ABSTRACT

Numerous green regulations currently require companies to be responsible for their effect on the natural environment, in addition to achieving their economic goals. In view of this, many companies have implemented the ISO14001 system in their supply chain to comply with green regulations. However, implementing such a system involves technical and communication efforts; hence, an effective method is needed to support the implementation. In this paper, the authors propose a value engineering (VE)-based model with quality tools to support the implementation of the ISO14001 system in the Green Supply Chains. In it, they applied the framework of VE with the quality engineering tools Fishbone Analysis and Failure Mode Effect Analysis for the qualitative and quantitative analysis of green issues in supply chains to cover quality, risk, and value of the system. The proposed method was applied to a global electronics manufacturing company in Taiwan, and the application results showed positive outputs in terms of CO2 emission, power consumption, water consumption, and waste water recovery. Based on the evidence, academic and industrial implications are discussed.
1. INTRODUCTION

The green supply chain concept is a model in which companies minimize the environmental impact of their industrial activities while maintaining their quality, reliability, cost-efficiency, performance, and energy efficiency. The concept involves a paradigm shift in business operations by transforming the end-of-pipe control operations of an organization to conform to environmental regulations that facilitate the minimization of ecological damage, while maximizing total economic profits (Srivastava 2007). From researching different manufacturing companies, implemented ISO14001 is the way to set up robust environment policy by transforming the entire supply chain to green through greener products and strong regulatory pressure from government and non-government organizations (Dey and Cheffi, 2013). It is critical for organisations to meet the requirements of green guidelines by producing green products and managing their entire supply chain. This also implies an obligation for organisations to treat used materials and products appropriately. Because external pressures have encouraged innovators to identify or develop greener processes and products, companies must incorporate environmental factors into their supply chain system to meet customer expectations (Swanson et al., 2005; Grote et al., 2007).

Walton et al. (1998) asserted that the green supply chain is a value-added concept that assists companies to maintain stable long-term relations with suppliers to benefit both the environment and businesses. However, implementing a green supply chain is complicated. The industrial survey by Al-Darrab et al. (2013) found that most implementation of quality management projects was unproductive and required an integrated approach. We developed a value engineering (VE)-based model combined with quality tools to improve the green performance of a supply chain. To achieve this, we considered the balance between environmental expenses and firm benefits.

In this paper, we first review related literature and then present the methodology of the VE-based model with quality tools in Section 3. We then apply this method to an industrial case in Section 4. On the basis of the application evidence, we discuss the academic and industrial implications in Section 5. Finally, we present our conclusion and suggestions for future research.

2. LITERATURE REVIEW

In this section, we review the literature on green supply chains and research methods. First, we review ISO14001 and green supply chain models. Second, we review green businesses. Third, we review papers on VE and its use in environmental and quality improvements. Lastly, we discuss the findings and gaps in the literature.

2.1. ISO14001 and Green Supply Chain Model

ISO14001 provides the industry with primary guiding principles for developing an environmental management system, and offers self-checking mechanisms on environmental performance. The ISO14001 objectives include both quality and environmental aspects that seek to mitigate emissions and effluents, reduce the environmental effect of industries, and enhance customer satisfaction (Chen, 2005). Nishitani (2009) stated that the relationship between the adoption of ISO14001 and economic performance is positive; implementing ISO14001 satisfies stakeholders because it demonstrates that a firm employs advanced environmental management practices (Prajogo et al., 2014). Asif et al. (2011) discussed envi-