Sustainable Supplier Selection in Medical Device Industry: Toward Sustainable Manufacturing

Pezhman Ghadimi*, Cathal Heavey

*Enterprise Research Centre, University of Limerick, Limerick, Ireland.

Abstract

In order to achieve sustainability in manufacturing operations, sustainability needs to be incorporated in all stages of an organization’s supply chain. One aspect of sustainable manufacturing includes the manufacturing of sustainable products in which procurement of sustainable components by eligible suppliers plays an important role. Recently, green/sustainable supplier evaluation and selection has achieved a considerable amount of attentions among researchers. Current research narrows the gap in sustainability evaluation of suppliers specifically operating in medical device industry using an efficient Fuzzy Inference System (FIS). Finally, it is concluded that how sustainable procurement can lead a manufacturer to move toward sustainable manufacturing.

Keywords: Sustainability; sustainable product design; sustainable supplier selection; sustainable manufacturing.

1. Introduction

According to the National Council for Advanced Manufacturing [1] in the U.S., sustainable manufacturing includes the manufacturing of “sustainable” products and the sustainable manufacturing of all products. Consequently, the first part of this definition includes manufacturing of renewable energy, energy efficiency, green building, and other green and social equity-related products and the second part focuses on the sustainable manufacturing of all products with consideration of full life cycle stages of product manufactured.

Jayal et al. [2] pointed out that incorporating sustainability in manufacturing not only requires considering sustainability in products and manufacturing processes but also in the entire supply chain. Vinodh and Joy [3] pointed out that manufacturing organizations can survive in the competitive environment by integrating important drivers of sustainable manufacturing (environmental, economic, and social sustainability). Recently, Gunasekaran and Spalanzani [4] investigated that environmentally friendly manufacturing has become an interesting issue among companies around the world. Consequently, manufacturing a more sustainable product can help an organization to move toward sustainable manufacturing. A product consists of many components that all need to be sourced from other manufacturing companies or suppliers. All those sourced components are required to be aligned with the sustainability policies of the buyer company. Hence, the Triple Bottom Line (TBL) concept where all three dimensions of sustainability are considered needs to be incorporated into the supplier selection policies of the buyer company, if the buyer organization seeks to move toward sustainable manufacturing.

The main focus of this paper is to shed light on the process of supplier selection in the medical device manufacturing industry sector where there are limited academic research activities published. One of the main challenges in the medical device sector is the sharing of data across the supply chain echelons due to its high confidentiality. Before introducing some of the main criteria involved in the process of supplier selection in medical device industry, a literature review of previous research activities in the research domain
of sustainable supplier selection is presented.

Bai and Sarkis [5] utilized grey system and rough set theory with the explicit consideration of sustainability attributes for the supplier selection process. In their study, they presented a comprehensive literature review of the available criteria for supplier selection.

Govindan et al. [6] mentioned that achieving TBL benefits rely on the suppliers’ environmental and social collaboration. They developed a fuzzy Multi-Criteria Decision Making MCDM approach for supplier selection decisions with consideration of sustainability criteria. One drawback of their research activity was to introduce a hypothetical illustrative example rather than providing a real world application.

Dai and Blackhurst [7] developed a an integrated analytical approach, combining Analytical Hierarchy Process (AHP) with Quality Function Deployment (QFD), to enable the ‘voice’ of company stakeholders in the process. Their developed methodology consisted of four hierarchical phases: linking customer requirements with the company’s sustainability strategy, determining the sustainable purchasing competitive priority, developing sustainable supplier assessment criteria, and lastly assessing the suppliers.

Buyukozkan and Cifci [8] developed a novel approach based on fuzzy analytic network process within multi-person decision-making schema under incomplete preference relations. The method not only makes sufficient evaluations using the provided preference information, but also maintains the consistency level of the evaluations. The main criteria considered in their study were organization, financial performance, service quality, technology and social responsibility and environmental competencies. Their proposed framework was applied in a Turkish white goods industry.

Amindoust et al. [9] proposed a ranking method on the basis of fuzzy inference system (FIS) in order to evaluate and rank a given set of suppliers. In the evaluation process, decision makers’ opinions on the importance of deciding the criteria and sub-criteria, in addition to their preference of the suppliers’ performance with respect to sub-criteria are considered in linguistic terms.

Azadnia et al. [10] proposed an integrated approach of Fuzzy Analytical Hierarchy Process (FANP) and fuzzy logic in order to solve the sustainable supplier selection problem. In their research, greenhouse effect, pollution and environmental protection were considered as environmental elements. Cost and service were categorized as economic elements with risk and social reputation were included in social sustainability.

Recently, Govindan et al. [11] published a review paper in the area of green supplier evaluation considering three points for analyzing the papers: (i) which selection approaches are commonly applied?, (ii) what environmental and other selection criteria for green supplier management are popular?, (iii) and what limitations exist?. They concluded that “environmental management systems” is the most common criterion in the literature. Brandenburg et al. [12] also published a more recent review paper on mathematical models that focus on environmental or social factors in forward supply chains.

In this paper, the most important criteria of supplier selection in medical device industry is gathered and categorized that can be considered as the main contribution of the paper. A short description of some of these criteria (exclusively being used in medical device sector) is provided in this paper to give a better understanding to the readers. An efficient Fuzzy Inference System (FIS) is utilized in order to quantify the data and information regarding each of the sub criteria. The rest of this paper continues with section 2 that gives a description of the methodology. Section 3 presents the main parts of this paper that is about addressing the problem in medical device industry and implementation of the methodology together with results and discussion. Finally, some remarks were concluded in Section 4.

2. Methodology

The utilized methodology in current research activity is based on previously conducted research activity by Ghadimi et al. [13] in assessing the sustainability of a typical product design. The core approach of that methodology is modified in order to evaluate the suppliers with regards to TBL attributes. The flow diagram of the methodology is shown in Fig. 1.

3. Real world application

The main focus of this research activity is to highlight the process of supplier selection in Medical device industry as it is almost neglected in the current supplier selection literature. Company XYZ is a manufacturer of medical devices for hospitals and health care organizations. It is located in Shannon, Ireland. The company currently employs 16 people. XYZ added a new section to its family of departments in 2006 that has specialized competence in miniature spring components for the medical device industry. As such XYZ is ISO13485 (specifies requirements for a quality management