

# Supplier Selection in a Sustainable Supply Chain

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**Abstract**— Supplier selection is a process by which the firms identify, evaluate, and select the suppliers of their required raw materials. Although this process deploys an overwhelming amount of any firm's financial resources, it would give substantial advantages if suppliers with high value are selected. Moreover, with paying more attention to the exhaustible natural resources and industrial pollution, sustainable supply chain management and sustainable supplier selection have significantly attracted the academic and corporate attention in recent years. Besides conventional criteria such as price and quality, sustainability cares about environmental and ecological respects of industrial activities. Reviewing the literature and considering the previous proposed frameworks for sustainable supply chain, this paper firstly aims at presenting a new structure which considers all of the influential relations between the members of the supply chain. Secondly, based on the new framework, the essential supplier selection measures and criteria are discussed. As the result, the offered scheme can be used by the manufacturers to select the most appropriate suppliers who contribute to the movement of the supply chain toward sustainability.

**Index Terms**—supply chain management, supplier selection, sustainable development

## I. INTRODUCTION

In the conventional supply chain management, the companies usually evaluated their suppliers based on price, quality, delivery time, and their provided services. However, due to the increasing prices of energy, industrial contamination, dearth of imperative raw materials and natural resources, and environmental disasters, sustainability has been considered as the most decisive criteria regarded by the firms/ companies for selecting the most suitable supplier in the recent researches. These firms are mainly referred to as the focal firms/companies which are the ones responsible for managing the supply chain, for interacting with the consumers, and for designing the manufactured product or provided service. In other words, they are the companies and firms known by all stakeholders including government, customers, shareholders, etc. in charge of every single problem caused. Moreover, the characteristics of the raw materials can be the most influential factor in forming the final product's features. Therefore, selecting the appropriate raw materials and their supplier is very important in producing perfect

products that satisfies all the stakeholders, who affect and/or would be affected by the firms' activities.

For having a clear understanding of the subject, we firstly define the important words used throughout this research. Supply chain includes all of the activities related to the material, capital, and information flow between the members of the chain involving the suppliers, manufacturers, distributors, retailers, and customers who are accompanying with each other in satisfying the end customers' needs and requirements. So, supply chain management (SCM) seeks to integrate these activities to help the supply chain and its members to obtain their specified goals.

According to WCED definition in 1987 [1], sustainable development means satisfying the present needs without jeopardizing the future generations' ability in meeting their own requirements and needs. Later, in 1999, National Academy Press [2] defined sustainability as the level of persistent human activity and consumption, so that humans can provide goods and services indefinitely. In the current literature, however, sustainability is described by three major dimensions which are environment, society and economy. These dimensions are illustrated in [3] by Fig. 1, which is called the triple bottom line (TBL) principle. They are also referred to as the three sustainability pillars including profit, planet, and people. Moreover, [4] believes in adding technology as the fourth dimension, while [5] and [6] consider it as one of the sustainability enablers.

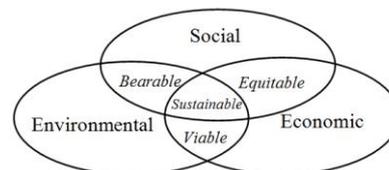


Figure 1. Three basic pillars of sustainability [3]

Socially looking, sustainability aims at meeting human needs without violating their moral and legal rights. Economic sustainability intends to maximize the income flow that could be generated while minimizing the stock of assets or capital yielding this income. From the environmental perspective, companies' activities should not risk the environment, natural systems and life on the Earth.

Sustainable supply chain management can be now defined as managing and conducting the material, capital, and information flow while all of the fundamental pillars of sustainability (economy, society, and environment) are

considered. In this point of view, it is the focal company's responsibility to take the economic, environmental, and social issues into account in the entire supply chain. In other words, the focal companies must be responsive to the stakeholders for the quality, price, and social and environmental effects of the produced products, regardless of its upstream members and their roles. Moreover, the features of the raw materials, such as the quality and price, used in the production can play a major role in meeting the needs of the customers, shareholders, government, and any other stakeholders. Therefore, supplier selection is a fundamental step in seeking the stakeholders' satisfaction.

## II. CONVENTIONAL SUPPLIER SELECTION

One of the necessary and important steps in managing the companies' corporate legitimacy and reputation is controlling and monitoring the supplier evaluation and selection [7] which is one of the main concerns of many researchers. It is obvious that every single firm in the supply chain is mostly trying to maximize its profit. Moreover, the price of the raw materials has a great influence in the total cost of the firm. Hence, the 'price' can be considered as the most important factor in supplier selection and evaluation. Based on the recent researches, price is the prime criterion considered by industries [8].

Many studies have been conducted to depict the role of quality management and show its relation with supplier evaluation. Subsequently, quality has been recognized by [9] as the second key criterion in supplier evaluation and selection. The next important criterion in supplier evaluation referred in the studies is delivery time. There are also some researches about the effect of services provided by the suppliers in meeting the buyers' demand. This means the ability of the suppliers in satisfying the buyers' requirements in a timely manner as well as responding quickly to the demand changes while satisfying their price expectations simultaneously (for more information, refer to [8]). Therefore, conventional criteria such as price, quality, delivery, and service can play a key role in supplier evaluation and selection.

## III. SUSTAINABLE SUPPLIER SELECTION

Besides the papers related to the conventional supplier selection, the number of the researches incorporating the environmental and social factors in supplier evaluation and selection is increasing. For instance, [10] concluded that having environmental evaluation criteria would lead to choosing more compliant suppliers. Ref. [11] classified

environmental supplier selection criteria into four categories including green competencies, current environmental efficiency, supplier's green image and net life cycle cost. Ref. [12] also proposed an instrument based on Ishikawa fishbone for suppliers evaluation from the environmental point of view. They identified four factors of supplier evaluation including supplier evaluation as a company, his processes assessment, product evaluation, and transportation. A non-economic criteria is integrated into the purchasing process in [13] and both green and social supplier selection criteria are considered. Ref. [14] studied the potential impact of social responsibility on the supply chain relationships. Ref. [15] presented a framework of environmental qualitative and quantitative criteria that the companies can consider in their supplier selection processes. Moreover, a review of metrics, indicators, and classification of social sustainability and corporate social responsibility (CSR) is done by [16]. They also demonstrated how decisions can be made to improve the social sustainability of a supply chain. Ref. [17] described the result of a pilot study of corporate responsibility (CR), which embraces social, ethical and environmental challenges, within the replenishment processes of nine large organizations. On the field of sustainable supply chain, [18] reviewed the literature and proposed a conceptual framework considering the related researches. An investigation of the effect of ethical culture on purchasing and supply management is conducted in [19] and the elements for socially and environmentally sustainable supplier selection are identified. Ref. [20] analyzed the impact of stakeholder pressure on supplier selection decisions in terms of social, environmental, and economic criteria.

Ref. [18] represented Fig. 2 as the framework for sustainable supply chain. In this figure, the focal company interacts with the supplier on one hand and must satisfy the government, customer, and shareholder on the other hand. Moreover, in order to produce sustainable products in a sustainable supply chain, it must consider the sustainability criteria in selecting the proper suppliers.

Here, we extend this framework to Fig. 3 which gives a more comprehensive overview of how the supply chain members affect each other in a sustainable context and what the process of supplier selection is.

As shown in Fig. 3, the entities or stakeholders of a focal company are:

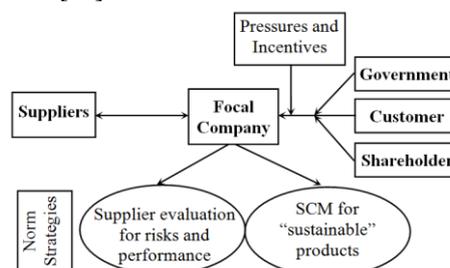


Figure 2. Triggers for sustainable supply chain management

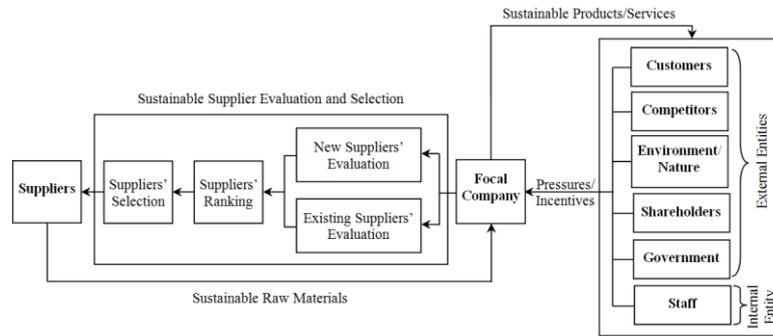


Figure 3. The proposed framework for supplier selection in a sustainable supply chain

#### A. Customers

Actually, the request from the customers is a stimulus to the supply chain which makes the focal company to produce their required goods. For this purpose, it needs some materials for production which would be supplied by a supplier. The customers mainly think about the quality and the price of the product and accordingly decide from which company to buy. These factors are mostly affected by the price and quality of the raw materials used in the production line.

#### B. Competitors

The competitors make the company concern more about customers' satisfaction. So, it must try to reduce the price and improve the quality of the products simultaneously compared to its competitors to be able to survive in the market.

#### C. Environment

The environment is highly affected by the manufacturing and industrial activities which will directly influence the quality of life on earth. This is through consuming raw materials and energy, emitting toxic gases and materials which causes air pollution, and making sound pollution. The company can control and even prevent these harmful results by sparingly using invaluable energy and applying safer materials and methods.

#### D. Stakeholders

The shareholders mostly think about their capital and expect the focal company to return them great revenue. What a company needs to do is reducing the costs of operation and production. These costs are highly related to the technology and the used raw materials. The more advanced technology a company uses and the more high-quality materials it applies, the less capital is needed in the long term as the percentage of defective items and remanufacturing decreases.

#### E. Staff

The other pressure of any factory is from its staff seeking their basic human rights such as health and proper salary. They expect the company, in which they are working, to care about their health by reducing the amount of toxic materials applied in the production and

using safe techniques and machines. They also request for having proportional salary to their efforts.

#### F. Government

The government is the most influential entity of any focal company as it concerns about all of the other entities and their rights. It, actually, cares about economic, social, and environmental issues related to the company's operations and activities.

### IV. SUSTAINABLE CRITERIA FOR SUPPLIER SELECTION

Regarding the previous chapters and the aforementioned entities and their requirements, the characteristics of the raw materials play an essential role in fulfilling the stakeholders' needs. So, evaluating the suppliers of the raw materials and selecting the best suppliers would be of great importance. Accordingly and with referring to [7], [8], some of the criteria for sustainable supplier evaluation and selection which best fit the stakeholders' expectations can be categorized into following four groups;

- Business criteria: quality of the products and services, time of delivery, commitment to continuous improvement, information sharing, product development, flexibility in changing product volume, launching new products, using new technologies, warranty and insurance, and geographical location.
- Economic criteria: initial price, financial stability, and credit strength.
- Social criteria: discrimination in employment (age, religion, gender, and other similar factors), child labor, flexible working arrangements, satisfactory working environment, health and safety of the staff and customers, customer privacy, and cultural properties.
- Environmental criteria: environmental management systems for preventing and controlling pollution (such as emissions, effluents, and waste), resource consumption (energy, water, minerals), recycling, and animal rights.

### V. CONCLUSION

The introduction of sustainability into the manufacturing industries has obliged the supply chains and specifically the focal companies to move instantly

toward producing long-life sustainable products. This, in turn, desires a powerful infrastructure which is implementing sustainability in every single member of the chain. So, recognizing the relationships and effects of the supply chain members on each other would be of considerable importance. Moreover, as the suppliers supply the prerequisites of the production, raw materials, they would play a key role in forming and preserving a sustainable supply chain. Consequently, supplier selection process and criteria has attracted the attention of many researchers and is being studied vastly. This paper represents an extended framework of sustainable supply chain and then explains the expectations of supply chain members from the focal company and defines the most important supplier selection criteria based on sustainability.

The area of sustainability in supplier selection has a great potential for further researches. This paper, for example, can be extended by conducting a survey to compare overall performance of the companies which care about sustainability issues and the ones who do not. The effects of every criterion on company's performance and stakeholders' satisfaction can be then studied statistically to ascertain the most critical measures.

#### REFERENCES

- [1] World Commission on Environment and Development WCED, Our Common Future, New York, 1987.
- [2] Our Common Journey: A Transition Toward Sustainability, National Academy Press, 1999.
- [3] J. Elkington, "Towards the sustainable corporation: Win-win-win business strategies for sustainable development," *California Management Review*, vol. 36, no. 2, pp. 90–100, 1994.
- [4] R. Baud, "The concept of sustainable development: Aspects and their consequences from a social-philosophical perspective." *YES Youth Encounter on Sustainability Summer Course Material*, Braunwald, Switzerland, 2008.
- [5] M. Garetti and M. Taisch, "Sustainable manufacturing: Trends and research challenges," *Production Planning & Control: The Management of Operations*, vol. 23, no. 2–3, pp. 83–104, 2012.
- [6] Z. Molamohamadi and N. Ismail, "Developing a new scheme for sustainable manufacturing," *International Journal of Materials, Mechanics and Manufacturing*, vol. 1, no. 1, pp. 1–5, 2013.
- [7] C. Bai and J. Sarkis, "Integrating sustainability into supplier selection with grey system and rough set methodologies," *International Journal of Production Economics*, vol. 124, no. 1, pp. 252–264, Mar 2010.
- [8] V. Baskaran, S. Nachiappan, and S. Rahman, "Indian textile suppliers' sustainability evaluation using the grey approach," *International Journal of Production Economics*, vol. 135, no. 2, pp. 647–658, Feb 2012.
- [9] R. K. Kannan and V. Tan, "Supplier selection and assessment: their impact on business performance," *The Journal of Supply Chain Management*, vol. 38, no. 4, pp. 11–22, 2002.
- [10] K. Green, B. Morton, and S. New, "Purchasing and environmental management: Interactions, policies and opportunities," *Business Strategy and the Environment*, vol. 5, no. 3, pp. 188–197, 1996.
- [11] G. Noci, "Designing 'green' vendor rating systems for the assessment of a supplier's environmental performance," *European Journal of Purchasing & Supply Management*, vol. 3, no. 2, pp. 103–114, 1997.
- [12] L. Enarsson, "Evaluation of suppliers: how to consider the environment," *International Journal of Physical Distribution and Logistics Management*, vol. 28, no. 1, pp. 5–17, 1998.
- [13] I. Maignan and B. A. S. Hillebrand, "Managing socially-responsible buying: how to integrate non-economic criteria into the purchasing process," *European Management Journal*, vol. 20, no. 6, pp. 641–648, 2002.
- [14] M. M. Carter and C. R. Jennings, "The role of purchasing in corporate social responsibility: A structural equation analysis," *Journal of Business Logistics*, vol. 25, no. 1, pp. 145–186, 2004.
- [15] P. Humphreys, R. McIvor, and F. Chan, "Using case-based reasoning to evaluate supplier environmental management performance," *Expert Systems with Applications*, vol. 25, no. 2, pp. 141–153, Aug. 2003.
- [16] M. J. Hutchins and J. W. Sutherland, "An exploration of measures of social sustainability and their application to supply chain decisions," *Journal of Cleaner Production*, vol. 16, no. 15, pp. 1688–1698, Oct 2008.
- [17] I. Harwood and S. Humby, "Embedding corporate responsibility into supply: A snapshot of progress," *European Management Journal*, vol. 26, no. 3, pp. 166–174, Jun 2008.
- [18] S. Seuring and M. Müller, "From a literature review to a conceptual framework for sustainable supply chain management," *Journal of Cleaner Production*, vol. 16, no. 15, pp. 1699–1710, Oct 2008.
- [19] P. Goebel, C. Reuter, R. Pibernik, and C. Sichtmann, "The influence of ethical culture on supplier selection in the context of sustainable sourcing," *International Journal of Production Economics*, vol. 140, no. 1, pp. 7–17, Nov 2012.
- [20] C. Reuter, P. Goebel, and K. Foerstl, "The impact of stakeholder orientation on sustainability and cost prevalence in supplier selection decisions," *Journal of Purchasing and Supply Management*, vol. 18, no. 4, pp. 270–281, Dec 2012.