Influence of Lean, Resilient and Green Practices on Supply Chain Sustainability

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Abstract: - This paper aims to propose a conceptual model to analyse the influence of lean, resilient and green supply chain management practices on supply chain sustainability. A deductive research approach was used to develop a conceptual model from the literature review. The SCM practices focused in this study are: waste elimination, Total Quality Management, just-in-time; supply chain risk management, flexible transportation, flexible sourcing, cleaner production, ISO 14001 certification and reverse logistics. The sustainability is studied considering its three dimensions: environmental, social and economics. The economic dimension is the most focused in literature and the social dimension the lesser.

Key-Words: - Lean, resilient, green; supply chain, sustainability, conceptual paper.

1 Introduction

In present-day there is the assumption that SC’s should compete instead of companies [1], being the success of supply chains mainly determined by the marketplace. Therefore, Supply Chain Management (SCM) is considered a strategic factor for the better attainment of organizational goals such as enhanced competitiveness, improved customer service and increased profitability [2]. It is necessary also to implement practices that not only promote company and overall SC performance, but also that focuses on social, economic and environmental concerns [3]. The literature shows that almost researches have been focused on the study of individual paradigms in supply chain management [4], [5], [6]. However, the simultaneous integration of lean, resilient, and green paradigms in supply chain management may help supply chains to become more efficient, streamlined, and also more sustainable. Consequently, this paper main objective is to propose a conceptual model to analyze the influence of lean, resilient and green practices on economic, social, and environmental sustainability of supply chains. A deductive research approach was used to develop the conceptual model from the literature review. The paper is organized as follows. Following the introduction, a background on the three paradigms lean, resilient and green are described from a supply chain management perspective, and several practices are pointed out. After that, some insights on supply chain sustainability are presented. Subsequently, a conceptual model is proposed as a means of suggesting a set of lean, resilient and green practices and their relationships with environmental, social and economic sustainability. Finally, some considerations are drawn.

2 BACKGROUND

2.1 Lean, resilient and green supply chain management

A supply chain can be described as a chain that links various agents, 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 [7]. In present-day business there is the assumption that supply chain’s compete instead of companies [1], while the success or failure of supply chains is mainly determined in the marketplace. According to Womack, Jones, and Roos [8], the lean paradigm provides a way to do more and more with less and less (less human effort, less equipment, less time, and less space), while coming closer to customer requirements. The importance of this philosophy is highlighted by Gunasekaran and Tirtiroglu [2] when they stated: “The viability of a firm now largely depends on how well it can respond to customer requirements while becoming lean”. Whereas in the past, the principal objective in supply chain design was cost minimization or service optimization, the emphasis today has to be upon resilience [9]. Resilience refers to the supply chain’s ability to cope with unexpected disturbances. In supply chain’s systems, the purpose is to react efficiently to the negative effects of disturbances.

Shrivastava [10] defined green supply chain management (GSCM) as integrating environmental thinking into supply chain management. GSCM has emerged as an organizational philosophy by which to achieve corporate profit and market-share objectives by reducing environmental risks and impacts while improving the ecological efficiency of such organizations and their partners [11]. Table 1 contains the main, lean, resilient and green supply chain management practices. The WCED [22] considers the sustainability as economic practices which meet the needs of the present without compromising the ability of future generations to meet their own needs. According to Shrivastava [10], an organization must manage not only short-term financial results, but also risk factors resulting from its products, environmental waste, and worker and public safety. The environmental sustainability, often involves the Triple Bottom Line (3Ps): planet, people, and profit [23]. Efforts to make supply chains more environmentally friendly have gained priority due to increasing threats arising from the global warming and climate change [24]. Although general indicator frameworks can be developed [25], it is commonly agreed that indicators need to be established on a supply chain basis. Some of the environmental, social and economic indicators of sustainability found in literature are: i) Environmental indicators - emissions (per unit produced) [26]; [21], [27], [28]; water used (litres) [26] landfill waste (tons) [26], [21], [5], [27]; hazardous material content [26], [27], [29]; and total energy used [26], [29]; ii) Social indicators: wages [26]; healthcare benefits [26], [28]; opportunity for career development [26]; and hours of safety training per employee [26]; iii) Economic indicators: order fill lead time [26], [21]; product defect rate [26]; [27]; transportation cost per unit [26], [11]; productivity [26]; and cost of goods sold [26].

### Table 1 Lean, resilient and green SCM practices

<table>
<thead>
<tr>
<th>Supply Chain</th>
<th>Upstream</th>
<th>Focal Company</th>
<th>Downstream</th>
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<tbody>
<tr>
<td></td>
<td>Developing visibility [17]</td>
<td>[19]</td>
<td>Demand-based management [20]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ISO 14001 certification [18]</td>
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### 3 Conceptual Model Proposed

In this section a conceptual model is proposed to explore the influence of lean, resilient and green SCM practices on SC sustainability.

A deductive research approach was used to develop the conceptual model from the literature review.

#### 3.1 Influence of Lean practices on SC sustainability

There are evidences on literature about the influence of lean philosophy on environmental and social sustainability of SCs. According to Fliedner [30] sustainability is the next evolutionary stage of lean as it goes beyond the internal waste elimination of Ohno’s seven lean principles encouraging the external waste reduction across the supply chain and leading to improved social conditions globally [30]. Non value-adding activities consume resources and therefore are not economically sustainable over the long run. Cost reduction has enhanced companies’ bottom-line performance through lean and sustainability initiatives [30]. From this perspective the following propositions are derived:
$p_1$: The lean practice "waste elimination" influences the economic sustainability

$P_2$: The lean practice "waste elimination" influences the social sustainability

From the point of view of the environmental dimension Rusinko [31] considers that the quality management is particularly well suited to aid managers in implementing environmentally sustainable practices [31]. Also, due to increased competitive pressure, today's managers are looking to the TQM as a way to improve and sustain organizational performance. The implementation of TQM practices involves also training of employees in multiple skills sets and empowered to make decisions relevant to their work in organizations [32]. Moreover, focusing on cultural and behavioural issues, Gunasekaran [33] identified communication, teamwork cross-functional activities, empowerment, training, and education as important enablers of TQM implementation. Being so, the following propositions are derived:

$P_3$: The lean practice "Total Quality Management" influences the economic sustainability.

$P_4$: The lean practice "Total Quality Management" influences the social sustainability.

In the literature there is also evidences about the influence of the lean practice "Just-in-time" on the environmental and economic sustainability. Beam [34] considers that Just-in-time (JIT) requiring small transportation batch sizes, appears to be at odds with environmental management. Also, JIT distribution requires that items to be delivered in very small batches which leads to reduced storage costs and increased available capital. However, small volume shipments yield more frequent deliveries, which lead to increased traffic congestion, noise and air pollution [35]. JIT practice seems to have also some influence on economic sustainability. Msimangira [36] argues that the use of JIT can improve a firm's manufacturing performance. Ansari and Modarress [37] defend its positive impact on the inventory levels, [34] on increase productivity and efficiency, reduced lead times, and improved customer service. According to the literature the next propositions are suggested:

$P_5$: The lean practice "Just-in-time" influences the environmental sustainability.

$P_6$: The lean practice "Just-in-time" influences the economic sustainability.

3.2- Influence of resilient practices on SC sustainability

In the literature there are evidences of the influence of the resilient practice "Supply chain risk management" on the economic sustainability. Beam [38] argues that total supply chain cost and profit that account for both benefits and costs of risk management strategies are important outcomes that need to be measured to ascertain the effectiveness of a risk management strategy. On the supply side, two outcomes of interest are supply disruptions and total inbound lead time [39]. On the demand side, the outcomes most emphasized include stock-outs [39]; fill rates [40]; lead times, and delays to customers [39]. Operational outcomes of interest in global supply chains include average inventory [41]. The proposition derived is:

$P_7$: The resilient practice "Supply chain risk management" influences the economic sustainability.

Another resilient practice found in literature is the "flexible transportation". To support supply chain contingency plans in case of a catastrophe, many companies are working in a flexible base of transportation modes. Most of them, however are motor-based which have the most unfavorable environmental impact per ton mile [42]. Also, this same practice seems to influence the economic sustainability. According to Golicic et al. [42] the use of flexible transportation contributes to a lead time reduction and consequently to less holding inventories. That leads to the following propositions:

$P_8$: The resilient practice "Flexible transportation" influences the environmental sustainability.

$P_9$: The resilient practice "Flexible transportation" influences the economic sustainability.

As regards the resilient practice "Flexible sourcing" it seems to influence both the social and the economic sustainability. Sourcing activities includes analyzing expenses, identifying potential suppliers, requesting quotations, negotiating contracts, monitoring and improving suppliers [43]. Sourcing flexibility is the ready capability of firms' supply chain architecture to cope up to change [44]. The influence of "Flexible sourcing" on social sustainability is argued by Porter [45]. This author considers less risky adopting a flexible sourcing strategy domestically than abroad. From his point of view the volatile nature of various cultural, economic and political environments abroad could lead to failed sourcing strategies. Contrary, he argues that implementing flexible and domestically sourcing strategies can be a potential source for achieving a competitive advantage and social progress when a company applies its considerable resources to activities that benefit society. Also, Beam [38] and Gunasekaran and Tiritioglu [2] defend the impact of flexible sourcing on performance of organizations and supply chains.
Considering the literature the following propositions are derived:

\( P_{10} \): The resilient practice "Flexible supply base/flexible sourcing" influences the social sustainability.

\( P_{11} \): The resilient practice "Flexible supply base/flexible sourcing" influences the economic sustainability.

3.3- Influence of green practices on SC sustainability

Considering the green practice "cleaner production" it was founded by UNEP in 1989 [46]. For Kjaerheim [47] cleaner production means using energy and resources efficiently in order to eliminate toxic raw materials, and to reduce both the amount and toxicity of all emissions and wastes. When applying cleaner production the following economic, environmental and social improvements can be reached [48]; improved efficiency; lower costs; conservation of raw materials and energy; improved compliance to market requirements; improved environment; better compliance with environmental regulations; more cohesive working environment for labourers and; better public image of the company. Attending to that the following propositions are derived:

\( P_{12} \): The green practice "Cleaner production" influences the economic sustainability

\( P_{13} \): The green practice "Cleaner production" influences the social sustainability

\( P_{14} \): The green practice "Cleaner production" influences the environmental sustainability

As regards the green practice "ISO 14001 certification" from the point of view of Schaltegger and Burritt [49] the effect of this practice on environmental and economic sustainability occurs as organisations prepare for certification since their facilities realise a variety of technological and managerial opportunities to cut material and energy waste [50] which contributes to increase expectations of direct economic advantages. Being so, the following two propositions are suggested:

\( P_{15} \): The green practice "ISO 14001 certification" influences the economic sustainability.

\( P_{16} \): The green practice "ISO 14001 certification" influences the environmental sustainability.

Considering the green practice "reverse logistics" it represents backwards flows from the point of consumption to the point of origin for the purpose of recapturing value or of proper disposal [51]. According to Beullens [52] this green practice prevents waste by diverting materials from landfills and conserving natural resources such as energy and materials. The influence of reverse logistics on economic sustainability can be found in Tonanont [53] who argues that a well organized reverse logistics not only reduces costs but also increases customer satisfaction and gains competitive advantages. Based on the anecdotal evidences from literature the following propositions are derived:

\( P_{17} \): The green practice "Reverse logistics" influences the economic sustainability.

\( P_{18} \): The green practice "Reverse logistics" influences the environmental sustainability.

The suggested eighteen proposition based on literature are translated into an innovative theoretical framework presented in the Fig. 1.

![Fig. 1 Proposed conceptual framework](image)

4 Conclusions

This paper investigates the influence of lean, resilient and green practices on SC sustainability.

The identification of the conceptual relationships between the SCM practices and SC sustainability is a contribution that the authors hope to become a forward step in the development of new theoretical approaches and empirical research in the field of supply chain management and sustainability. This paper makes several contributions. First, this conceptual model for the influence of lean, resilient and green practices on supply chain sustainability is theory-driven and can be applied to any supply chain setting. Second, by using the proposed model, researchers can develop empirical research studies that can better explore the proposed relationships. Although the objective of the study was successfully accomplished, limitations of the study should be noted. The social dimension of sustainability is underexplored, since there is a lack of literature about it. Also, no validation of the conceptual model were performed. Future research requires testing the propositions derived from the model, being necessary to develop scales for both the SCM practices and sustainability dimensions.
References: