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ORIGINAL PAPER

THE IMPACT OF LEAN & GREEN SUPPLY CHAIN PRACTICES ON SUSTAINABILITY: LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

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ABSTRACT. Background: The adoption of lean and green practices, sequentially or simultaneously, in the context of supply chain management has been recommended by researchers and practitioners as strategies to gain a sustainable competitive advantage while reducing negative social and environmental impacts. Hence, there is a growing interest in this topic. This attention is evident through the increased number of publications on lean and green supply chain practices. However, only a few studies have listed and classified these practices according to the different levels of the supply chain. Moreover, there is a restricted number of research papers that have highlighted the specific practices that impact each measurement of sustainable performance. Thus, this research aims to contribute to the literature in the field of supply chain management by presenting, in a simple and structured way, the different lean and green practices that have been studied by previous researchers, focusing on their impact on sustainable performance measurements.
Methods: A rigorous literature review in seven steps was followed, based on the study and analysis of 23 research articles dealing with lean and green practices and their impact on the supply chain's sustainable performance.
Results: The novelty of this research is that it presents, at the same time (i) a review of lean and green practices used in the context of supply chain management, and classified based on their citation frequency and level of use (upstream, internal and downstream), (ii) a focus on the practices that have been empirically studied as having an impact on supply chain's sustainable performance, as well as highlighting the indicators that are directly influenced by these practices, and (iii) a development of a conceptual framework, to present in a simplified way the lean and green practices that have an impact on one or more sustainable performance dimensions. The results of the study indicated that regarding the different levels of the supply chain, there is a dominance of practices used internally, with a greater number of lean practices compared to green practices. In addition, the majority of the practices identified have a positive impact on sustainable performance, except for some practices, namely « Cooperation with suppliers », « JIT philosophy », « Total Productive Maintenance », « Small lot-sizing » and « Reverse logistics », that have shown a disagreement between previous studies. It was concluded that the supply chain's environmental performance aspects are the most studied, followed by economic performance, then social performance
Conclusions: Numerous recommendations are provided to help managers and decision-makers in their choices of lean and green strategies according to their sustainability objectives, and to guide academics in their future studies on this field.

Key words: Lean Practices, Green Practices, Supply Chain Management, sustainable performance, Conceptual Framework

INTRODUCTION

In a period of global environmental degradation, resource depletion, and climate change, sustainable practices evolved as a strategy for maintaining balance within enterprises' three pillars of sustainable performance, by addressing stakeholders' requirements while maintaining market competitiveness. In this setting, lean and green paradigms have emerged as critical solutions for sustainability. These approaches, implemented together, may increase corporate and supply chain performance while generating social, economic, and environmental benefits. With the lean paradigm, waste is seen as being reduced, and thus costs as well, quality and productivity improved, and better utilization of resources

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ensured so that consumers receive more value. By reducing waste at every stage along the product lifecycle, including manufacturing, process, and supply chain management, lean has the potential to enhance sustainable performance [Abualfaraa et al. 2020, Cherrafi et al. 2019, King & Lenox 2001]. On the other hand, green paradigm aims to eliminate environmental effects while increasing ecological efficiency. Companies may be able to cut their expenses in the long run by maximizing the use of resources and minimizing waste [Cherrafi et al. 2019, Farias et al. 2019, Kovilage 2020, Singh et al. 2020].

In the context of supply chain management, combining lean and green paradigms in one integrated approach has gained popularity among scholars and practitioners, for instance, Abualfaraa et al. [2020] carried out a systematic literature review and identified similarities, differences and the main success factors to integrate lean and green to achieve sustainability. Cherrafi et al. [2019] proposed a model for integrating lean and green through the use of Gemba-Kaizen approach to improving firms resources consumption and environmental performance. Farias et al. [2019] developed a framework to assess the performance, practices and relationships between green and lean paradigms. Leong et al. [2019] conducted a literature review that presented the application, benefits and synergies of lean and green paradigms in the manufacturing industry. Notwithstanding, these growing research efforts toward lean and green subsequent or simultaneous implementation and their link with sustainability, only a limited number of studies have addressed the integration of the two strategies in the supply chain and their influence on different dimensions of sustainable performance [Galeazzo et al. 2013, Huo et al. 2019, Rodrigues et al. 2020, Sharma et al. 2021]. Thus, there are several research gaps that require further investigation; empirical results vary from negative to positive outcomes, leading to ambiguous and contradictory conclusions. Moreover, many studies have dealt with the supply chain as an integrated concept, failing to investigate whether green and lean practices in each component of the supply chain, i.e., upstream, internal, and downstream levels, would have a different impact on sustainable performance aspects. [Abualfaraa et al. 2020, Campos & Vazquez-Brust 2016, Dües et al. 2013, Engin et al. 2019, Farias et al. 2019, Galeazzo et al. 2013, Garza-Reyes 2015, Huo et al. 2019, Rodrigues et al. 2020]. Therefore, this paper aims to review the extant literature, identify and classify the most important lean and green practices within the upstream, internal and downstream levels of the supply chain, also clarify the relationships between lean and green practices and the three dimensions of sustainable performance from a supply chain perspective, highlighting the performance measurements that are most impacted by these practices. This study proposes, as well, a conceptual framework linking lean and green practices to sustainable performance three dimensions. This paper is prepared as follows: Section 2 presents a literature review. Section 3 illustrates the followed research methodology. The findings and discussion are presented in section 4. Finally, Section 5 presents the summarized conclusion and future research directions.

LITERATURE REVIEW

Lean and Green Supply Chain Management

Lean management is a cost-cutting and flexibility-based strategy that focuses on process improvements by reducing or eliminating unnecessary operations and wastes. Whereas the green approach has arisen as an organizational concept based on decreasing the environmental impact of operations while boosting resource efficiency [Azevedo et al. 2012]. Several authors claim that the adoption of the lean system has well demonstrated a better use of resources when successfully implemented, thus, improving operational performance [Farias et al. 2019, Galeazzo et al. 2013], while the implementation of green practices may help to enhance the efficient use of resources, thus improving environmental performance [Dües et al. 2013, Galeazzo et al. 2013, Kovilage 2020].

In the context of supply chain management, regardless of the fact that their drivers, tools, and practices diverge, these two paradigms serve together to improve the different dimensions of supply chain

management, hence, they are frequently employed as complementary strategies. When it comes to the company's internal level, lean management can be used to increase process performance and product quality and to optimize the flow of different materials, through several tools such as Just-in-time (JIT) or Pull flow, Quality Management Systems (QMS), Total Productive Maintenance (TPM) and Value Stream Mapping (VSM) [Campos & Vazquez-Brust 2016, Carvalho et al. 2010, Engin et al. 2019, Govindan et al. 2013, Sharma et al. 2021, Singh et al. 2020, Wu et al. 2015]. While green paradigm focuses on reducing resource consumption and environmental impacts using a variety of tools including Environmental Management System (EMS), Reduce, Reuse and Recycle (3R) and Green technology [Campos & Vazquez-Brust 2016, Carvalho et al. 2010, Duarte & Cruz-Machado 2019, Engin et al. 2019, Govindan et al. 2013, Hussain et al. 2019]. Regarding the upstream and downstream levels, lean management aims essentially to develop long-term collaborations and partnerships at the operational scale between the company and its suppliers and customers, using many practices, e.g., Geographic concentration from suppliers [Campos & Vazquez-Brust 2016, Carvalho et al. 2017, Engin et al. 2019, Sharma et al. 2019] and Delivery time reduction to customers [Alqudah et al. 2020]. Green supply chain management also supports the improvement of suppliers and customers alliances through transferring and spreading green awareness by means of green practices, e.g., Environmental Management System mandatory for suppliers and Reverse logistics [Alqudah et al. 2020, Azevedo et al. 2011, Campos & Vazquez-Brust 2016, Carvalho et al. 2010].

Lean-Green supply chain management practices and sustainable performance

Through waste reduction and resource efficiency, the synergy between lean and green paradigms has been highlighted, resulting in improved environmental, social and economic performances. Several studies of how green and lean strategies can impact supply chain sustainable performance are provided in the literature. However, there is a number that specifies the influence of each practice on a given economic, social or environmental performance measurement. Sawhney et al. [2007] have proposed a framework called En-Lean, to help companies in developing the relationship between a set oflean practices and their environmental impact. It also takes into account some measures of social performance such as employees' health and safety. Afterwards, this framework was applied to a metal cutting industry in order to highlight the overall environmental and social impacts of lean practices for this specific process. The results indicate that many of the lean principles if properly implemented, have a positive impact on the environmental and social indicators; « mistake-proofing » and « employee involvement and empowerment » are considered as best lean practices that represent an opportunity for improving environmental and social parameters. However, the case study shows that there is a conflict between lean production and environmental performance. Furthermore, it should be borne in mind that the framework developed in this paper and its results only concern a particular production process. Based on a literature review, Carvalho et al. [2010] have developed a conceptual model linking the different lean and green practices with the economic, environmental and operational performance measures of the supply chain, while highlighting the nature of the impact that each practice has on each performance measure. It has been found that lean practices taken into account in the model contribute poorly to the environmental performance of the supply chain, only the relationships with suppliers contribute to the reduction of the company's waste. When it comes to green practices, they have a minimal effect on the operational and economic performance of the supply chain. This study has great importance to discover the impact of each practice on supply chain performance. However, the conceptual model was developed based only on empirical data available in the literature, without any validation. After having collected a very significant number of green practices and classifying them into upstream, focal company and downstream categories, Azevedo et al. [2011] have developed a theoretical framework to understand the influence of these practices on the economic, environmental and operational performances of the supply chain. Then, they have conducted five case studies from the Portuguese automotive supply chain, in order to empirically test the influence of

green practices on the supply chain performance. They have concluded that automotive companies implement green practices to manage their supply chains, as they consider the implementation of these practices to be essential to achieve the highest levels of environmental performance, especially when it comes to cooperation with suppliers. These companies consider some measures to be more appropriate than others for properly assessing the impact of these practices on the supply chain performance; the most important one is « environmental cost », however, it is the least used measure by companies. They also consider that specific green practices have a greater potential influence on some performance measures, such as « waste minimization », « reverse logistics », « environmental collaboration with customers » and « environmentally friendly packaging ». Azevedo et al. [2012] have proposed a theoretical framework aiming to analyse the influence of upstream lean and green supply chain management practices on companies' sustainable performance. They have then carried out a case study at a Portuguese car manufacturer in order to test the validity of this framework. As a result, it has been highlighted that the implementation of lean upstream supply chain practices, such as « just-in-sequence », « deliveries directly to the point of use » and « geographical concentration », enables the improvement of the economic, social and environmental performance. Regarding the green upstream supply chain practices, their implementation has a positive impact on social and environmental performances. However, it has a minor impact on economic performance, especially when it comes to some practices like « mandate for a first-tier supplier to have environmental management systems », « monitoring suppliers' environmental performance » and « using green purchasing guidelines and sourcing from environmentally responsible sources ». This study has contributed to the identification of lean and green practices that impact the three dimensions of sustainability, but it has only focused on the upstream supply chain level. In addition, the results could not be generalized since only one company in the automotive industry was studied. Govindan et al. [2013] have used the interpretive structural modelling approach to identify the inter-relationships among lean, green and resilient practices and different elements of the Portuguese automotive supply chain performance, namely: operational cost, business wastage, environmental cost and customer satisfaction. They have concluded that the most important practices that the top management should focus on to manage the automotive supply chain are « just-in-time », « flexible transportation » and « environmentally friendly packaging », which together contribute to the improvement of « total quality management », « strategic stock », « ISO 14001 », « operational cost », « business wastage » and « environmental cost ». Then, all of these practices and performance enhancement lead finally to « customer satisfaction ». Hence, this study has recommended the lean, green and resilient practices, that make the automotive industry ready to meet customers' requirements, providing eco-products with short lead times and high-quality levels, thus achieving the economic and environmental objectives. Nonetheless, social performance has not been taken into account by this study. Martínez-jurado & Moyano-fuentes [2013] have reviewed the existing literature related to the relationships between lean management, supply chain management and sustainability. After having analysed 58 articles, they have highlighted that the impact of lean practices on environmental performance is inconclusive since both positive and negative relationships were reported from the literature, especially when it comes to « JIT » practice, which is undergoing a great debate as to its impact on « environmental pollution ». Furthermore, many studies have stated that the use of lean practices is important in promoting and facilitating the adoption of green practices, thus enabling to reinforce the effect of lean practices on environmental performance. Cherrafi et al. [2018] have proposed a conceptual model linking lean, green and process innovation practices with green supply chain performance. They have then conducted a questionnaire survey of 374 industrial companies from 13 different countries all over the world and used the SEM method to analyse the data collected with the aim of understanding the impact of the practices studied on selected green performance measures, such as « economic efficiency », « cost », « value creation » and « sustainability ». The results of this research

have highlighted the best practices that manufacturing companies can use to improve the green performance of their supply chains. Regarding lean practices, the best ones to implement are « JIT », « set up time reduction », « cellular manufacturing » and « waste elimination ». For green practices, the best ones to be employed include « eco-design », « life cycle assessment », « green manufacturing », « reverse logistics », and « waste management ». Nevertheless, it has been argued that process innovation practices do not have a direct impact on the improvement of green supply chain performance. They do however reinforce the effect achieved by lean and green practices. Zhan et al. [2018] have developed a research model in order to examine how business and environmental performances of Chinese organizations are affected by lean and green practices, and also to analyse the moderation role of « guanxi » in this relationship, which is a Chinese concept based on strong networks with the organization' business partners. Through the application of structural equation modelling on 172 questionnaires' responses, it has been concluded that the adoption of lean and green practices is beneficial to improve the supply chain business and environmental performances. Some of the indicators improved by these strategies include « reduction of air emissions », « reduction of wastewater », « decreased consumption of hazardous/harmful/toxic materials » and « sales improvement ». In addition, it has been found that the use of guanxi initiatives is very essential as a preliminary step, which precedes the adoption of lean and green practices, in order to achieve positive results in terms of business and environmental performances. Despite the contribution of this study concerning the existence of a positive effect of lean and green practices on performance, it remains limited as it deals with this relationship in a general way, not specifying which practices are at the origin of this effect. Farias et al. [2019] have conducted a systematic literature review of 65 articles in the field of lean and green, then they have developed a conceptual framework that includes lean and green practices for assessing operational and environmental performances. The framework also illustrates how the practices and performance measures can be combined for performance assessment purposes and how lean and green practices can be used in a synergic way to improve each of the performance measures. For example, « energy consumption » can be reduced using lean practices such as « value stream mapping », « setup time reduction », « 5S », « kaizen », « total productive maintenance », « cellular manufacturing », « JIT » and « standardized work », as well as green practices such as « environmental management system », « design for environment », « environmental emission control » and « 3R ». The strength of this assessment framework is that it is considered to be an integrated system, as it treats lean and green practices as having the same objectives in terms of improving specific performance measures, whereas it only assesses the operational and environmental dimensions of performance, without taking into account economic and social aspects.

RESEARCH METHODOLOGY

For the purpose of expanding the scope of knowledge in the field, an in-depth literature review was carried out. As initially stated, the main objective of this research is to clarify the relationships between lean and green practices and the three dimensions of sustainable performance. Thus, the examination of the literature on lean and green practices implemented in the context of supply chain management and their link with sustainable performance has been done using different databases. Numerous journal papers, conference proceedings have been chosen. We have started with the extraction of lean and green practices used in the context of supply chain management, then we have classified them into three categories: upstream, internal and downstream practices. Afterwards, in order to identify the impact of lean and green practices on supply chain sustainable performance, we have been most interested in the studies that have specified the practices that directly influence each measurement of the economic, social and environmental aspects. The steps below were followed:

1. **Research purpose:** Identify and classify the most important lean and green practices within the upstream, internal and downstream levels of the supply chain, and

clarify the impact of these practices on the three pillars of sustainable performance (economic, social and environmental).

2. **Keywords used:** Lean, Green, Supply chain management, Sustainable performance, Sustainability, Environmental performance, Social performance, Economic performance

3. **Inclusion criteria:** Qualified international scientific publications (journal papers and conference proceedings), in English, on the adoption of lean and green supply chain management practices in an integrated way and analysing the impact on one or several aspects of sustainable performance.

4. **Exclusion Criteria:** Books, reports, essays and theses were all excluded.

5. **Literature Searches:** Research on electronic databases: Scopus, Emerald, Science Direct (Elsevier), Web of Science and IEEE Xplore. We have also done complementary research on Google Scholar.

6. **Data extraction:** 23 papers were selected to be examined

7. **Synthesis and added value:** The creation of two synthetic tables. The first identifies and classifies the lean and green practices used at different levels of the supply chain management, according to their frequency of citation in the literature. The second focuses only on studies that have clarified the impact of these practices on each of sustainable performance measurements, allowing us to develop a conceptual framework to better perceive these relationships.

RESULTS AND DISCUSSION

Classification of lean and green practices used in the SC context

Table 1 outlines the main lean and green practices that are used jointly in the supply chain management, grouped according to the three levels of the supply chain: upstream, internal and downstream. Within each of these categories, we have three types of practices: lean practices, green practices, and L&G practices that belong to both the lean and green approaches. Upstream practices are used to manage and improve the relationships between a corporation and its suppliers. A number of 8 upstream practices was gathered from the literature. Based on the frequency of citation, « Geographic concentration from suppliers » is the most identified lean practice in previous research and « Environmental Management System (EMS) mandatory for suppliers » has been found as the most important green practice. Moreover, only one practice « Cooperation with suppliers » has been found as shared between lean and green approaches at the upstream level. Afterwards, internal practices are used within the company in order to improve its operational processes and efficiency. These are the practices that exist the most in the literature. According to the papers reviewed, 27 internal practices were found, 20 of them belong to the lean paradigm headed by « Just-in-Time (JIT)/ Pull philosophy », while 6 other practices are part of the green paradigm with « Life cycle assessment (LCA) » as the most significant one. « Waste minimization » is the only internal practice shared between lean and green. The final category includes downstream practices, which are used by the company in order to develop and maintain long term and fruitful relationships with its customers. « Distribution network configuration » is the only lean practice found at this level, « Reverse logistics » is the most weighted one as a green practice, and « Cooperation with customers » is the only lean-green practice found as well. On a final note, while classifying the different practices, we have found that « Information spreading through the network » is a common practice that can be part of all categories (Upstream, Internal and Downstream). This practice has a significant weight in the literature, and it is considered very important to manage all the levels of the supply chain. In conclusion, the literature on supply chain management focuses more on the internal practices with a strong emphasis on the lean paradigm, followed by the upstream practices, then the downstream practices that are not sufficiently addressed by the previous papers.

Table 1. Classification of lean and green practices used in the supply chain

Category	Type	Practices	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Fequency
Upstream	Lean	Geographic concentration from suppliers				✓		✓		✓				✓	✓				✓							6
		Just-in-Time (JIT) delivery				✓		✓		✓				✓					✓							5
		Reducing number of suppliers						✓		✓				✓	✓											4
	Green	Environmental Management System (EMS) mandatory for suppliers						✓			✓	✓		✓	✓			✓						✓		7
		Green purchasing		✓		✓			✓					✓	✓									✓		6
		Green/less packages from suppliers						✓		✓					✓				✓							4
		Environmental risk sharing with suppliers						✓															✓			2
	L&G	Cooperation with suppliers	✓			✓		✓			✓	✓		✓	✓		✓	✓			✓		✓	✓		8
Internal	Lean	Just-in-Time (JIT)/ Pull philosophy	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓		✓	✓		✓	✓		✓		15
		Inventory minimization		✓	✓	✓		✓	✓				✓	✓		✓	✓								✓	10
		Human Resources Management (HRM)				✓		✓	✓		✓			✓			✓			✓	✓	✓		✓		10
		Quality Management Systems (QMS)	✓			✓		✓	✓			✓		✓		✓		✓				✓				9
		Total Productive Maintenance (TPM)	✓			✓		✓	✓					✓						✓	✓	✓				8
		Shorter lead times		✓	✓	✓		✓						✓	✓	✓										7
		Kaizen/ Continuous Improvement						✓	✓		✓									✓		✓			✓	6
		Value stream mapping (VSM)		✓			✓	✓			✓									✓						5
		Set-up time reduction			✓	✓		✓						✓				✓								5
		Cellular manufacturing			✓	✓								✓							✓	✓				5
		Total time reduction				✓		✓						✓				✓				✓				5
		5S				✓		✓			✓									✓						4
		Kanban				✓		✓														✓		✓		4
		Quick changeover				✓								✓							✓	✓				4
		Small lot sizing				✓								✓							✓	✓				4
		Work standardization							✓		✓			✓						✓						4
		Sustainable VSM (SVSM)		✓		✓		✓																		3
		Poka-yoke/ Mistake proofing				✓															✓					2
		Six sigma				✓		✓																		2
		Innovation management	✓																							1
	Green	Life cycle assessment (LCA)		✓	✓	✓		✓	✓			✓	✓	✓		✓	✓		✓					✓		12
		Reduce, Reuse and Recycle (3R)				✓		✓			✓	✓		✓	✓	✓		✓	✓			✓				10
		Environmental Management System (EMS)				✓		✓	✓		✓	✓		✓		✓		✓	✓					✓		10
		Cleaner production				✓		✓				✓		✓				✓		✓		✓		✓		8
		Green technology				✓		✓	✓					✓												4
		Efficiency of resource consumption		✓		✓		✓			✓			✓												3
	L&G	Waste minimization		✓	✓	✓		✓	✓		✓			✓	✓	✓	✓	✓		✓		✓		✓	✓	15
Downstream	Lean	Distribution network configuration				✓																				1
	Green	Reverse logistics		✓	✓	✓		✓						✓									✓	✓		7
		Environmental risk sharing with customers						✓															✓			2
	L&G	Cooperation with customers	✓			✓		✓			✓	✓		✓	✓					✓		✓	✓	✓		8
Common	Lean	Information spreading through the network		✓	✓	✓		✓		✓	✓		✓	✓	✓		✓						✓			11

References 1-Singh et al. (2020); 2-Dües et al.(2013); 3-Cherrafi et al. (2018); 4-Engin et al. (2019); 5-Martínez-Jurado and Moyano-Fuentes (2013); 6-Campos and Vazquez-Brust (2016); 7-Hussain et al. (2019); 8-Sharma et al. (2019); 9-Duarte and Cruz-Machado (2019); 10-Zhu and Sarkis (2004); 11-Kainuma and Tawara (2006); 12-Carvalho et al. (2010); 13-Azevedo et al. (2012); 14-Govindan et al.(2013); 15-Duarte and Cruz-Machado (2014); 16-Hajmohammad et al. (2013); 17-Carvalho et al. (2017); 18-Verrier et al. (2016); 19-Sawhney et al. (2007); 20-Wu et al. (2015); 21-Espadinha-Cruz et al. (2011); 22-Azevedo et al. (2011); 23-Zhan et al. (2018)

Impact of lean & green practices on sustainable performance

Relationships between lean and green practices and sustainable performance of the supply chain are shown in Table 2, linking each practice to the performance measurement it is able to influence. These results are very useful to identify the performance measurements that are more sensitive to various lean and green practices, in the context of supply chain management.

In fact, the majority of the practices presented in this table impact positively the different performance measurements, hence, we will focus more on those that disagree with performance results. Starting with the upstream practices, « Cooperation with suppliers » is one of the most important practices to be used to manage supply chains, however, according to Sawhney et al. [2007], its impact on LCA and employee's health and safety may be positive or negative depending on materials purchased. When it comes to internal practices, the adoption of « JIT philosophy » based on a pull system is the most influential one. This practice is undergoing a great debate in the literature, especially with regard to environmental aspects. According to the articles reviewed, JIT has a positive impact on green image [Azevedo et al. 2012, Farias et al. 2019], business wastage [Azevedo et al. 2012, Govindan et al. 2013], cost [Azevedo et al. 2012, Carvalho et al. 2010, Govindan et al. 2013], ROA, cash-to-cash cycle and efficiency [Carvalho et al. 2010], as well as employee's health and safety [Sawhney et al. 2007]. However, disagreement is about LCA, which allows the quantification of energy, water and materials usage and environmental releases. Thus, while Sawhney et al. [2007], Farias et al. [2019] and Cherrafi et al. [2018] stated that JIT impacts positively the LCA measurement, Azevedo et al. [2012] and Martínez-jurado & Moyano-fuentes [2013] outlined that this may have a negative impact on supply chain's environmental performance. Along the same lines, « Total Productive Maintenance » is also a vital practice to improve supply chain's performance in terms of green image [Farias et al. 2019], cost, ROA, efficiency [Carvalho et al. 2010] and employee's safety [Sawhney et al. 2007]. Nevertheless, this lean practice can have a negative impact on LCA due to more wastewater, energy use, packaging materials, plastic wraps and paper used during frequent maintenance operations [Sawhney et al. 2007]. Another practice under conflict in the literature is « Small lot-sizing », which causes increased air pollution, more energy use and increased wastages, impacting negatively LCA measurement and employee's health [Sawhney et al. 2007]. Furthermore, « Reverse logistics » is a downstream practice that has several positive impacts on LCA, benefits and LCA measurements [Azevedo et al. 2011] as well as business wastage, however, it may also have negative impacts because it represents an additional environmental cost for the organization [Carvalho et al. 2010]. Finally, we can notice that the supply chain's environmental performance aspects are the most studied by previous research, followed by economic performance, then social performance.

Conceptual framework

In order to simplify the identification of lean and green practices impacting each dimension of sustainable performance, we have developed the conceptual framework (Fig. 1). Thus, from this conceptual framework, we can identify the lean, green and L&G practices that have an impact on:

- Environmental performance alone,
- Economic performance alone,
- Economic and environmental, performances
- Environmental and social performances, and
- Economic, environmental and social performances

Table 2. The impact of lean and green practices on the supply chain's sustainable performance

Category	Type	Measurements / Practices	Environmental performance				Economic performance				Social performance				
			Environmental costs	Green image	Business wastage	Life cycle assessment (LCA)	Cost	Return on Assets (ROA)	Cash to cash cycle	Efficiency	Corruption risk	Supplier screening	Local suppliers	Employee's health	Employee's safety
Upstream	Lean	Geographic concentration from suppliers		2	2	2	2						2		
		Reducing number of suppliers					2								
	Green	Green purchasing	1	2	1 ; 2	1 ; 3	2				2	2			
		EMS mandatory for suppliers		2	2	2	2					2			
	L&G	Cooperation with suppliers	1		1 ; 5	1 ; 4	1							4	4
Internal	Lean	JIT/ Pull philosophy		2 ; 6	2 ; 3	2 ; 4 ; 6 7 ; 8	1 ; 2 ; 3	1	1	1				4	4
		TPM		6		4 ; 6	1	1		1					4
		QMS			3		3	1		1					
		Set-up time reduction				7	1	1	1						
		Cellular manufacturing				4 ; 6 ; 7								4	4
		Poka-yoke				4								4	4
		Quick changeover				4								4	4
		Small lot sizing				4		1						4	
		VSM		6		6									
		Kaizen		6		6									
		5S		6		6									
		HRM				4									
		Work standardization				6									
	Green	EMS	1	3 ; 6	1 ; 3	6	3								
		Green packaging	1		1 ; 3	1	3			5					
		Reduction of toxic materials	2 ; 5		1	1 ; 5	5								
		3R		2 ; 6	2	6	2								
		Eco-design			5										
	L&G	Waste minimization	1 ; 5		1 ; 3 ; 5	1 ; 5 ; 7	1 ; 3 ; 5			1 ; 5					
Downstream	Green	Reverse logistics	1 ; 9		1	5	5			5					
	L&G	Cooperation with customers	1 ; 5		1 ; 5	1 ; 5	5			1 ; 5					
Common	Lean	Information spreading through the network			2		2								
		References	1-Carvalho et al. (2010); 2-Azevedo et al. (2012); 3-Govindan et al. (2013); 4-Sawhney et al. (2007); 5-Azevedo et al. (2011); 6-Farias et al. (2019); 7-Cherrafi et al. (2018); 8-Martínez-Jurado and Moyano-Fuentes (2013)										

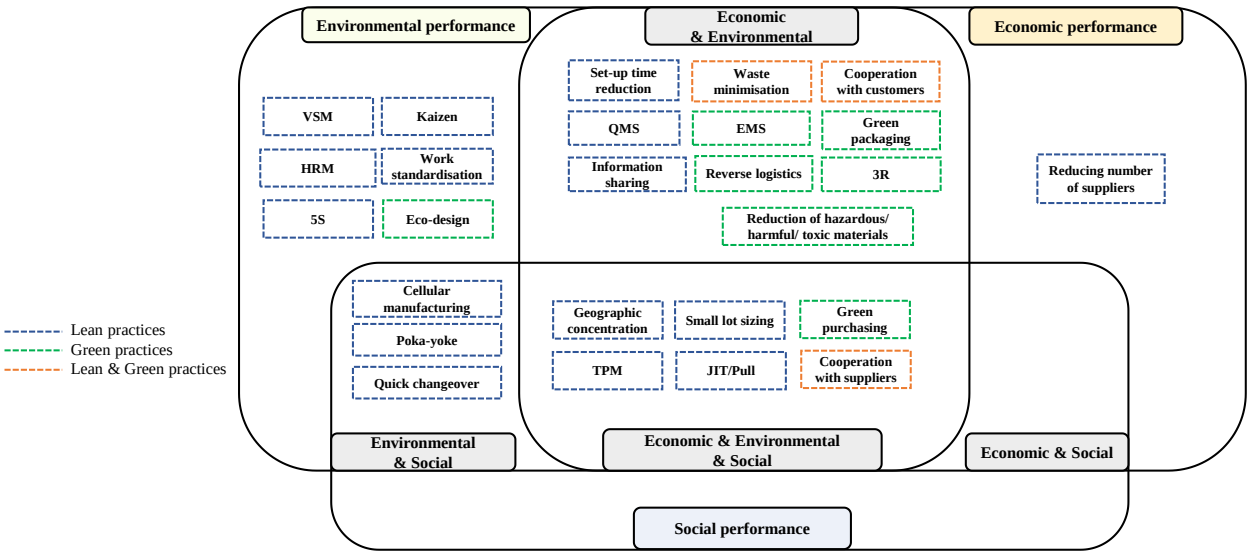

Fig. 1. Conceptual framework of lean & green practices and their impact on sustainable performance

It can be noticed that, based on the papers examined, there are no practices that impact either the social performance alone or the economic and social performances together.

CONCLUSION

Successful integration of lean and green practices within firms supply chain levels requires a complete understanding to determine the set of practices that have the most important contribution to improve each component of sustainable performance. This was the reason behind this research paper, which aims to review the extant literature in the field of lean and green supply chain management.

This research is important and relevant to other scientists in the same field since it identified and classified the most important lean and green practices within the upstream, internal and downstream levels of the supply chain. It also clarified the relationships between lean and green practices and the three dimensions of sustainable performance from a supply chain perspective.

In addition, the conceptual framework developed by this paper is a very important tool, allowing to focus on lean and green practices that have an impact on one or more sustainable performance dimensions. This might be helpful for managers and decision-makers concerned with supply chain management, in several ways. Our results can help companies looking for new solutions to improve their supply chains, by showing the powerful outcomes of combining lean and green practices on sustainability results, especially when it comes to the environmental side. Thus, this paper proposed to these companies the most important lean and green practices, enabling them to meet the requirements of their stakeholders, by enhancing their profitability, while being socially and environmentally responsible. On the other hand, if the company is already using lean and green practices, our results help to make an assessment in order to identify which practices to keep, which to eliminate, and which to add, depending on sustainability objectives. It would also be preferable to be careful with lean and green practices that have shown conflict in the literature. For example, if the company aims to improve economic, environmental and social results at the same time, it would be recommended to focus on the following practices: « Geographic concentration from suppliers » and « Green purchasing », while being vigilant towards the practices « Cooperation with suppliers », « JIT », « Total Productive Maintenance » and « Small lot-sizing », in an effort to take advantage of their positive impacts and avoid any potential negative effects.

However, this study has certain limitations that might be transformed into further possibilities for future research. Particularly, a systematic literature review and an empirical evaluation of lean and green supply chain management practices on a firm's sustainable performance, with a focus on the social aspect which has not yet been sufficiently studied. Therefore, this study will be extended into an empirical investigation in order to identify the most used lean and green practices within the supply chain and their classification according to the degree of importance.

We would also like to point out that the results of this paper are based on previous empirical studies. Nevertheless, there are a very large number of lean and green practices that have not been empirically tested in terms of their impact on sustainable performance. It is for this reason that we recommend that more practices be the subject of future empirical studies, in order to identify other lean and green practices that may be advantageous for sustainability improvement. Also, synergies and trade-offs between lean and green paradigms in the supply chain perspective have not been considered in this research. Therefore, future research might be conducted in this area.

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