
Editorial

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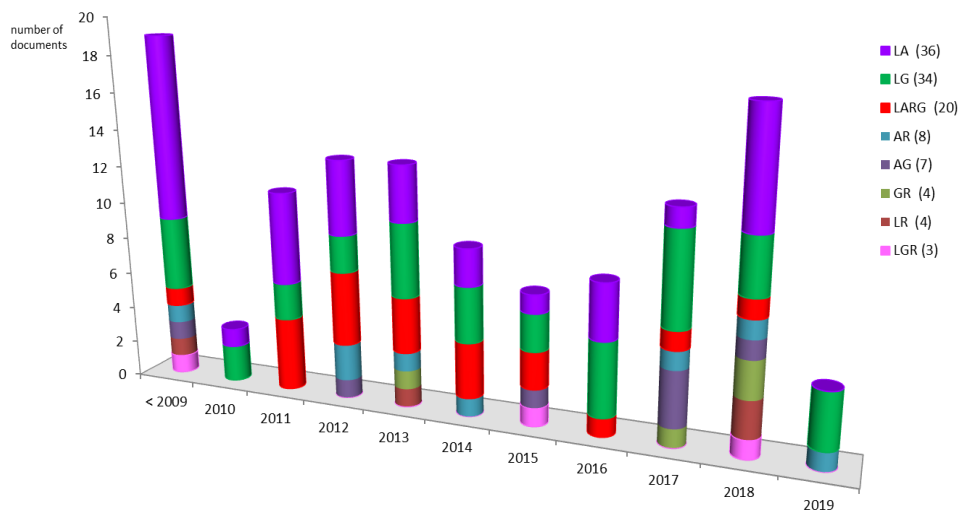
1 Introduction

This special issue aims to introduce the lean, agile, resilient and green paradigms in the context of production and supply chain. The acronym LARG was coined by Carvalho and Cruz-Machado (2009) to refer to the simultaneous deployment of the four paradigms:

- 1 the lean focus on waste and non-value added activities elimination to achieve higher levels of efficiency, profitability, and flexibility
- 2 the agile is related to market sensitiveness, it confers the companies the ability to reading and responding to real demand
- 3 the resilient focuses on the SC ability to recover to the desired state after a disruption occurrence
- 4 the green is concerned with the reduction environmental risks and their negative impacts.

To evaluate the research developed by the scientific community until now on the LARG supply chain management topic a structured literature review was conducted. For this purpose, the set of strings present in Table 1 was used to combine the different pairs of paradigms. The SCOPUS database was selected to search for documents published until 15 January 2019. The search strategy was to select the documents that contain the search strings in the field 'title'. A sample of 116 documents had returned from the search. In a first screening of the search results, no document was excluded from the sample. Table 1 also contain the number of documents resulted from the literature for each search stream. Figure 1 provides an overview of the LARG topic evolution.

Figure 1 Papers publish on LARG topic (see online version for colours)



From results two main research streams emerged: lean-agile (LA), with a total of 36 documents in the sample, and lean-green (LG), with a total of 34 documents. Most of the studies related to these two research streams intent to evaluate the impact of LA and LG on supply chain performance, in order to reduce cost, increase efficiency, and reduce

the environmental impacts (e.g., CO₂ emissions). However, recent studies, e.g., Ciccullo et al. (2018) or Cherrafi et al. (2018), also consider its impact on the supply chain social performance, providing a triple bottom line perspective for supply chain sustainability. A total of 20 documents in the sample focus the simultaneous deployment of LARG paradigms; most of these documents were published in 2011 and 2015. Recently, Rachid (2018) propose the use of a risk management approach to anticipating the problems related to LARG paradigms implementation in the supply chain; they also did a simulation study to illustrate the stages necessary to build a LARG risk map. From a strategic perspective Jamali et al. (2017) develop a study about the LARG supply chain management competitive strategies.

Table 1 Research strings

<i>Acronym</i>	<i>Combine</i>				<i>Search string</i>	<i>No. of documents</i>
	<i>Lean</i>	<i>Agile</i>	<i>Green</i>	<i>Resilient</i>		
LARG	x	x	x	x	{[lean* AND green* AND agil* AND resilien*] OR LARG OR LARGeSCM } AND 'supply chain'	20
LGR	x		x	x	lean* AND green* AND resilien* AND 'supply chain' AND NOT agil*	3
LAG	x	x	x		lean* AND green* AND agil* AND 'supply chain' AND NOT resilie*	0
AGR		x	x	x	green* AND agil* AND resilien* AND 'supply chain' AND NOT lean*	0
LAR	x	x		x	lean* AND agil* AND resilien* AND 'supply chain AND NOT green*	0
LA	x	x			lean* AND agil* AND 'supply chain' AND NOT (green* AND resilien*)	36
LG	x		x		lean* AND green* AND 'supply chain' AND NOT (agil* AND resilien*)	34
LR	x			x	lean* AND resilien* AND 'supply chain' AND NOT (agil* AND green*)	4
AG		x	x		agil* AND green* AND 'supply chain' AND NOT (lean* AND resilien*)	7
AR		x		x	agil* AND resilien* AND 'supply chain' AND NOT (lean* AND green*)	8
GR			x	x	green* AND resilien* AND 'supply chain' AND NOT (lean* AND agil*)	4
<i>Total</i>						<i>116</i>

Despite the advances on LARG topic, there is still a need for more research. There is not clear how to manage supply chains according to different philosophical orientations since by deploying different management practices to reach its performance goals, synergies and trade-offs can emerge. Considering a given management practice, for instance, the just-in-time, positive gains on operational performance could be achieved, however negative environmental externalities also could arise. Thus, to support the coexistence of different management paradigms in the supply chain a balanced approach is necessary.

This special issue intends to enlarge the research on the LARG topic providing a forum for the publication of articles that address the challenges its deployment in the supply chain and production context, considering theoretical and application aspects.

2 Overview of the papers included in the special issue

A total of seven papers were selected after a peer review process. The papers were revised according to the reviewer's suggestion and recommendations.

The published papers provide an integrative perspective of the four paradigms by converging more than one paradigm in the research; namely, the following sets were the object of study: LARG, lean-agile-resilient (LAR), LG, and green-resilient (GR). There are also papers that explore in-deep just one paradigm, namely the lean, green, or agile paradigm.

Diverse research contexts, such as logistics and distribution activities, as well as different productive settings such as the building materials, automotive, pharmaceutical, steel, sugar beet industries are object of study in the special issue. Also, the selected papers focus on dissimilar economic and cultural contexts countries including developing countries (such as Iran, Jordan and the Caribbean region) and European countries (Italy and Germany). This allows exploring if LARG paradigms could be influenced by business, economic and political environment. Since there were no constraints on the type research methodology, different research methodologies are used in the selected papers: mathematical techniques (namely TOPSIS, mixed-integer linear mathematical programming model and genetic algorithm), survey and case study. This multiplicity of approaches provides an overview of different supply chain issues that need to be considered when LARG is used to design new supply chain configurations, manage operations and optimise supply chain performance. A vast set of decision-making variables emerged from the special issue papers, e.g., energy costs, GHG/CO₂ emission rates, stock level, cost/profit, resilience, quality, delivery, flexibility, customer focus, know-how, and innovation.

The major contribution and findings of special issues papers are summarised below:

- 'Enhancing stock efficiency and environmental sustainability goals in direct distribution logistic networks', by Marco Bortolini, Francesco Gabriele Galizia, Mauro Gamberi, Cristina Mora and Francesco Pilati

This paper addresses the topic of matching lean management and green management principles in the design of a direct distribution logistic network. The study proposed a linear mathematical programming model bi-objective model to decrease the stock level (lean waste) and the logistic environmental emissions (green waste) for direct distribution logistic networks. The model is applied to a mid-scale regional distribution network for building materials located in the Emilia-Romagna region (Italy) and shows the network cost analysis. Its application allows identifying best balance network configurations, i.e., production batch sizing and allocation, shipping plans, storage plans at customers, as exemplified by the industrial case study. This quantitative model pretends to provide some insights on how to integrate LG paradigms despite its possible divergences in the distribution network performance.

- ‘Exploring ecosystem network analysis to balance resilience and performance in sustainable supply chain design’, by Vitor de Souza, Jacqueline Bloemhof-Ruwaard and Milton Borsato

It introduces the ecosystem network analysis to evaluate the resilience of different configurations resulting from the design of a sugar beet supply chain. The study develops a multi-objective, mixed-integer linear programming model to maximising profit and minimising GHG emissions in the supply chain design. Using the ϵ -constraint method a Pareto curve is generated to reveal trade-offs between these objectives. Solutions are compared regarding their economic, environmental and ecosystem network analysis performance. The results show that a sustainable supply chain configuration influence not only economic and environmental dimensions, but also the resilience to disturbances; these results are used to balance resilience and sustainable performance. ENA showed an interesting potential to support the pursuit of balance between resilience and performance, bringing insights during early design stages.

- ‘Green optimisation for LRP problem using a genetic algorithm and a dynamic island model’, by Zineb Benotmane, Ghalem Belalem and Abdelkader Neki

A green management optimisation is presented for the two-echelon location routing problem consisting of three disjoint sets of nodes corresponding to depots (origins), distribution centres intermediate facilities) and customers (final destinations). To optimise the assignment between provider centres and clients a genetic algorithm is used. For the problem of vehicle tours, a dynamic island model is used to minimise environmental costs and CO₂ rate.

- ‘Trade-off among lean, agile, resilient and green paradigms: an empirical study on pharmaceutical industry in Jordan using a TOPSIS-entropy method’, by Taghrid Suifan, Moutaz Alazab and Salah Alhyari

In this paper, it is proposed an assessment model to analyse trade-offs among the LARG supply chain management paradigms. The model considers different competitive priorities for the Jordan pharmaceutical supply chain context. The TOPSIS-Entropy method is used to rank feasible alternatives and find the proper sequence of sequence of competitive priorities. The results show that first ‘quality’ should be developed, then ‘know-how’, ‘flexibility’, ‘delivery’, ‘customer focus’, ‘innovation’, and finally, ‘cost’. Also, the study demonstrates that there is a trade-off between competitive priorities and supply chain management paradigms. The practices of each paradigm have different impacts when it comes to achieving competitive priorities over competitors.

- ‘Improvement of steel melting operations at a Caribbean company: a lean manufacturing approach’, by Boppana V. Chowdary and Christopher Fullerton

The lean manufacturing techniques are explored in a Caribbean steel manufacturing company considering key areas such as cost, quality, health, safety, and environment. In a case study setting focusing the steel melting operations, the value stream mapping, in conjunction with five-why and fishbone quality tools, were used

for operational improvements. The study proposes the deployment of lean strategies such as total productive maintenance, 5S, production smoothing, and setup time reduction to improve the plant operational performance regarding processing time, work-in-process inventory, and change over time. Also, other benefits such as improved cleanliness of the work areas and improved morale of the plant employees are demonstrated.

- ‘The effect of IT integration on improving agility, integration and performance of supply chain’, by Reza Samizadeh, Saedeh Aghagoli and Sahar Vatankhah

The paper pretends to analyse the effects of ‘information technology integration’ on ‘supply chain integration’ and ‘supply chain agility’, and the effects of those variables on ‘supply chain performance’. Data were collected from a sample of 163 Iranian auto parts companies, to test the hypotheses a structural equation model was developed using smart PLS. Overall, the analysis showed that the ‘information technology integration’ can increase ‘supply chain integration’ and enhance ‘supply chain agility’. According to the study results ‘information technology integration’ does not have a direct effect on improving ‘supply chain performance’, but it can improve the performance of the supply chain by affecting its integration and agility.

- ‘Which practices are lean, agile and resilient? Literature review and practitioners’ perspective’, by Maryam Lotfi

The paper pretends to clarify the boundaries between lean, agile and resilient (LAR) paradigms. Data were collected in a survey to 185 managers of companies belonging to different German industries. A confirmatory factor analysis (CFA) was performed and three models developed (one for each paradigm). Through the empirical study shows that there are some management practices that purely affect just one paradigm:

- 1 lean: ‘TPM’, ‘JIT’, ‘TQM’ and ‘producing outputs with minimum resources’
- 2 agile: ‘integrating different functions in the company’, ‘responding rapidly to changing situation somewhere in the supply chain’, ‘introducing new products quickly’, ‘flexible manufacturing equipment to produce different products with the same facilities’, and ‘knowledge management’
- 3 resilient: ‘business continuity team’, ‘contingency plans made’, ‘detection systems in place to detect any supply chain disruption’, and ‘establishing communication line in case of a disruption in the supply chain’. Also, it was identified other set of practices that affect more than one paradigm; for example: ‘excess capacity’ and ‘redundant suppliers’ affect both resilience and agility significantly.

3 Conclusions comments

The papers included in this special issue illustrate the diverse range of themes that currently are being investigated in the LARG supply chain management topic. These papers are representatives of the current research challenges that researchers and professional are facing actually on the supply chain: How LARG paradigms could be implemented in a supply chain setting with multiple echelons? How LARG practices are

related to supply chain competitive priorities? How LARG can contribute for business innovation? Which is the impact of LARG on supply chain social performance? How the trade-offs among LARG paradigms could be overcome? It is expected that this special issue provide motivations to work on those challenging issues.

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