Sci.Int.(Lahore),26(5),1841-1844,2014 ISSN 1013-5316; CODEN: SINTE 8

SUSTAINABLE CRITERIA IN A SUPPLIER SELECTION: A PRE-REVIEW

Wan Hasrulnizzam Wan Mahmood[1], Rahayu Tukimin[1,2], Mohd Razali Muhamad[1], Muhamad Zaki Yusup[1,2],

[1]Sustainable and Responsive Manufacturing Research Group,
Faculty of Manufacturing Engineering, Universiti Teknikal Malaysia Melaka,
76100 Hang Tuah Jaya, Melaka, Malaysia

[2]Kolej Kemahiran Tinggi MARA Kuantan, Km 8, Jalan Gambang,
25150 Kuantan, Pahang, Malaysia
Correspondent Email: rahayu@kktmkuantan.edu.my

ABSTRACT : *Recently, a supplier selection has received great attention since a cost of raw material constitutes a main cost of the product. Choosing the best supplier will ensure the gaining of the best quality of materials, on time, affordable price, and a good services. Due to the globalization in business, competitive market situations and the changing customers' demands, organizations should add environmental and social aspects to the existing supplier selection criteria to retain the sustainable in supply chain. Reviewing the literature and considering the developed framework for sustainable supplier selection and semi-structured interview with a few of supply chain managers in the manufacturing sector, this paper aims to present the sustainable supplier selection criteria and show the interdependency between the criteria presented.*

KEYWORDS: Supplier Development; Supplier Selection; Supplier Selection Criteria; Sustainability

1.0 INTRODUCTION

A supplier Development (SD) is widely defined as the process of working collaboratively with a supplier in improving or expanding the capabilities in supply chain. It is becomes one of the essential elements of the supply chain success and starts to gain traction as a business idea after the Second World War, predominantly in Japan [1]. An implementation of SD is suitable for the company that intends to reduce cost and streamline their operation while minimizing their defective product. SD program encourages constant communication between companies and their supplier, which enables supplier to better understand their roles towards the company success.. Generally, this program is needed for two reasons [2, 3]; (1) to reduce costs, improve quality, and delivery performance by completing projects jointly while the customer is on-site, (2) to teach suppliers a systematic process for improvements.

A supplier selection (SS) is a first step in SD. SS process has become a very important and critical activity as its results have a great impact on the quality of goods and performance of organizations and supply chains [4, 5]. Selecting a right suppliers could bring benefit in the reduction in purchasing cost, decrease in supplying risk and improve a product quality. Setak et. al [6] suggested that the achievement of the company is highly influenced by the selection of a proper supplier. A number of researches in SS have examined the decision method and criteria used to assess supplier performance [6, 7, 8, 9]. Even though many publications exist on SS, unfortunately, very little research has been conducted on the sustainable SS. So, the objective of this paper is to highlight the sustainable SS process and to determine the most common criterion considered by the manufacturer for selecting and evaluating the most suitable supplier. Besides that, this paper also showed the relationship between the criteria presented.

2.0 SUSTAINABLE SUPPLIER SELECTION

Numerous studies by researchers have highlighted several criteria in selecting and evaluating of the supplier. From review, three criteria namely; quality, delivery and price are the most vital criteria that been used in this process [9, 10, 11, 12]. By integrating all the criteria with agreement by a few supply chain managers, a supplier selection framework could be developed in strengthening supplier selection process, as shown in Figure 1.

From Figure 1, the process of SS begins when the manufacturer searches for a new supplier for a completely new product, replacing current suppliers or choosing suppliers for a new product from the existing pool of suppliers. This step will involve maybe a very large number of suppliers. This situation demands a decision making approach to make a perfect choice. The manufacturer should convert their requirement into decision criteria as a guide of choice. There are several criteria, both quantitative and qualitative [13] that should be considered in the selection process. All the criteria and the influencing factors proposed by the researchers are categorized into three dimension of sustainability; economic, social and environmental. Traditionally, SS only consider economic aspects for many years. Due to the globalization in business, competitive market situations and changing of customers' demands, organizations should add environmental and social aspects to the SS criteria to retain the sustainability in the supply chain. For instance Ho et. al [9] found that economic aspect which based on lowest cost could not guarantee that the selected supplier is a global optimal because other aspect were not being considered.

Govindan et. al [14] stressed that the social aspect should integrated the economic and environmental aspect in meeting the increasing market pressures and demands from various stakeholders. Lee et. al [15] emphasized that organization should consider environmental criteria in order to extend the product life cycle and to pursue enterprise perpetuity. Besides that, it could also help to lessen the environmental risks and increase the competitiveness of the firm.

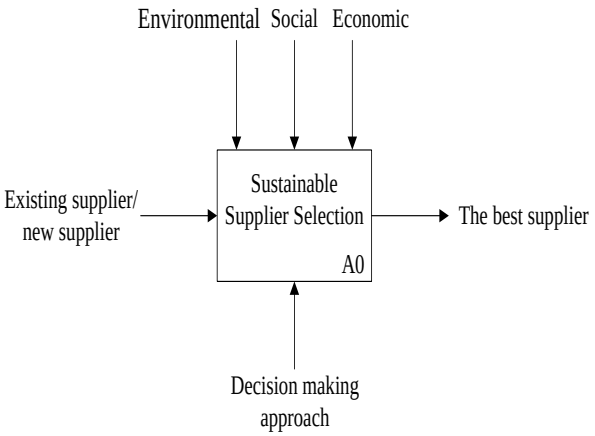

Figure 1: Sustainable Supplier Selection

Sustainable SS is complex and it is a multi-criteria decision-making (MCDM) problem because it usually involves more than one criterion and these criteria often conflict with each other. Organizations need to find the best way to evaluate and select a reliable supplier. It is a crucial decision in the management of supply chain as it could affect the overall degree of sustainability in the supply chain [16]. Therefore, it becomes the important issue in SS process [4]. Because of that, a variety of different methods used to deal with namely linear weighted models, total cost models, mathematical programming models, statistical models and artificial intelligent (AI) based techniques. Chen [17] classified the selection method into two models namely single model and combined model. From the literature, analytical hierarchy process (AHP) has become a preferred method for solving MCDM problem in real situation. Since the selection criteria are both in qualitative and quantitative, the technique and method used in decision process must be able to suit with both nature. The use of correct technique and method could bring effectiveness and efficiency to the selection process. Lima Junior et. al [5] highlighted several aspect to be considered in choosing the technique for the decision process such as adequacy to support group decision making, adequacy to changes of criteria, agility in the decision process, computational complexity and uncertainty. However, the method used for examining and selecting the supplier may vary depending on the firm's need.

2.1 Sustainable Supplier Selection Criteria

The selection sub-criteria and the influencing factors were identified based on the three dimensions of sustainability namely, environmental, social and economic. Figure 2 shows the interdependency between sub-criteria of supplier selection for the three dimensions of sustainability. These sub-criteria are viewed as important during the supplier selection process.

Based on the literature review conducted by Ho et. al [9], the most popular sub criteria is quality followed by delivery, cost, service and technology. In addition, Chang et. al [18] has summarized the previous articles and found that the most important sub-criteria are quality, price and service. Services should always be included in selection criteria because any purchase activity must involve some degree of service. A review of 170 articles published during 2000 to 2010 by Setak et. al [6] found that the most common used criteria are quality, lead time or delivery time and price. A study by Kumar et. al [19] in Indian Manufacturing Industries indicated that product quality, delivery compliance and price have a maximum criticality. Technological capability also important. Every sub criteria in the economic criteria have their own influencing factor. The influencing factor for the sub criteria based on previous studies could be described as)w:

(a) Service: handling of product, product identification and traceability, customer complaint handling, post market surveillance, capability of handling on time and capability of technology support.
(b) Quality: Quality related certificates, capability of quality management and capability of handling abnormal quality
(c) Cost: Production, transportation and ordering
(d) Technology capability: Technology level, failure mode effect and critical analysis, capability of research and development, capability of design and capability of handling pollution.
(e) Delivery: Ability to meet due date, delivery performance and delivery reliability.

For the environment criteria, the sub-criteria are green image, pollution control, green competencies and green product [20, 21, 22, 23]. The influence factors for each sub criteria are described as follow:

(a) Green image: Market reputation and customer reputation.
(b) Pollution control: Solid waste, use of hazard material, air emission, waste water, hazardous waste and energy
(c) consumption.
(d) Green competencies: Ability to alter product and process for reducing the impact on natural resources, social responsibility and green process.
(e) Green product: Recycle, reuse, green packaging and cost of component disposal.

Consequently, beside the economic and environmental factors, consideration of social factors needs to be at the forefront of companies' supplier selection agenda. Two important sub criteria, namely safety and health and employment practice could be included into the social criteria [20, 24, 25, 26]. These two factors are important to educate and train workers regarding new standards and guidelines for paying attention to their safety and health as any serious incident during manufacturing could affect the company's reputation [20]. The influencing factor for the sub criteria in the social criteria could be described as follow:

(a) Safety and health: Safety audit and assessment, OHSAS 18001 and Standardize health and safety condition.
(b) Employment practice: Training and Disciplinary and security practice.

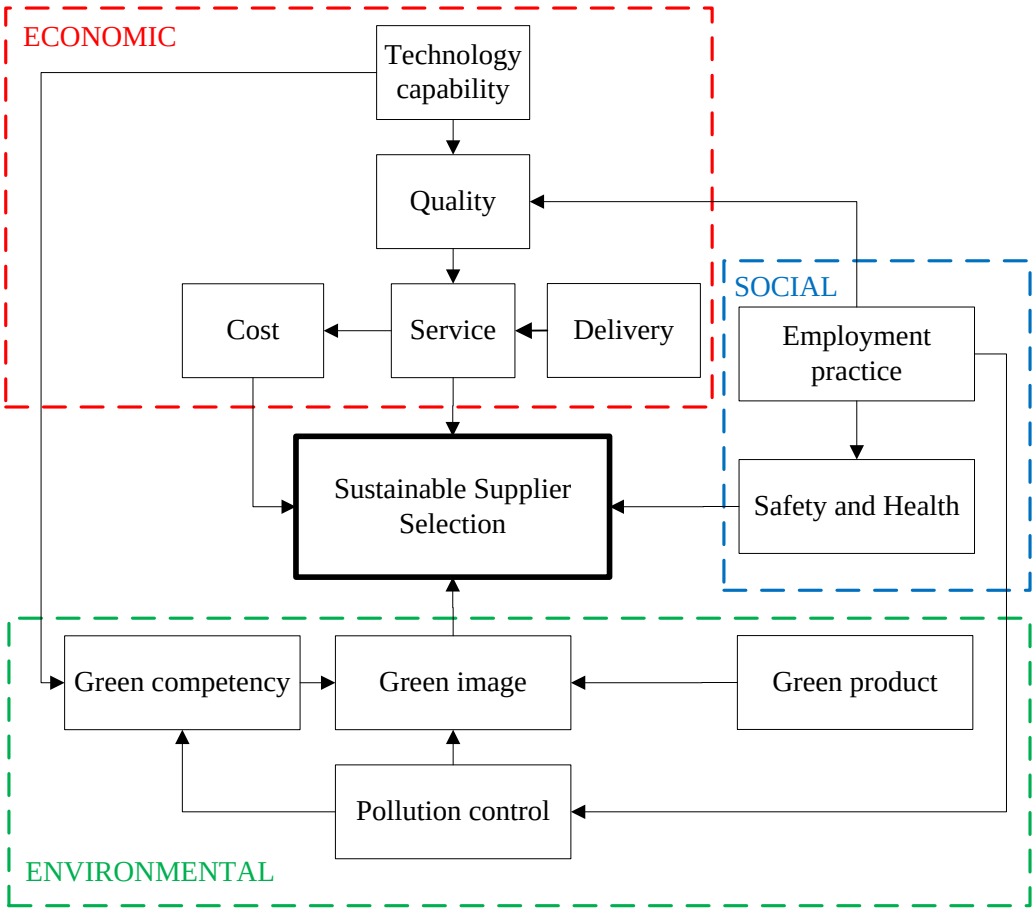

Figure 2: Interdependency between supplier selection criteria.

There is a connection between sub criteria under three dimensions of sustainability shown in Figure 2. Technological capability is one of the criteria used in assessing the quality since it helps organizations to produce a better quality products. Service criteria will be affected by the quality and delivery criteria where a good quality and delivery will lead to better service and in turn leads to cost efficiency.

For the social dimension, two criteria involved, employment practice and safety and health. Employment practice will lead to safety and health. Generally, suppliers who implement an effective safety management could prevent workplace injuries and reduce associated costs. Besides that, employment practice also has a relationship with other two criteria, pollution control and quality. It is because employment practice will lead to better quality and pollution control.

There are four criteria under environmental factor; namely, green product, pollution control, green competency and green image. Green image will be affected by other three criteria, whereas green competency will be affected by pollution control and technological capability.

3.0 CONCLUSION

In conclusion, one of the important activities in supply chain management is supplier selections, which aim to select the best supplier. It is generally considered as a complex process because many uncontrollable and unpredictable factors and criteria affecting the decision. Due to that reason, deciding which criteria have the most significant roles in decision making is a very critical step in supplier selection. Traditionally, the selection of the supplier is based on the ability of the supplier to meet economic aspect such as quality and cost. But as environmental consciousness increased, sustainability becomes an important requirement in the supply chain. Organizations start to add environment and social aspect to their supplier selection criteria. From the literatures, numerous studies defined the supplier selection criteria as a guideline in SS process and also decision making approach. Therefore, this paper developed a framework in strengthening the SS process by combining three dimensions of sustainability and show the relationship between three criteria mentioned. For future research, a comprehensive study could be conducted to compare performance of an organization that concern about sustainability in their supplier selection and vice versa.

ACKNOWLEDGEMENTS

This research was co-funded by Universiti Teknikal Malaysia Melaka (UTeM) under a University Research Grant (PJP/2013/FKP (11A)/S01201).

REFERENCES

[1] S. Scott Frahm, "Supplier Development: A Survey of Risks and Benefits," 2003. [Online]. Available: http://scm.ncsu.edu/scm-articles/article/supplier-development-a-survey-of-risks-and-benefits. [Accessed: 11-Jun-2014].

[2] Y. Thomas, "Supplier Development : Customers As A Catalyst Of Process Change," *Business Horizons*, pp. 37–44, 1996.

[3] C. Sánchez-Rodríguez, D. Hemsworth, and Á. R. Martínez-Lorente, "The effect of supplier development initiatives on purchasing performance: a structural model," *Supply Chain Manag. An Int. J.*, vol. 10, no. 4, pp. 289–301, 2005.

[4] C.-T. Chen, C.-T. Lin, and S.-F. Huang, "A fuzzy approach for supplier evaluation and selection in supply chain management," *Int. J. Prod. Econ.*, vol. 102, no. 2, pp. 289–301, Aug. 2006.

[5] F. R. Lima Junior, L. Osiro, and L. C. R. Carpinetti, "A comparison between Fuzzy AHP and Fuzzy TOPSIS methods to supplier selection," *Appl. Soft Comput.*, vol. 21, pp. 194–209, Aug. 2014.

[6] M. Setak, S. Sharifi, and A. Alimohammadian, "Supplier Selection and Order Allocation Models in Supply Chain Management : A Review," vol. 18, no. 1, pp. 55–72, 2012.

[7] L. de Boer, E. Labro, and P. Morlacchi, "A review of methods supporting supplier selection," *Eur. J. Purch. Supply Manag.*, vol. 7, no. 2, pp. 75–89, Jun. 2001.

[8] B. D. Rouyendegh (Babek Erdebilli) and T. E. Saputro, "Supplier Selection Using Integrated Fuzzy TOPSIS and MCGP: A Case Study," *Procedia - Soc. Behav. Sci.*, vol. 116, pp. 3957–3970, Feb. 2014.

[9] W. Ho, X. Xu, and P. K. Dey, "Multi-criteria decision making approaches for supplier evaluation and selection: A literature review," *Eur. J. Oper. Res.*, vol. 202, no. 1, pp. 16–24, Apr. 2010.

[10] N. García, J. Puente, I. Fernández, and P. Priore, "Supplier selection model for commodities procurement. Optimised assessment using a fuzzy decision support system," *Appl. Soft Comput.*, vol. 13, no. 4, pp. 1939–1951, Apr. 2013.

[11] J. J. H. Liou, Y.-C. Chuang, and G.-H. Tzeng, "A fuzzy integral-based model for supplier evaluation and improvement," *Inf. Sci. (Ny).*, vol. 266, pp. 199–217, May 2014.

[12] C.-N. Liao and H.-P. Kao, "An integrated fuzzy TOPSIS and MCGP approach to supplier selection in supply chain management," *Expert Syst. Appl.*, vol. 38, no. 9, pp. 10803–10811, Sep. 2011.

[13] P. K. Humphreys, Y. K. Wong, and F. T. S. Chan, "Integrating environmental criteria into the supplier selection process," vol. 138, pp. 349–356, 2003.

[14] K. Govindan, R. Khodaverdi, and A. Jafarian, "A fuzzy multi criteria approach for measuring sustainability performance of a supplier based on triple bottom line approach," *J. Clean. Prod.*, vol. 47, pp. 345–354, May 2013.

[15] A. H. I. Lee, H.-Y. Kang, C.-F. Hsu, and H.-C. Hung, "A green supplier selection model for high-tech industry," *Expert Syst. Appl.*, vol. 36, no. 4, pp. 7917–7927, May 2009.

[16] A. Amindoust, S. Ahmed, A. Saghafinia, and A. Bahreininejad, "Sustainable supplier selection: A ranking model based on fuzzy inference system," *Appl. Soft Comput.*, vol. 12, no. 6, pp. 1668–1677, Jun. 2012.

[17] Y.-J. Chen, "Structured methodology for supplier selection and evaluation in a supply chain," *Inf. Sci. (Ny).*, vol. 181, no. 9, pp. 1651–1670, May 2011.

[18] B. Chang, C.-W. Chang, and C.-H. Wu, "Fuzzy DEMATEL method for developing supplier selection criteria," *Expert Syst. Appl.*, vol. 38, no. 3, pp. 1850–1858, Mar. 2011.

[19] A. Kumar Kar and A. K. Pani, "Exploring the importance of different supplier selection criteria," *Manag. Res. Rev.*, vol. 37, no. 1, pp. 89–105, Jan. 2014.

[20] P. Ghadimi and C. Heavey, "Sustainable Supplier Selection in Medical Device Industry: Toward Sustainable Manufacturing," *Procedia CIRP*, vol. 15, pp. 165–170, 2014.

[21] M. Igarashi, L. de Boer, and A. M. Fet, "What is required for greener supplier selection? A literature review and conceptual model development," *J. Purch. Supply Manag.*, vol. 19, no. 4, pp. 247–263, Dec. 2013.

[22] T. Chiou, H. Kai, F. Lettice, and S. Ho, "The influence of greening the suppliers and green innovation on environmental performance and competitive advantage in Taiwan," *Transp. Res. Part E*, vol. 47, no. 6, pp. 822–836, 2011.

[23] D. Kannan, R. Khodaverdi, L. Olfat, A. Jafarian, and A. Diabat, "Integrated fuzzy multi criteria decision making method and multi-objective programming approach for supplier selection and order allocation in a green supply chain," *J. Clean. Prod.*, vol. 47, pp. 355–367, May 2013.

[24] C. Gauthier, "Measuring Corporate Social and Environmental Performance: The Extended Life-Cycle Assessment," *J. Bus. Ethics*, vol. 59, no. 1–2, pp. 199–206, Jun. 2005.

[25] Z. Molamohamadi, N. Ismail, Z. Leman, and N. Zulkifli, "Supplier Selection in a Sustainable Supply Chain," *J. Adv. Manag. Sci.*, vol. 1, no. 3, pp. 278–281, 2013.

[26] C. Bai and J. Sarkis, "Integrating sustainability into supplier selection with grey system and rough set methodologies," *Int. J. Prod. Econ.*, vol. 124, no. 1, pp. 252–264, Mar. 2010.

Specia issue
Sci.Int.(Lahore),26(5),1841-1844,2014 ISSN 1013-5316; CODEN: SINTE 8