Encapsulation of a Decision-Making Model to Optimize Supplier Selection via Structural Equation Modeling (SEM)

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Abstract. This paper proposes a conceptual framework to compare criteria/factor that influence the supplier selection. A mixed methods approach comprising qualitative and quantitative survey will be used. The study intend to identify and define the metrics that key stakeholders at Public Works Department (PWD) believed should be used for supplier. The outcomes would foresee the possible initiatives to bring procurement in PWD to a strategic level. The results will provide a deeper understanding of drivers for supplier’s selection in the construction industry. The obtained output will benefit many parties involved in the supplier selection decision-making. The findings provides useful information and greater understanding of the perceptions that PWD executives hold regarding supplier selection and the extent to which these perceptions are consistent with findings from prior studies. The findings from this paper can be utilized as input for policy makers to outline any changes in the current procurement code of practice in order to enhance the degree of transparency and integrity in decision-making.

1. Introduction

The procurement and purchasing function in an organisation is viewed as a critical component of supply chain management in construction industry [1]. Hence, an appropriate supplier selection can significantly lessen the purchase cost of the companies and consequently enhance the enterprise competitiveness [2].

However, there is scarce on supplier selection criteria in the Malaysian construction industry. Different criteria need to be considered for the supplier selection process. Degraeve and Roodhooft [3] declared that main focus of supplier selection were given to the price consideration. Research done by Suzari [4], indicates that factors such as supplier relationship management and supplier delivery performance emerged as the two most critical factors in the supplier selection. Their research also shows other tangible and intangible factors should also be given due consideration when making selection decisions, depending on the business context and organisational requirements. The interrelationship among the criteria of supplier selection should be given strong consideration while selecting the supplier. This is due to the multiple supplier selection criteria being interrelated to each other which could affect the supplier selection decision. According to Frödell [5], achieving efficient contractor-supplier relations has been defined as cutting costs, and reducing lead times, through reciprocal involvement by contractor, and supplier in the interface-related value creating processes.
The construction industry activities are vital to the achievement of national socio-economic development goals of providing infrastructure, shelter and employment. It is a risky business and can be classified as the most fraudulent industry worldwide, providing the perfect environment for ethical dilemmas, with its low-price mentality and fierce competition [6]. The scenario in the Malaysian construction industry is no exception, where graft and malpractices are numerously reported in the media. This lack of control would subsequently inhibit growth in the construction industries and directly restrict the effectiveness of the procurement process. Therefore, great attention are paid to develop a procurement decision-making and few studies have been conducted to optimize supplier selection in Public Work Department (PWD). However, most studies do not investigate how the critical criteria vary across members and factors that influence supplier selection. This paper aims to examine the factors that influence supplier selection, analyze the correlation exist among critical criteria and their respective significance to the supplier selection.

2. Supplier Selection Practice In The Malaysian Construction Industry

In Malaysia, construction industry has begun since independence in 1957. The increased of construction output from 1965 to 2003 reflects the industry’s important role in providing the infrastructure to satisfy development needs and facilitate investment in other economic sectors [7]. Malaysia has achieved much progress in this direction but there is more to be done. On 28 August 2007, the Malaysian Construction Industry Master Plan (CIMP) was approved by the Cabinet Committee for Investment and Infrastructure which was chaired by the Deputy Prime Minister of Malaysia [8]. This plan outlines the 10-year strategic roadmap for the Malaysian Construction Industry to develop into a world-class, innovative and knowledgeable global solution provider.

However, there have been significant changes in the technical and economic conditions prevailing in the construction industry globally in the last decades. A number of supply chain management (SCM) initiatives had been launched by the construction industry to improve internal and external efficiency, reducing waste and adding value across the entire supply chain and trying to remove their adversarial inter-organizational purchaser-supplier relationships and fragmented business process [9]. Nevertheless, it have not made the breakthrough in construction industry yet, as the attempts to replicate the benefits obtained by supply chains in other industries still testify a scarce of effectiveness and a partial and slow implementation. SCM application has particularly found obstacles in construction sector as a consequence of its particular context of “temporary multiple organization” [10] and due to the difficulties in managing networks of a large number of different companies, supplying materials, multiple services and components [9].

A systematic approach for selection of the most appropriate system is now needed [11]. The procurement and purchasing function in an organisation is viewed as a critical component of supply chain management. It is an important part of supply chain management such that successful organisations have developed comprehensive procurement strategies which are aligned to the companies’ business objectives with the purpose of helping the companies boost their business performance in the long term [4]. The role of procurement has extended far beyond merely sourcing products and services to meet internal organizational needs [12].

The new era of globalization and liberalization had caused developing country throughout the world move towards developed and industrialized nation. Thus, causing all kind of industry including construction sector to respond to the changes in demand such as broadening of customers’ and suppliers’ markets which have become more competitive [13]. One of the most important stages in the course of any supply chain which determines the success of any organization is supplier selection. It is a multi-criteria decision making process involving various criteria which may be quantitative as well as qualitative. The criteria for the supplier selection are determined by the buyer/retailer according to his requirement. The criteria may differ according to the situation [14]. Supplier selection is a critical issue in a supply chain partnership. Such partnerships involve a worldwide network of suppliers, factories, warehouses, distribution centers, and retailers through which raw materials are acquired, transformed, and delivered to customers [15]. Thus, it is important to maximize the purchasing function’s contribution to achieving the goals of the organization.
3. Formulation of a Structural Equation Model for Supplier Selection

Supplier selection attained the state of highest significance for companies in the current scenario because of increasing competition. Improper selection of suppliers will have a poor impact on the overall performance of the manufacturer. Thus, it is vital to maximize the supplier selection to achieving the goals of the organization. By data gathering and analysis, the organization could identify which criterion is the most important and compare criteria that influence the supplier selection. According to Suzari (2013), procurement strategies developed by the purchasing department must be integrated with overall business strategies which support the goals and objectives of the organization. Continuous evaluation to develop alternative supply options and competitive suppliers as well as monitoring market trends on critical products and services help organizations to achieve an effective procurement process.

Structural equation modeling (SEM) is a multivariate method that allows assessment of both direct and indirect effects of each variable on the other variables [16]. The use of SEM is justified to avoid excessive multi-collinearity that can lead to bias and unstable findings. Its aim to explore the causal relationship between objects, and to express it through model of causal relationship, path diagram and so on. Figure 1 shows the conceptual model of SEM. There are 5 steps of SEM application which are assumption, identification, estimation, evaluation and modification [17].

Figure 1: Conceptual model of SEM
4. Conclusion
Supplier selection is an integral part of the supply chain network, and choosing the right suppliers to work with will have an impact on the companies’ business operations and performance. The supplier selection criteria will continue to change based on an expanded definition of excellence to include traditional aspects of performance in addition to non-traditional. Effective supplier evaluation and purchasing processes are critical success factors for many organizations. The supplier selection decision is affected by the multiple supplier selection criteria because they are interrelated to each other. Therefore, inter relationship among the criteria of supplier selection should be given strong consideration while selecting the supplier.

5. References
[1] Sarkis, J. and Talluri, S. (2002), "A Model for Strategic Supplier Selection", Journal of Supply Chain Management, vol. 38, no. 1, pp. 18-28.
[2] Ghodspour, S. .. & O’Brien, C. (2001). The total cost of logistics in supplier selection, under conditions of multiple sourcing, multiple criteria and capacity constraint. International Journal of Production Economics, 73(1), 15–27
[3] Degraeve, Z. and F. Roodhooft, Effectively Selecting Suppliers Using Total Cost of Ownership. The Journal of Supply Chain Management, 1999. 35(1): p. 5-10.
[4] Suzari, A.R., Supplier Selection in the Malaysian Telecommunications Industry. 2013, Brunel University London: Uxbridge, United Kingdom.
[5] Frödell, M., Criteria for achieving efficient contractor-supplier relations. Engineering, Construction and Architectural Management, 2011. 18(4): p. 381-393.
[6] Adnan, H., Hashim, N., Mohd, N., Yusuwan, & Ahmad, N. (2012). Ethical Issues in the Construction Industry: Contractor’s Perspective. Procedia - Social and Behavioral Sciences, 35, 719–727.
[7] Abdulllah, P. M. D. F., Chiet, C. V., Anuar, K., & Shen, T. T. (2004). An Overview On The Growth and Development Of The Malaysian Construction Industry
[8] Karib, M. S. A. (December 2008). A Report on The Proposal for A Malaysian Construction Industry Payment and Adjudication Act. Kuala Lumpur.
[9] Aloini, D., Dulmin, R., Mininno, V., & Ponticelli, S. (2012). Supply chain management: a review of implementation risks in the construction industry. Business Process Management Journal, 18(5), 735–761.
[10] Cheng, J. C. P., Law, K. H., Bjornsson, H., Jones, A., & Sriman, R. (2010). A service oriented framework for construction supply chain integration. Automation in Construction, 19(2), 245–260.
[11] Alhazmi, T., & McCaffer, R. (2000). Project Procurement System Selection Model. Journal of Construction Engineering and Management, 126(3), 176–184.
[12] Cousins, P. D., & Lawson, B. (2007). Sourcing strategy, supplier relationships and firm performance: an empirical investigation of UK organizations. British Journal of Management, 18(2), 123-137.
[13] Micheli, G. J. (2008). A decision-maker-centred supplier selection approach for critical supplies. Management Decision, 46(6), 918–932.
[14] Punniyamoorthy, M., Mathiyalagan, P., & Parthiban, P. (2011). A strategic model using structural equation modeling and fuzzy logic in supplier selection. Expert Systems with Applications, 38(1), 458–474.
[15] Khalfan, M. M. A., & Maqsood, T. (2012). Supply chain capital in construction industry: coining the term. International Journal of Managing Projects in Business, 5(2), 300–310.
[16] Chinda, T., & Mohamed, S. (2008). Structural equation model of construction safety culture. Engineering, Construction and Architectural Management, 15(2), 114–131.
[17] Tang, L., Shen, G. Q., Skitmore, M., & Wang, H. (2014). Procurement-Related Critical Factors for Briefing in Public-Private Partnership Projects: Case of Hong Kong. Journal of Management in Engineering, 04014096.