extremely important*

**B9 Product innovation**

Not at all important  $\xrightarrow{\text{Degree of importance}}$  Extremely important  
 1 2 3 4 5

The supplier:

- B9.1 designs new products
- B9.2 develops customized products
- B9.3 develops new product functions
- B9.4 is quick in introducing new products
- B9.5 is willing to share key technological information
- B9.6 adopts new production technology

**B10 Quality management systems**

Not at all important  $\xrightarrow{\text{Degree of importance}}$  Extremely important  
 1 2 3 4 5

The supplier:

- B10.1 has a quality manual and documented procedure for its quality system
- B10.2 constantly improves its quality assurance system
- B10.3 has an effective products database and traceability of product records.
- B10.4 achieves various quality system certifications (e.g. ISO).

Direction: Please tick (✓) your answer according to the following scale:

- 1 – Not at all important
- 2 – Unimportant
- 3 – Neither important nor unimportant
- 4 – Very important
- 5 – Extremely important

**B11 Management and organization**

Not at all important Degree of importance Extremely important  
 1 2 3 4 5

The supplier's:

- |       |  |                          |                          |                          |                          |                          |
|-------|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| B11.1 | complete organizational structure                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B11.2 | management policies                                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B11.3 | management attitude                                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B11.4 | degree of alignment with customer's future plans     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B11.5 | stable workforce employment                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B11.6 | compatibility of ethical standards with the customer | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**B12 Customer's training**

Not at all important Degree of importance Extremely important  
 1 2 3 4 5

The supplier:

- |       |   |                          |                          |                          |                          |                          |
|-------|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| B12.1 | has competent instructors   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B12.2 | provides adequate training materials  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B12.3 | provides training tailored for different skill levels (e.g., novice, experienced, advanced) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B12.4 | provides training specific to the needs of the customer                                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



**Direction: Please tick (✓) your answer according to the following scale:**

- 1 – Not at all important*
- 2 – Unimportant*
- 3 – Neither important nor unimportant*
- 4 – Very important*
- 5 – Extremely important*

**B13 Employee training and development**

Not at all important      Degree of importance      Extremly important  
 1      2      3      4      5

The supplier:

- |       |  |                          |                          |                          |                          |                          |
|-------|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| B13.1 | ensures employees undergo necessary occupational health tests          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B13.2 | provides career advancement and training development for its employees | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B13.3 | has a well-planned training module for the employees                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B13.4 | allocates sufficient funds for training                                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**B14 Performance history**

Not at all important      Degree of importance      Extremly important  
 1      2      3      4      5

The supplier's:

- |       |   |                          |                          |                          |                          |                          |
|-------|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| B14.1 | local/international track record (position in industry) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B14.2 | number of completed jobs with renowned customers        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B14.3 | pending or possible legal suits                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Direction: Please tick (✓) your answer according to the following scale:

- 1 – Not at all important
- 2 – Unimportant
- 3 – Neither important nor unimportant
- 4 – Very important
- 5 – Extremely important

**B15 Customer focus**

Not at all important Degree of importance Extremely important  
 1      2      3      4      5

The supplier:

- |       |  |                          |                          |                          |                          |                          |
|-------|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| B15.1 | has a strong sense of loyalty to its customers   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B15.2 | dedicates whatever manpower and resources it takes to meet the given contract expectations | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B15.3 | encourages visits to its facilities on a regular basis                                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B15.4 | treats each relationship with its customers as an alliance to seek long term partnership   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B15.5 | keeps us informed about events or changes that may affect us                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B15.6 | is willing to make a long-term investment in helping us                                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B15.7 | provides information that might be of help   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B15.8 | is committed through strengthening of warranties   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B15.9 | handles complaints promptly  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Direction: Please tick (✓) your answer according to the following scale:

- 1 – *Not at all important*
- 2 – *Unimportant*
- 3 – *Neither important nor unimportant*
- 4 – *Very important*
- 5 – *Extremely important*

**B16 Corporate social responsibility**

Not at all important Degree of importance Extremely important  
1      2      3      4      5

The supplier's:

- |       |   |                          |                          |                          |                          |                          |
|-------|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| B16.1 | commitment to use a portion of its profits to help nonprofits | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B16.2 | corporate giving to community programmes                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B16.3 | code of ethics is published and distributed to employees      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B16.4 | encouragement in recycling and use of recycled products       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Direction: Please tick (✓) your answer according to the following scale:

- 1 – Not at all important
- 2 – Unimportant
- 3 – Neither important nor unimportant
- 4 – Very important
- 5 – Extremely important

**B17 Safety awareness**

		Degree of importance				
		Not at all important				Extremely important
		1	2	3	4	5
The supplier:						
B17.1	has zero number of lost times from accidents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B17.2	provides adequate personal protection equipment (PPE) to employees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B17.3	provides adequate safety instructions in the plant	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B17.4	has an emergency plan and evacuation procedure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B17.5	has periodic safety audit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B17.6	provides safety training for employees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B17.7	has certifications for safety practices (e.g. NTSP)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B17.8	has a safety officer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B17.9	is able to satisfy safety requirements at customer's premise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Direction: Please tick (✓) your answer according to the following scale:

- 1 – Not at all important  
 2 – Unimportant  
 3 – Neither important nor unimportant  
 4 – Very important  
 5 – Extremely important

**B18 Environmental attributes**

Not at all important      Degree of importance      Extremely important  
 1      2      3      4      5

Design of products for:

- |       |   |                          |                          |                          |                          |                          |
|-------|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| B18.1 | reduced consumption of material                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B18.2 | reduced consumption of energy                             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B18.3 | reuse, recycle, recovery of material, and component parts | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B18.4 | avoidance or reduction in usage of hazardous products     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Existence of environmental management components:

- |       |  |                          |                          |                          |                          |                          |
|-------|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| B18.5 | Environmental Management Systems (EMS) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B18.6 | ISO 14001 certification                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B18.7 | Total quality environmental management | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Cooperation with customers for:

- |        |                                     |                          |                          |                          |                          |                          |
|--------|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| B18.8  | environment friendly product design | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B18.9  | cleaner production                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B18.10 | green packaging                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

<b>Section C: Demographic details</b>
---------------------------------------

**Direction: Please tick (✓) your answer in the respective boxes.**

**C1. Where are you currently serving? (Tick the best answer that applies)**

- |   |   |
|---|---|
| <input type="checkbox"/> Generation Division                        | <input type="checkbox"/> TNB Janamanjung Sdn. Bhd.                    |
| <input type="checkbox"/> Transmission Division                      | <input type="checkbox"/> TNB Properties Sdn. Bhd.                     |
| <input type="checkbox"/> Distribution Division                      | <input type="checkbox"/> TNB Repair & Maintenance Sdn. Bhd.           |
| <input type="checkbox"/> Procurement Division                       | <input type="checkbox"/> TNB Research Sdn. Bhd.                       |
| <input type="checkbox"/> TNB Engineering Corp. Sdn. Bhd.            | <input type="checkbox"/> Universiti Tenaga Nasional Sdn. Bhd.         |
| <input type="checkbox"/> TNB Integrated Learning Solution Sdn. Bhd. | <input type="checkbox"/> Malaysia Transformer Manufacturing Sdn. Bhd. |
| <input type="checkbox"/> TNB Energy Services Sdn. Bhd.              | <input type="checkbox"/> TNB Engineers Sdn. Bhd.                      |
| <input type="checkbox"/> TNB Fuel Services Sdn. Bhd.                | <input type="checkbox"/> Tenaga Switchgear Sdn. Bhd.                  |
| <input type="checkbox"/> Kapar Energy Ventures Sdn. Bhd.            | <input type="checkbox"/> Others                                       |

If others, please specify: \_\_\_\_\_

**C2. Number of years working at Tenaga Nasional Berhad inclusive of experience with Lembaga Elektrik Negara (Tick the best answer that applies).**

- |  |   |
|--|---|
| <input type="checkbox"/> 0 – 5 years   | <input type="checkbox"/> 6 – 10 years   |
| <input type="checkbox"/> 11 – 15 years | <input type="checkbox"/> 16 – 20 years  |
| <input type="checkbox"/> 21 - 25 years | <input type="checkbox"/> Above 25 years |

**C3. What is your current role in supplier selection process? (Tick the best answer that applies)**

- Initiator
- Influencer
- Decision-maker
- Buyer (Procurement Officer)
- User



# Appendix 7



Sivadass Thiruchelvam  
School of Engineering  
Sivadass@uniten.edu.my

31 August 2011

Dear Sir/Madam,

I am a sponsored staff member by Universiti Tenaga Nasional, pursuing a doctoral program in Engineering at Auckland University of Technology (AUT). My research is about understanding supplier selection practices in the Malaysian electricity supply industry. As you are directly involved in the purchasing process in Tenaga Nasional Berhad (TNB), I would like to invite you to participate in this research project.

The purpose of this research is to design a supplier decision model that can reflect TNB staff's orientations and preferences about supplier selection. However, this research study is carried out with the sole intention for the completion of my doctoral study at AUT. This fact-finding mission is only for academic purposes and is not carried out on behalf of TNB to assess its employees on the supplier selection issues.

The enclosed package consists of a participant information sheet, a reply-paid envelope and the questionnaire. It will be of great importance to this project to receive your input. You may be assured that the confidentiality of your response will be respected.

The results of this survey will be summarized in a report and sent to all interested participants.

I would be very happy to answer any questions you may have and can be contacted on 03-8921 2020.

Thank you for your assistance.

Yours sincerely



Sivadass Thiruchelvam  
School of Engineering



# Appendix 8

## Participant Information Sheet



### (Questionnaire Survey)

#### Date Information Sheet Produced:

30 May 2011

#### Project Title

Improving supplier selection criteria using a decision support model: A case study of a government linked company in Malaysia.

#### An Invitation

Hello, my name is Sivadas Thiruchelvam. I am a sponsored staff member by Universiti Tenaga Nasional, pursuing a doctoral program in Engineering at Auckland University of Technology (AUT). My research is about understanding supplier selection practices in the Malaysian electricity supply industry. As you are directly involved in the purchasing process in Tenaga Nasional Berhad (TNB), I would like to invite you to participate in this research project. Your participation in this project is entirely voluntary. You may choose to withdraw at any time without providing an explanation and this will not affect you in any way.

#### What is the purpose of this research?

The purpose of this research is to design a supplier decision model that can reflect TNB staff's orientations and preferences about supplier selection. However, this research study is carried out with the sole intention for the completion of my doctoral study at AUT. This fact-finding mission is only for academic purposes and is not carried out on behalf of TNB to assess its employees on the supplier selection issues. Therefore, the outcome of this study has no financial interest to the researcher, UNITEN or TNB. I also plan to employ the findings for conference proceedings and other refereed publications.

#### How was I identified and why am I being invited to participate in this research?

My main participants of this research are TNB engineers and senior executives experienced in purchasing. You will probably come across about this study from emails and online adverts.

#### What will happen in this research?

It is important to understand that your involvement in this study is voluntary. While I would be pleased to have you participate, I respect your right to decline. If you agree to participate in this project, I will invite you fill up a questionnaire. It will take you not more than 30 minutes to complete the questionnaire. By completing this questionnaire you are indicating your consent to participate in this research. The research will asks standard questions on the existing supply chain model of TNB as well as participants' suggestion of new criteria that they think may be useful.

#### What are the discomforts and risks?

Participants are not required to divulge any personal feelings about their work or their organisation and therefore there should be no emotional or psychological risks to the participants in this research. Participants' privacy and confidentiality are assured as the questionnaires are anonymous and no personal information that may divulge a participant's identity. Any reporting of findings will have no names or details of demographics that will permit identification of participants.

**How will these discomforts and risks be alleviated?**

The survey will be conducted at a time and place that will not inconvenience your daily duties. At any time during the survey, you may choose not to answer questions that you may find distressing. You may also withdraw from the survey and request for your data to be destroyed. I will also ensure that all identifiable personal information is omitted from the findings. You may also request for a copy of my final thesis when this is available. It is most unlikely that any discomfort of any type will be felt since the research involved is the discussion of professional practice within a professional organization by recognized professionals in their field. Consequently, given that anonymity can be guaranteed using the protocol explained, there is minimal likelihood of discomfort.

**What are the benefits?**

You will be assisting me in completing my PhD thesis. You will also be contributing valued information that could provide insights to supplier selection process in the Malaysian electricity supply industry.

**How will my privacy be protected?**

Your anonymity, privacy and confidentiality will be protected at all times during this research. This survey is anonymous. If you choose to participate, do not write your name on the questionnaire. No marking or serial numbering of individual questionnaires that will be used as identifiers of participants will be used. No one will be able to identify you, nor will anyone be able to determine which division you work for. No one will know whether you participated in this study. Nothing you say on the questionnaire will in any way influence your present or future employment with your company. The only individual who will have access to the original data will be me and my main supervisor. TNB as the participating organisation will only be given a summary of the findings at the end of the research. All original data will be stored in a locked cabinet at the Construction Management premises of Auckland University of Technology City Campus for six years. All original data will be destroyed after six years.

**What are the costs of participating in this research?**

There is no financial cost involved in participating in this research. I will ensure that this questionnaire is conducted at a time that is agreeable to you and at your convenience with as little interruption to your daily duties as possible.

**What opportunity do I have to consider this invitation?**

Your participation is voluntary. It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and required to complete the questionnaire. By returning this questionnaire (using a reply-paid envelope), you are giving your consent to participate in this research. If you decide to take part you are still free to withdraw at any time and without giving a reason. Please take one week to consider your possible involvement as a research participant. If you are willing to participate in this research or have questions about it, please email me at [sivadass@unitek.ac.nz](mailto:sivadass@unitek.ac.nz) or call Malaysian office number 03-89212020 ext: 6276.

**How do I agree to participate in this research?**

As this research involves an anonymous questionnaire, your consent to participate in this research is implied by the return of the completed questionnaire. Please return your completed questionnaire in the postage paid envelope not later than August 31, 2011.

**Will I receive feedback on the results of this research?**

All participants are entitled to feedback from this study. Summary results of this research will be available on TNB's online news bulletin board in July 2012.

**What do I do if I have concerns about this research?**

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor, Associate Professor Dr. John E. Tookey (email: [jtookey@aut.ac.nz](mailto:jtookey@aut.ac.nz) or office telephone: 0064-9-921 9512 (NZ)).

Concerns regarding the conduct of the research should be notified to the Executive Secretary, AUTEC, Madeline Banda, [madeline.banda@aut.ac.nz](mailto:madeline.banda@aut.ac.nz), 0064-9-921 9999 ext 8044 (NZ).

**Whom do I contact for further information about this research?**

***Researcher Contact Details:***

Sivadass Thiruchelvam (email: [sivadass@uniten.edu.my](mailto:sivadass@uniten.edu.my) or office telephone: 03-89212020 ext: 6276 (M'sia)).

***Project Supervisor Contact Details:***

Associate Professor Dr. John E. Tookey (email: [jtookey@aut.ac.nz](mailto:jtookey@aut.ac.nz) or office telephone: 0064-9-921 9512 (NZ)).

Approved by the Auckland University of Technology Ethics Committee on type the date final ethics approval was granted,  
AUTEK Reference number type the reference number.

# Appendix 9



Sivadass Thiruchelvam  
School of Engineering  
Sivadass@uniten.edu.my

7 September 2011

Dear Sir/Madam,

Last week a questionnaire seeking your input about strategic sourcing supplier selection practices in TNB was mailed to you upon your request to participate in this study.

If you have already completed and returned it to me, please accept my sincere thanks. If not, I would appreciate it if you could do so today. It is extremely important that data about your perceptions be included in the study if the results are to accurately represent TNB.

The enclosed package consists of a participant information sheet, a reply-paid envelope and the questionnaire

I would be very happy to answer any questions you may have and can be contacted on 03-8921 2020.

Thank you for your assistance.

Yours sincerely



Sivadass Thiruchelvam  
School of Engineering

# Appendix 10



Sivadass Thiruchelvam  
School of Engineering  
Sivadass@uniten.edu.my

15 September 2011

Dear Sir/Madam,

Recently I wrote to you seeking some information about strategic sourcing supplier selection practices in TNB. As of today I have not received your completed questionnaire.

Universiti Tenaga Nasional has sponsored this study to further our knowledge about TNB staff's orientations and preferences about supplier selection. By obtaining objective information about strategic sourcing supplier selection, entities related to the power industry will have a reliable source of information on which to base future decisions.

I am writing you again because of the significance each questionnaire has to the usefulness of this study. In order for the results of this study to be truly representative of TNB, it is essential that every participating executive return the questionnaire.

The enclosed package consists of a participant information sheet, a reply-paid envelope and the questionnaire

I would be very happy to answer any questions you may have and can be contacted on 03-8921 2020.

Your contribution to the success of this study will be greatly appreciated.

Yours sincerely



Sivadass Thiruchelvam  
School of Engineering

# Appendix 11



## MEMORANDUM

### Auckland University of Technology Ethics Committee (AUTEC)

To: John Tookey  
From: Charles Grinter Ethics Coordinator  
Date: 20 July 2011  
Subject: Ethics Application Number 11/111 Improving supplier selection criteria using a decision support model: A case of study of a government linked company in Malaysia.

Dear John

Thank you for providing written evidence as requested. I am pleased to advise that it satisfies the points raised by the Auckland University of Technology Ethics Committee (AUTEC) at their meeting on 9 May 2011 and I have approved your ethics application. This delegated approval is made in accordance with section 5.3.2.3 of AUTEC's *Applying for Ethics Approval: Guidelines and Procedures* and is subject to endorsement at AUTEC's meeting on 8 August 2011.

Your ethics application is approved for a period of three years until 19 July 2014.

I advise that as part of the ethics approval process, you are required to submit the following to AUTEC:

- A brief annual progress report using form EA2, which is available online through <http://www.aut.ac.nz/research/research-ethics/ethics>. When necessary this form may also be used to request an extension of the approval at least one month prior to its expiry on 19 July 2011;
- A brief report on the status of the project using form EA3, which is available online through <http://www.aut.ac.nz/research/research-ethics/ethics>. This report is to be submitted either when the approval expires on 19 July 2011 or on completion of the project, whichever comes sooner;

It is a condition of approval that AUTEC is notified of any adverse events or if the research does not commence. AUTEC approval needs to be sought for any alteration to the research, including any alteration of or addition to any documents that are provided to participants. You are reminded that, as applicant, you are responsible for ensuring that research undertaken under this approval occurs within the parameters outlined in the approved application.

Please note that AUTEC grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to make the arrangements necessary to obtain this. Also, if your research is undertaken within a jurisdiction outside New Zealand, you will need to make the arrangements necessary to meet the legal and ethical requirements that apply within that jurisdiction.

When communicating with us about this application, I ask that you use the application number and study title to enable us to provide you with prompt service. Should you have any further enquiries regarding this matter, you are welcome to contact me by email at [ethics@aut.ac.nz](mailto:ethics@aut.ac.nz) or by telephone on 921 9999 at extension 8860.

On behalf of AUTEC, I wish you success with your research and look forward to reading about it in your reports.

Yours sincerely

Charles Grinter

On behalf of Dr Rosemary Godbold and Madeline Banda Executive Secretary  
Auckland University of Technology Ethics Committee

Cc: Sivadas Thiruchelvam [sthiruch@aut.ac.nz](mailto:sthiruch@aut.ac.nz), Nevan Wright, James Rotimi

# Appendix 12



Rujukan Kami : TNB/SMK (GF&P) 15/13/11

3 Ogos 2011

**Kepada:**

Encik Sivadass a/l Thiruchelvam  
No. Pekerja: U10272  
School of Engineering of Technology  
Level 3 WS Building  
34 St. Paul Street  
Auckland 1010, New Zealand

**Melalui:**

Profesor Dr. Mohd. Zamri Bin Yusoff  
Dekan, Kolej Kejuruteraan,  
Universiti Tenaga Nasional

**MEMOHON KEIZINAN UNTUK MEMBUAT KAJI SELIDIK  
DI KALANGAN EKSEKUTIF TENAGA NASIONAL BERHAD.**

Saya merujuk kepada surat tuan bertarikh 15 Julai 2011 dan emel daripada Prof. Dr. Mohd Zamri bin Yusoff, Dekan Kolej Kejuruteraan, Universiti Tenaga Nasional mengenai perkara yang tersebut di atas.

2. Sukacita dimaklumkan bahawa pihak pengurusan TNB tiada halangan untuk membenarkan En Sivadass a/l Thiruchelvam, (U10272) untuk membuat kaji selidik akademik di bawah tajuk *"Improving Supplier Selection Criteria Using Decision Support Model: A Case Study of Government Linked Company in Malaysia"* di kalangan para eksekutif di dalam TNB.

3. Perlu diingatkan bahawa, segala maklumat yang diperolehi adalah bagi tujuan pembelajaran dan kaji selidik sahaja dan segala proses kaji selidik yang akan dilaksanakan mestilah secara beretika bagi melindungi kepentingan Tenaga Nasional Berhad. Manakala hasil kajian melalui kaji selidik ini jua akan disalurkan kepada pihak pengurusan sebagai rujukan.

*Bersambung di mukasurat sebelah.*

4. Sepanjang tempoh kaji selidik ini dijalankan tuan bolehlah menghubungi saya atau pegawai saya seperti berikut:

Nama Pegawai	No. Telefon Pejabat	No. Telefon Bimbit	emel
Pn. Suzana Ahmad	03-2296 6005	019-263 3606	suzanaa@tnb.com.my
Pn. Ruslin Rusli	03-2296 6377	013-615 3057	ruslinr@tnb.com.my

Sekian, terima kasih.

*"WE'VE GOT THE POWER – to serve, to deliver, to excel"*



(SUZANA AHMAD)

**Pengurus Kanan (Perhubungan Pekerja)**  
**Jabatan Pengurusan Ganjaran Faedah & Pentadbiran**  
**Bahagian Sumber Manusia Kumpulan**

s.k. Naib Presiden (Sumber Manusia)  
Bahagian Sumber Manusia Kumpulan



# Appendix 13



Our Reference : UNITEN/JUR 15/30/5-U10272

Date : 14<sup>th</sup> October 2011



**Winner**  
Prime Minister's Award  
and  
Quality Management Excellence Award  
2009



**TO WHOM IT MAY CONCERN**

Dear Sir/Madam,

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**RE : SIVADASS THIRUCHELVAM (STAFF NO. 90010272)**

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This letter is to confirm that Mr. Sivadass Thiruchelvam (Staff No. 90010272) is a senior lecturer in the Department of Civil Engineering, College of Engineering, Universiti Tenaga Nasional (UNITEN).

Mr. Sivadass is currently pursuing his PhD study at the Auckland University of Technology, Auckland, New Zealand under UNITEN scholarship. The title of his PhD dissertation is "*Improving Supplier Selection Criteria Using a Decision Support Model: A Case Study of a Government Linked Company in Malaysia*". This involves the study of supplier selection practices related to equipment procurement practices in the Malaysian electricity supply industry.

Any assistance to him in conducting his PhD research is greatly appreciated.

Thank You.

Prof. Dr. Mohd. Zamri Yusoff,  
Dean, College of Engineering,  
Universiti Tenaga Nasional.