



Close-loop or open hierarchical structures in green supply chain management under uncertainty



Ming-Lang Tseng^{a,1}, Ru-Jen Lin^{a,*}, Yuan-Hsu Lin^b, Rong-Hui Chen^a, Kimhua Tan^c

^a Department of Business Administration, Lunghwa University of Science and Technology, Taiwan

^b Department of Finance, MingDao University, Taiwan

^c Business School, the University of Nottingham, United Kingdom

ARTICLE INFO

Keywords:

Close-loop and open hierarchical structures
Green supply chain management
Fuzzy set theory
Analytical network process

ABSTRACT

This study aims to explore the differences between close-loop and open hierarchical structures, which are used in the analytical network process (ANP) analysis of green supply chain management (GSCM) under uncertainty. Specifically, this study examines the interdependence among the proposed aspects and criteria used to assess GSCM in two hierarchical structures and compares these results to those of a real situation. Additionally, the aspects and criteria involve qualitative preferences in GSCM evaluation. Hence, this study proposes to use both hybrid fuzzy set theory and ANP methods. Examining two types of hierarchical structure provides the ability to examine study problems that have similar aspects and criteria with respect to situations that occur in GSCM. This study argues that while many of the commonly employed close-loop and open hierarchical structures display numerous worthwhile operational processes, further refinement of the criteria and methods are needed to improve the field. The results indicate that the close-loop hierarchical structure more closely resembles existing applications. The managerial implications of this result are discussed, and concluding remarks are provided.

© 2013 Elsevier Ltd. All rights reserved.

1. Introduction

Environmental management has evolved to include boundary-spanning activities in the supply chain, and both upstream and downstream activities are included in green supply chain management (GSCM) (Lee, Kang, Hsu, & Hung, 2009; Sarkis, 1998). The European Union has established a variety of environmental policies, including the restricted use of hazardous substances in electrical and electronic equipment (RoHS) and waste electronics and electrical equipment directives (WEEE). These directives ban manufacturers, sellers, distributors and recyclers of electrical and electronic equipment from launching new equipment that contains hazardous materials and electronic waste on the market (Muduli, Govindan, Barve, & Geng, 2013; Tseng, 2010; Tseng, Chiang, & Lan, 2009a). Zhu, Sarkis, and Lai (2008) showed that even though there are significant environmental reasons to motivate close-loop supply chains, regulatory, competitive and economic pressures also play roles in the adoption and implementation of closed loop supply chains across industries. Fahimnia, Sarkis,

Dehghanian, Banihashemi, and Rahman (2013) presented a win-win goal of improving both economic and environmental performance; the green growth decoupling is the explicit objective of the close-loop supply chain model. Nonetheless, this study generates a hierarchical framework to represent firms when selecting suitable suppliers. Nevertheless, a limited understanding of the close-loop hierarchical structures of GSCM has hindered the development of a widely accepted framework that characterizes and categorizes the relevant environmental activities.

Currently, a wide variety of studies on GSCM can be found in the literature (Srivastava, 2007; Toke, Gupta, & Dandekar, 2012; Tseng, 2010; Zhu & Geng, 2001; Zhu et al., 2008). Through GSCM, firms can select from a wide variety of suppliers and can leverage resources throughout the firm to eliminate the environmental impact of supply chain activities (Tseng, 2010; Tseng, Divinagracia, & Divinagracia, 2009b). Firms typically expect their suppliers to go beyond environmental compliance and to develop efficient green product designs. In addition, suppliers are expected to assess the life cycle of a product. GSCM utilizes the supplier's processes and technologies, as well as the supplier's ability to integrate environmental concerns and to enhance the firm's competitive advantage. Nevertheless, a firm's suppliers must satisfy GSCM aspects and criteria under the constraints of incomplete information and subjective human preferences (uncertainty). A hierarchical structure is always the basis for multi-criteria decision making (MCDM).

* Corresponding author. Address: #300 Sec. 1, Wanshou Road, Gueishan Township, Taoyuan 33306, Taiwan.

E-mail addresses: tsengminglang@gmail.com (M.-L. Tseng), linrujen01@gmail.com (R.-J. Lin), yuanshu@mdu.edu.tw (Y.-H. Lin).

¹ Address: #300 Sec. 1, Wanshou Road, Gueishan Township, Taoyuan 33306, Taiwan.

The GSCM evaluations are often based on subjective preferences or incomplete information in real systems.

In the literature, proposed an open hierarchical decision framework that is based on the literature and environmentally conscious business practices for an evaluation of GSCM. Tseng and Chiu (2013) presented a study on practicing GSCM and selecting a green supplier that meets their requirements in a close-loop hierarchical structure. Choosing suitable suppliers is a key strategic task for eliminating the environmental impact in GSCM. Academically, Kainuma and Tawara (2006) extended the range of the supply chain to include reuse and recycling throughout the life cycle of products and services and proposed a multiple attribute utility theory for assessing a lean and green supply chain; the performance of a supply chain is assessed not only from the managerial viewpoint but also from the viewpoint of environmental performance. Additionally, GSCM and logistics efforts have caused organizations to consider closing the supply chain loop. Within management practices, recoverable product environments and the design of the appropriate products and materials are important for environmentally conscious manufacturing and logistics (Beamon, 1999; Seuring, 2004; Zhu et al., 2008). None of these studies has compared the results of the real status, close-loop and open hierarchical structures of GSCM together.

In addition, there are studies to propose the open-structure using fuzzy set theory and analytical new work process (ANP) (Büyükoçkan & Çifçi, 2012; Dağdeviren & Yüksel, 2010; Luo, Zhou, Zheng, Mo, & He, 2010; Sevkli et al., 2012). GSCM and logistics efforts have caused organizations to consider closing the supply chain loop. The proposed study is only specifically investigating the role of environmentally based practices and pressures and what they mean to the management of close-loop supply chain (Chen & Chang, 2012; Chen & Chang, 2013; Zhu et al., 2008). However, these studies present the importance and modeling methods of close-loop supply chain. The way to analyses the close-loop GSCM is never being study in recent existing literatures, specifically, in MCDM. In close-loop ANP studies, Tseng, Wang, Chiu, Geng, and Lin (2013) proposes to evaluate green innovation practices using a hybrid MCDM analysis included fuzzy set theory and ANP with entropy weights. In addition, there are some studies applied close-loop fuzzy ANP (Tseng, 2011a; Tseng, 2011b; Tseng, 2013) in literatures. None of the prior GSCM literature has presented the close-loop and open hierarchical structures and compared their decision making outputs with a real situation. This comparison might improve the decision quality for an organization.

Hence, this study makes several contributions to the literature by comparing the GSCM of close-loop, open structure and real situation approaches to the examination of GSCM in different approaches, thus highlighting the managerial implications of GSCM for case firm. Importantly, this is the first study to compare the open structure and close-loop of GSCM at both the supply chain perspective (suppliers-manufacturer-customers). Moreover, only a limited amount of literature has empirically analyzed the linguistic preferences on firm-level GSCM. This study fills that gap by constructing a set of corporate aspects and criteria using ANP in the suppliers, manufacturer and customers perspectives and extract from the linguistic preferences of experts (Büyükoçkan & Çifçi, 2012; Sevkli et al., 2012; Tseng, 2011a, 2011b, 2013). The fuzzy set theory is used to translate perceptions into triangular fuzzy numbers (TFNs) and defuzzified them into crisp value. The ANP is used to analyze and interdependence the aspects and criteria and prioritize the hierarchical and interdependence relations among the GSCM aspects and criteria.

The objective of this study is to compare and evaluate the close-loop and open hierarchical structures with the real status of GSCM under uncertainty. A challenge of this study is that GSCM

evaluation involves uncertainty because of the rapid changes in environmental information, and these aspects and criteria are measured in linguistic terms. Additionally, in real situations, many aspects and criteria are interdependence when evaluating a supply chain. In Section 2 of this paper, a literature review of GSCM is provided. The method used to develop GSCM criteria was validated and is presented in Section 3. Section 4 presents the results of the real status of close-loop and open hierarchical structures, and the implications of the results are discussed in Section 5. This paper is concluded in Section 6 by summarizing the results, implications, and limitations of this study and by discussing potential topics for future research.

2. Literature review

This study establishes an analytical model and reviews GSCM perspectives, definitions, aspects and criteria measures. In addition, this study proposes the combined use of fuzzy set theory and ANP and examines GSCM measures in two types of hierarchical structures.

2.1. Green supply chain management

The GSCM criteria have been used to explain green planning, materials control and external information flows. Researchers categorize these criteria into strategic, inter-organization, and internal service quality, addressing the challenge of selecting green suppliers and purchasing to improve a firm's competitiveness. Wee and Quazi (2005) identified seven critical factors in their research into environmental management: top management commitment, the total involvement of employees, training, the use of green products and process design, supplier management, measurements, and information management. Chou and Chang (2008) proposed a system that evaluates alternative suppliers that utilize a supply chain management (SCM) strategy to identify supplier qualification criteria, and the resulting model allows decision-makers to incorporate the supply risks of individual suppliers into the process of final decision making. In addition, Zhu et al. (2008) encompassed a set of GSCM practices that are useful for logistics management, including reducing packaging and waste, assessing suppliers based on environmental performance, developing more eco-friendly products, and reducing carbon emissions that are associated with the transport of goods. Walker, Di Sisto, and McBain (2008) presented a GSCM that covers all of the phases of LCA, from the extraction of raw materials through the design, production, and distribution phases to the use of the product by consumers and the disposal of the product at the end of the LCA. Hence, a green supplier is necessary for a firm to satisfy the GSCM criteria and to determine the suitability of a supplier (Lee et al., 2009). These studies have uninvolved in customers, manufacturer and suppliers together in the examination of their aspects and criteria.

In conclusion, economic performance is an important reason why manufacturing firms seek to implement environment practices. Previous studies show that success in addressing environmental issues can provide new opportunities for competition and new ways to add value to core business and environmental practices. For example, internal and external GSCMs have positive relationships with an organization's economic performance as a component of win-win propositions (Chen & Chang, 2013; Lai, Cheng, & Tang, 2010; Montabon, Sroufe, & Narasimhan, 2007; Wagner, Schaltegger, Environmental, & Sheffield, 2006; Wong, Lai, Lun, & Cheng, 2012). An environmentally conscious purchasing approach must be compliant with customers' needs as well as with regulations. This study proposes a hybrid technique that is based on addressing two proposed hierarchical structures. There are very

Download English Version:

<https://daneshyari.com/en/article/10322101>

Download Persian Version:

<https://daneshyari.com/article/10322101>

[Daneshyari.com](https://daneshyari.com)