The evolution of the theory of Lean Supply Chain Management

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Abstract
This paper analyzed the evolution of academic research on international management of lean supply chain between 1995 and 2010. We conclude that the issue is still little addressed in the scientific community e other findings.

Keywords: lean supply chain management, theory, lean manufacturing

Background
The economic changes especially in the second half of the twentieth century has changed the foundations of industrial competitiveness in the world. Issues such as quality and product reliability, promptness in meeting the needs of the market, flexibility and cost, began to be considered as new dimensions of business success (Lima and Zawislak 2003). Moreover, regardless of branch of business, companies must focus on speed, efficiency and providing value to the customer, to be globally competitive (Elizabeth and Cassandra 2011; Cudney and Elrod 2010).

In order to meet these demands, companies establish processes for internal and external restructuring. In some industries, such as the automotive, it appears that this restructuring process has strong inspiration as a philosophy of organizing production: lean manufacturing - ME (Lima and Zawislak 2003). Lean Manufacturing (LM) supports companies in order to achieve significant economic benefits by improving the quality, cost and time of operations cycle. The LM is focused on identifying and eliminating waste in the production and development of product and service, considering activities that do not add value (Lamming, 1996). Although the principles of LM have been originally developed by Toyota to manufacture cars, they are increasingly being applied in routine processes and support functions of various business lines (Cudney and Elrod, 2010).

The principles of LM have been successfully applied in manufacturing with significant reduction of inventory in the supply chain and increase productivity and product quality.
Presents fast as possible to more efficiently and cost effectively market responses. In addition, lean manufacturing has replaced traditional manufacturing techniques in the world, mainly by the success of its implementation in the automotive industry (Apte and Goh 2004; Bhat 2008; Bhim et al 2010; Kimsey 2010). The LM also helps improve the flow of information and material. Waste are the result of delays, tasks, costs and unnecessary mistakes and second Womack and Jones (1996) can be classified into: overproduction, transportation, inventory, processing, waiting, motion and defects. The implementation of LM in an organization has shown considerable financial results (Cudney and Elrod 2010).

In this context, Wee and Wu (2009) to achieve market leadership in a globalized economy, companies can focus on the establishment of global supply chains. So will respond quickly to changes in its environment and adapt to unforeseen in less time. Thus, it seems that the psychic philosophy LM can expand to the supply base. However, Cudney and Elrod (2010) claim that this expansion has been more difficult and often random.

In addition to expanding their supply networks to a global environment, supply management more efficiently is required. According Blinco (2006), organizations whose global distribution and supply are managed in an integrated and synchronized way, has been able to apply the principles of LM in their supply chain. Lean Global trade allows companies to increase their operational efficiency, reduce inventory throughout the supply chain, improve the utilization of their assets, and reduce the cost of delivery and reduced total cost of products from global sources.

In managing the supply chain the value set by the consumer is the amount transferred over the processes in the supply chain (Lamming 1996). In this context, it is observed that after invading the spaces of the mind of managers and shop floor of many companies from various sectors worldwide, the LM starts to be also addressed the links between enterprises in supply chain. However, it still lies untapped in academia. This is because of the difficulty in making improvements throughout the supply chain due to the presence of a long lead time. In addition, there is the bullwhip effect with lots of measurable changes due to dynamic market (Wee and Wu 2009).

As the ever-growing challenge of improving the management and the rates of production of the links in the supply chain, lean manufacturing is now also leveraged as key to achieving these goals. It then discusses what the main practices and tools of lean manufacturing are ideal for supply chain. But, first, to identify the main objectives and practices of lean manufacturing in the supply chain is necessary to know through the academic production of articles which steps have been taken on this issue and how much has been accomplished. Thus, it is possible to identify research gaps to provide more efficient and effective means of dissemination of lean manufacturing in supply chain management. Thus, the management of the supply chain lean, term coined by Lamming (1996 ), becomes a new opportunity to improve efficiency in the supply chain both downstream and upstream, so that fosters the elimination or minimization of the main waste that occurs between the links. Lean manufacturing allows changes to be studied and perfected enables better management of the supply chain.

In this context, this work aims to analyze the evolution of international academic literature on management of lean supply (lean supply chain management) between 1995 and 2010 chain. The methodological approach was a literature review based on bibliometrics, explained in section 2. The main authors / researchers, journals, keywords, and references in the management of lean supply chain are presented in this paper. This work consists of the sections:
research method, results, findings and references. The research method section describes the procedures adopted for data collection, obtaining articles and literature portfolio variables. In the results section, analyze are presented. In conclusion are highlighted key findings and contributions, as well as possible limitations of this work.

Research Method

This study investigates the evolution of scholarship on the management of lean supply chain between 1995 and 2010. The research can be classified as descriptive as your goal. As for his approach to research is quantitative and technical procedures adopted fall within the research literature type based on bibliometrics. To investigate the various aspects of scientific production, use is generally bibliometric techniques that are important to know the stage in which the research is in a certain area. Some authors have already conducted bibliometric studies in several areas, for example, Seiford (1997), Martins (2002), Leal et al. (2003), Caldas and Tinoco (2004) and Cardoso et al. (2005).

Data collection was performed by the Scopus database. The key words to perform the search in the databases were chosen from a short reading some articles that addressed some aspect of managing lean supply chain. The following terms were used: lean production, lean manufacturing, lean thinking. These terms were combined with the following keywords: supply chain, value chain, Suppliers, logistic chain, supplier, supply, supply chain management, logistics chain, logistics, and logistics. Therefore, 22 combinations were used as keywords in the search for articles in the databases.

The search criteria in the databases were:
- The "articles" was selected;
- All areas of research available were investigated;
- The time period of the search was from 1995 to 2010.

From the search criteria, the use of keywords and the elimination of duplicate articles yielded an initial sample of 804 articles that were exported to EndNote X3 software. Subsequently, the publications were selected following the criterion alignment of the title to the subject investigated. Thus, a second partial sample 64 was formed articles. After reading these articles final sample, the bibliographic portfolio, with 17 articles come up: Arkader (2001), Cox and Chicksand (2005), Cox and Chicksand (2008), Lamming (1996), New and Ramsay (1997), Huallacháin and Wasserman (1999), Mccullen and Towill (2001), Michaels (1999), Hines et al. (1998), Fynes and Ainamo (1998), Wee e Wu (2009), Tinham (2005), Faust (2009), Perez et al. (2010), Cudney e Elrod (2010), Macduffie e Helper (1997), Phelps et al. (2004).

The articles were analyzed according to temporality, periodical published, authors, citations and keywords. Aspects of these publications that met the problem addressed in this study are discussed in the following sections.

Results

The articles that make up the portfolio literature were categorized according to the year, number of citations in the references of articles, journals, number of article citations in the Scopus database and used keywords. The 17 articles of the bibliographic portfolio are distributed in 12 different journals. The only journal indexed in the JCR (Journal Citation Reports) is the
Manufacturing Engineering whose impact factor is 0, 017. The JCR impact factor is a well known metric in citation analysis and provides a measure of frequency that a journal has been cited in a particular year. The impact factor helps to evaluate the relative importance of a journal, especially when compared with others who have the same scope of publication.

Periodic Supply Chain Management stands out with 4 publications in literature that focus on portfolio theory building on Lean Supply Chain. Then the journal European Journal of Purchasing and Supply Management and Integrated Manufacturing Systems have two articles in each portfolio. Periodicals too have only one article on “Lean Supply Chain “.

In the annual evolution of publications between the extreme dates of the study period (1995-2010), 17 in fifteen years on the topic “Lean Supply Chain Management" was published. It is observed that in 1995 no article on this topic was published. One hypothesis is not confirmed that the theme Lean Supply Chain Management began to be addressed by the scientific community only since 1996, with emphasis on the study of Lamming (1996).

The average of the articles published in the time period analyzed is 1.72 per year. The standard deviation is 0.56, i.e. the variation of the number of publications in the previous year is less than 1. Thus, it is concluded that the number of publications per year does not vary between 1995 and 2010. The number of articles published per year has remained constant around the average two articles per year, with the exception of the years 1996, 2004 and 2008 in which only one article was published.

The survey identified 31 authors who have addressed the theme "management of the supply chain lean" in his studies. The authors Andrew Cox and Daniel Chicksand stood out compared to the others, since published two articles together. The other published only one article each. It appears that five articles were written by only one author, approximately 30% of the sample. More than half of the articles bibliographic portfolio (53%) has two authors. Finally, three articles (17%) were published more than two participants. These data demonstrate the articles related to the topic are recurrent small groups of authors. To examine the representativeness of the items in the portfolio of bibliographic scientific community has researched the frequency of citations of each of the 17 items. For this we used the Scopus database.

The article with more quotes in other works was to Lamming (1996) which uses 34 references to support your study. Then the study McCullen and Towill (2001) is cited 23 times by other papers, the New and Ramsay (1997) that was cited 19 times and New and Ramsay (1997) cited 15 times. The other articles have a smaller representation. Three articles were not cited in other works of Scopus, studies MacDuffie and Helper (1997), Tinham (2005) and Cudney and Elrod (2010). On the other hand, 11 articles are cited less than 12 times by other jobs. Therefore, over 70 % of the portfolio literature has little or no representation in other academic studies. Moreover, it is observed that three of the four most cited articles are from the 1990s. The oldest article of the Lamming (1996) is the most cited.

The sum of the various references used by 15 of the Articles portfolio totals 321. The article had (2005) and Phelps et al. (2004) do not use any reference. The article New and Ramsay (1997) stands out for the number of references used. In this article the authors use approximately 83 references. Noting the relational perspective between the authors who have published articles on the topic of managing lean supply chain in the study (1995-2010) period, we observed the relational links between authors. In this sense, a matrix to verify the existence of relationships between the authors of the portfolio was structured. The authors Wee and Wu (2009) cite the
work of MacDuffie and Helper (1997). This is the only relational link between the articles of the portfolio.

The references of the articles identified portfolio up 585 different authors. The authors of the articles cited in these references are portfolio, but not the same Article of the sample analyzed. The author who has more articles cited in the references of the articles is Andrew Cox, with 23 citations. 14 authors of the articles do not have studies referenced by other items in the portfolio. Author Richard Lamming which has 123 citations according to the Scopus database was cited 16 times in the bibliographic references portfolio. The keywords of the articles of bibliographic portfolio were analyzed. This analysis was performed to verify the effectiveness of the method used to search for articles in the databases that make up the portfolio literature.

Table 2 shows that 96 different keywords were used in the summary of the articles 17. Two of the most used keywords in articles, supply chain management and lean production, were part of combinations to search the databases. The term “Lean Supply Chain Management” was not used by any article as a keyword. While lean supply is used 3 times as a keyword. Goes like nine terms used in the search for articles that comprise the portfolio match the keywords of the summaries of publications.

<table>
<thead>
<tr>
<th>Keywords</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>Supply chain management</td>
<td>6</td>
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<tr>
<td>Lean production</td>
<td>4</td>
</tr>
<tr>
<td>Industrial management</td>
<td>3</td>
</tr>
<tr>
<td>Lean supply</td>
<td>3</td>
</tr>
<tr>
<td>Societies and institutions</td>
<td>3</td>
</tr>
<tr>
<td>Brazil</td>
<td>2</td>
</tr>
<tr>
<td>Competition</td>
<td>2</td>
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<tr>
<td>Customer satisfaction</td>
<td>2</td>
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<tr>
<td>Kaizen</td>
<td>2</td>
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<tr>
<td>Lean</td>
<td>2</td>
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<tr>
<td>Mathematical models</td>
<td>2</td>
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<tr>
<td>Optimization</td>
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<tr>
<td>Production engineering</td>
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<td>Purchasing</td>
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Most of articles identified in the literature survey addressed issues such as benefits, essential factors for the implementation of lean manufacturing in the supply chain, but the difficulties encountered in their implementation are not presented. Another aspect that is featured in the implementation of this philosophy throughout the supply chain is impractical. It is observed that as there is a supply chain without any type of waste and / or activity that adds no value to the product / service to the end consumer, the concept of lean supply chain refers to the application of lean manufacturing tools to links that have certain characteristics based on the
principles mentioned above.

**Findings**

Extend lean manufacturing to supply chain does not seem to be an easy task. Few articles were found in the search performed, as shown in the results of the previous section. This fact demonstrates that the implementation of lean manufacturing in the links of the supply chain is still tentatively treated by the scientific community.

The benefits obtained by an individual company due to implantation of lean manufacturing into their operations justify its extension to other parts of the chain. A bibliometric analysis served to demonstrate that the management of the supply chain still has gaps in research and deserves scientific body to expand the field of knowledge in this area.

The main journal that publishes results on this topic is the Supply Chain Management, but it does not have an impact factor. But, this fact reinforces the central scope in the supply chain. The analysis of the annual number of publications showed no growth trend of articles under this theme. Only two authors were responsible for more than one article, Andrew Cox and Daniel Chicksand whose articles discuss lean manufacturing in the supply of food derived from pork chain in the UK.

On the other hand, only one article mentions another portfolio. This demonstrates that the social network this theme has not yet formed and the information contained in a study are not taken over by new works. Thus, it is suggested as a proposal for future research systemic content analysis of 17 articles bibliographic portfolio. Thus, the correlated factors and differences between these studies can be identified.

Another important aspect of the analysis is the importance of the term used for the management of lean supply chain. It is observed that there is not yet a consolidated term in the scientific community to this issue, and often used the term lean together with supply chain and supplier. The main limitation of this study is that the selection of articles was performed by reading the titles and abstracts. In order to reduce any impact of this limitation, the authors extensively reviewed the literature.

Therefore, the main contributions of this work are: i ) finding that this topic is rarely addressed in the scientific community , ii ) periodic high JCR do not address this issue; iii ) there is no term consolidated in English for this theme; iv ) authors who have published studies on this topic are not related and; v) the most cited articles in the database are not the most frequently cited by the bibliographic portfolio.

**References**


Tinham, B. How to make your supply chain lean. Manufacturing Computer Solutions, v.11, n. 3, p. 4-7, 2005.
