



Impact of supply chain management practices on sustainability



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ABSTRACT

This paper aims to investigate the impact of lean, resilient and green supply chain management practices on supply chain sustainability. A deductive research approach was used to derive a conceptual model. Eighteen research propositions are suggested and tested with empirical data derived from five case studies belonging to the Portuguese automotive supply chain. A conceptual model to assess the impact of lean, resilient and green practices on supply chain sustainability was derived from the data analysis. The practices with significant impact on supply chain sustainability are: “waste elimination,” “supply chain risk management” and “cleaner production.” The following lean, resilient and green supply chain management practices do not have a significant impact on supply chain sustainability: “flexible transportation,” “flexible sourcing,” “ISO 14001 certification,” and “reverse logistics.” The paper provides a taxonomy for lean, resilient and green supply chain management practices at three levels: upstream, organization and downstream. Practitioners can use this taxonomy as a checklist to identify possible practices to achieve their sustainability goals. The proposed model makes it possible for researchers to develop surveys in order to better explore the proposed relationships. This paper presents an innovative approach since it studies simultaneously the three dimensions of sustainability (environmental, social and economic), and the lean, resilient and green supply chain management paradigms which are considered strategic for supply chain competitiveness. Identification of the conceptual relationships between supply chain management practices and sustainability is a contribution that the authors hope will become a forward step in the development of new theoretical approaches and empirical research in the field of supply chain management and sustainability.

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1. Introduction

In the supply chain (SC) context, it is necessary to implement management practices that not only promote company and overall SC performance, but also that focus on social, economic and environmental concerns (Beske, 2012; Amin and Zhang, 2014; Alzaman, 2014). In other words, supply chain management (SCM) should be concerned with its sustainability as well. Lean, resilient, and green approaches are referred to as SCM paradigms which allow companies to become more competitive and sustainable in a volatile and high demand market. Existing literature focuses on two of these SCM paradigms and sustainability, e.g. the lean and green paradigms and sustainability are studied by Mollenkopf et al. (2010), and green and resilient as a way to increase the sustainability of companies and their supply chains by Azevedo et al. (2013).

However, there are no researches exploring simultaneously the three SCM paradigms and their impact on SC sustainability. So, this study intends to overcome this research gap and aims to propose a conceptual model to analyze the impact of lean, resilient and green SCM practices on SC sustainability. This approach will help the companies and their respective SCs to reduce their business wastes while it increases value to the customer, sustain their operations and overcome disruptions, and at the same time to reduce the negative environmental impacts. A deductive research approach is used to develop a conceptual model from the literature review and a case study is used to address the following three research questions: 1) Which lean SCM practices impact the SC sustainability?; 2) Which resilient SCM practices impact the SC sustainability?; and 3) Which green SCM practices impact the SC sustainability?

The paper is organized as follows. Following the introduction, a literature review on the lean, resilient and green paradigms is provided from a SCM perspective, and several management practices are proposed. After that, some insights on SC sustainability are presented. Subsequently, a conceptual model is proposed as a

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means of suggesting a set of lean, resilient and green practices and their relationships with environmental, social and economic dimensions of SC sustainability. After that, a case study on automotive companies is developed to validate the proposed conceptual model. Finally, some considerations are drawn.

2. Literature background

A SC can be described as a chain that links various entities, from the customer to the supplier, through manufacturing and services so that the flow of materials, money and information can be effectively managed to meet the business requirements (Stevens, 1989; Charkha and Jaju, 2014; Viskari and Karri, 2013). Researchers have started advocating radical changes in the way SCs are managed so far with profit as the sole aim. Efforts to make SCs more environmentally friendly have gained priority due to increasing threats arising from global warming and climate change (Shukla et al., 2009). Only more recently academics have recognized the importance of addressing sustainability issues in SCM (Linton et al., 2007; Carter and Rogers, 2008; Seuring et al., 2008; Krause et al., 2009; Seuring and Müller, 2008; Winter and Knemeyer, 2013; Santos et al., 2013; Topcu et al., 2013; Gobbo et al., 2014; Salimifard and Raeesi, 2014). The World Commission on Environment and Development (WCED, 1987) considers sustainability as economic practices which meet the needs of the present without compromising the ability of future generations to meet their own needs.

Azevedo et al. (2012a) consider that green and lean practices are two important pillars of the sustainable development of business. The deployment of these practices along the SC enables an enhanced social, environmental and economic performance. According to Vinodh et al. (2011) and Fliedner (2008), some of the benefits of synchronizing lean and sustainability principles include reduced costs and lead time, improved process flow, compliance with customer expectations, improvement of environmental quality, as well as employee morale, and commitment. Vinodh et al. (2011) argue that the implementation of green SC practices can influence sustainability; one example is related to Ford that had implemented recyclable plastic containers for shipping their car parts as opposed to cardboard, reducing CO₂ emissions during transportation, improving process efficiency since new containers are handled easily by plant workers, and reducing transportation cost by over 25%.

According to Srivastava (2007) within the context of sustainability, an organization must manage not only short-term financial results, but also the risk factors resulting from its products, environmental waste, and worker and public safety. Carter and Rogers (2008) also consider that SC sustainability encompasses the ability to understand and manage the SC economic, environmental, and social risks. Because of the costs and SC disruption (fragility), the operations field has also become the focus of serious concerns about environmental sustainability, often involving the triple bottom line: planet, people, and profit (Stonebraker et al., 2009). More recently, Ahi and Searcy (2013) expand the business sustainability characteristics to an integrated perspective, including not only the environmental, social and economic focus, but also resilience along the focus on stakeholders, volunteers and long-term performance. Moore and Manring (2009) considered that small and medium size companies could find synergistic effects among resilience and sustainability to increase value creation. In this sense SC resilience is a critical pillar of SC sustainability.

These previous arguments support the simultaneous deployment of lean, resilient and green SCM paradigms to develop a sustainable SC. However, the literature shows that most researches have been focused on the study of individual paradigms in SCM or

on the integration of only a couple of paradigms. A review about the integration between lean management and SC sustainability can be found in Martínez-Jurado and Moyano-Fuentes (2014); the study of resilient SCM and sustainability is developed by Fiksel (2006) and Rosić et al. (2009); and the study of green and sustainability in a SC context is explored by Kainuma and Tawara (2006). In a review study about the definitions of SC sustainability, Ahi and Searcy (2013) conclude that resilience is also rarely addressed in definitions of business sustainability. So, new integrative management approaches are needed to deal with the SC sustainability challenge.

In this paper the focus is on lean, green and resilient SCM management paradigms considering its different, but complementary objectives (Carvalho et al., 2011), such as: i) increase value: the lean intends a systematic approach to identify and eliminate all non-value-added activities or “wastes” through continuous improvement; ii) cope with unexpected events: resilience refers to the SC's ability to react efficiently and overcome the negative effects of disturbances; iii) reduce negative environmental impacts: green SCM intends to reduce environmental risks and impacts while improving the SC ecological efficiency. Table 1 contains some of the main lean, resilient and green SCM practices found in literature.

Carvalho et al. (2011) provide a useful comparison of lean, green and resilient paradigms highlighting the existence of synergies and trade-offs among the SCM paradigms, e.g., the presence of strategic inventory reduces the companies' vulnerability to unexpected events that may interrupt the supply of materials, but this same practice could hide the causes of a bad supply chain performance and generate material obsolescence; for that reason, the lean and green paradigms prescribe the minimization of inventory levels. According to Govindan et al. (in press) the definition of lean, green and resilient constructs must take into consideration the interactions among practices. With this in mind, the interactions between practices was one criteria used in the selection of the practices belonging to each SCM paradigm. One example of these interactions is concerned with the practice of lead-time reduction (resilient) which is promoted by the just-in-time practice (lean) but could contribute to a reduction on the practice of energy consumption (green) since it demands higher fuel cost from urgent transportation utilization. The proposed set of lean, green and resilient practices was derived from Table 1 but also considering the practices more relevant for leanness, greenness and resilience of the automotive SC (e.g. Azevedo et al., 2012a,b; 2013; Govindan et al., in press). Also, according to the suggestion of Govindan et al. (in press), in order to guarantee the construct validity, each paradigm is defined using practices that contribute only to that paradigm and that are not related to the other ones. A set of three practices is suggested as follows:

- Lean paradigm: waste elimination, total quality management and just-in-time.
- Green paradigm: cleaner production, ISO 14001 and reverse logistics
- Resilient paradigm: flexible sourcing, SC risk management and flexible transportation

This paper aims to analyze the impact of lean, resilient and green practices on SC sustainability. To this end, the three dimensions of sustainability are considered: i) environmental; ii) social and ii) economic.

3. Conceptual model

In this section, a conceptual model is proposed to explore the impact of lean, resilient and green SCM practices on SC sustainability. That is, it intends to explore the relationships between the

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