The influence of lean construction on the strategy of civil construction companies: a systematic review of literature

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Abstract
The construction sector has suffered the impact of a series of structural changes, requiring construction companies to redirect their strategic plans. The purpose of this article is to discuss, through a systematic literature review, what influences the adoption of the lean construction management model in construction companies' strategies.

Keywords: Lean Construction, Strategy Implementation, Strategic Management

INTRODUCTION

The production systems are in permanent evolution, and to exemplify, the first productive systems were characterized by artisanal production that was developed to streamline mass production, mainly by using Fordism and Taylorism**,** and one of the current features is lean production. It is common that techniques from the automotive industry are disseminated to others sectors, as in the case of lean manufacturing, which has been applied to the healthcare area – lean healthcare; to services – lean services; and also to civil construction, where this system is known as lean construction.

According to Wolbers et al. (2005)**,** the most prominent authorities on lean construction are Koskela, with his work "Koskela's Transformation – Flow-Value"**,** and Ballard**,** with the development of the Last Planner System. Whereas the primary focus is on the identification of

what is really of value to the customer and on its generation, the secondary focus is on construction function planning and comes up with the Planned Percent Complete (PPC) concept, in which the main objective is to verify the reasons for delays and identify the roots of problems. Despite the company's reason to adopt lean construction, this adoption will affect its strategy.

According to Van den Boss et al. (2013), the changes in the civil construction market, with clients demanding more quality and delivery celerity, besides the competitiveness motivated by globalization oblige this sector to adopt new production strategies. Hence, lean construction becomes a possible option to enhance processes. Azevedo et al. (2010), meanwhile, says it is important to consider the company's strategy when it chooses to implement lean construction, so that the long-term objectives are achieved and the real market needs met.

As stated by Miranda Filho et al. (2001), for Lean Construction to be successfully implemented, it is necessary to consider the particular strategic and organizational characteristics of each company and it is the relationship that defines the success or failure of the implementation. In this context, this article aims to discuss, through a systematic review of literature, the influence of the adoption of lean construction in the building industry's strategy.

The importance that lean construction has for the sector is undeniable and can be verified in countless publications that show, through empirical studies, the gains from lean implementation. However, there are few studies dealing with the interface between this system and the changes that it leads to**,** or even demands from the organizational strategy.

THEORETICAL FRAMEWORK

In the 60s, discussions about strategic planning were emphasized and since then corporate leaders have adopted it as the best way to design and implement actions to improve the competitiveness of its business units (MINTZBERG, 1994). For nearly two decades, managers have been learning to act under a new set of rules, searching for flexibilities to quickly respond to competitive changes. However, with the same speed, competitors can copy any market position, i.e. the competitive advantage is, at its best, temporary (PORTER, 1996).

The essence of the strategic formulation is to deal with competition. For Mintzberg (1987), the word "strategy" has been implicitly used in different ways, and according to him the definition of strategy may be expressed in five ways: (1) as a plan, in which the strategy is a unified plan, broad and integrated in order to ensure that the basic goals of the project are achieved; (2) as a standard, in which it occurs, or is carried out independently whether it was intended or not; (3) as a position, in which it is intended to locate the company in its environment, improving its competitive position; (4) as a perspective, the way the company views the world itself, acting in accordance to this view collectively; and (5) as a ruse, where the strategy is a tactic used in order to trick the rival or the competitor.

According to Hayes (1985), in determined circumstances, the methodology of the traditional strategic plan, the corporate attitudes and the cultivated relationship may interfere in the capacity of the company to compete. The traditional strategic plan process is based on—*"targets-ways-means"*. The author points out four topics that might work incorrectly in this model: (1) the targets the companies usually select; (2) the ways the companies track the targets; (3) the means throughout these ways are accomplished and (4) the logic that links these elements.

The companies keep seeking to improve their market competitiveness in many ways, using techniques, philosophies and tools**,** such as Total Quality Management (TQM), Just-in-Time (JIT), Design for Manufacturability (DFM), and Lean reengineering among others. Despite the

excessive effort, the results didn't happen as expected, probably due to problems with its implementation (HAYES e PISANO, 1994).

The function of production can be either a competitive weapon or an obstacle for the organization. In this sense, the decisions related to production might become a restrictor of the corporation's strategic options (SKINNER, 1969). One of the reasons for this is that the connection between production and the company's success is generally seen as the achievement of high efficiency and low cost. However, for Skinner (1974), these goals do not fit the characteristics of fierce competition markets and, particularly, because of the low cost. Thus, high performance strategy is becoming less feasible in many industries. According to Skinner (1969), when companies aren't able to recognize the relationship between production decisions and the corporative strategy, they can overload the production system which is generally expensive and slow for some types of change. For the author, the relationship between the operation and the organizational strategy has not been fully understood by managers.

Regardless of the kind of industry, it is clear to the authors mentioned above, that it is essential for the company to define its approach, including civil construction companies, in order to meet long-term objectives, as highlighted by Azevedo et al. (2010), whereas the construction sector companies are suffering the impacts of a number of cyclical changes that require them to reorient their management strategies. In this sense, for the researchers, Pheng and Fang (2005), through Lean Construction it is possible to use lean production theories for the civil construction industry, as a model to improve a number of management problems in this sector (PASQUIRE, 2012).

Lean Construction (LC) is a concept of construction production inspired by the system originating in Toyota's factory in Japan. Despite the fact that the construction and the automotive industry are markedly different, both in resources and in products, Koskela (1992) introduced the idea of applying Lean to civil construction. The importance of this concept in this field is reflected in the activities of international organizations led by the Lean Construction Institute, founded in 1997 by Howell and Ballard. Due to its great potential in meeting the customer's objectives in terms of increasing added value and productivity, LC is seen as an alternative approach that might be implemented by the construction industry (MARHANI et al. 2013).

For Kim and Park (2006), since the introduction of Lean construction, it was considered an improvement mainly in the application of new technologies, tools and more efficient equipment. In addition to an increase in productivity, many authors draw attention to the impact of lean construction in sustainability, since this industry is traditionally a major waste generator.

RESEARCH PLANNING

The development of this article started with a literature review, previously presented, and from this review, it was realized that it's not clear how the implementation and the application of lean construction - LC interferes in the organization's strategy. In this context, a research approach was chosen in order to exploit this gap, as well as a systematic review of literature that will be described in detail in the following topics, which are organized with an approach to the research that deals with some aspects of the systematic review; research strategy detailing the steps taken and a flowchart summarizing the steps of the research.

Research approach

In accordance with Conforto et al. (2011), a systematic review of literature is a scientific method to identify and analyze articles that deal with a particular area of science. What differentiates this technique from literature review is that it reduces the researcher's subjectivity in the selection of the papers, as in this type of research there is a well-defined protocol that will become the selection criteria.

Levy and Ellis (2006) compare the systematic review of literature to a process that must have three macro stages: input, processing**,** and output. The input stage consists of the research's protocol definition, whereas the processing stage is about activities learning and literature comprehension, reviewing, results analysis; and the output comprises the outcome of the synthesis and evaluation of what was discovered in the previous stage.

Research strategy

To guide the strategy development it is important to have answered by the end of this paper the following question: Q1: What is the influence of the LC adoption on companies' strategy?

Based on the literature review and on the research question, it has been established that search string titles should contain the words "lean construction", and the body of the text should contain the word "strategy" or "strategies". From this point, it was determined that the researches were going to be carried out on the following bases: Ebsco, Web of science, Taylor & Francis, ScienceDirect, Emerald Insight and Scopus. The choice of the bases was due to their importance in operations management.

To select the papers that could really answer the research question**,** it was necessary to establish exclusion criteria**.** To accomplish this, the results of the searches would be analyzed at three difference times using different exclusion criteria, as detailed in the table 1.

Table 1: Criteria for exclusion

Filters	*Criteria for exclusion*
1º filter	Papers in which the language wasn't English
	Texts from books, technical reports, or other types of publications that were not scientific articles
	When the word "strategy" existed only in references
	When the word "strategy" was employed only in the sense of the research strategy
2º filter	Duplicate articles
	Studies that used the concept of modularization as a synonym of lean construction
	Articles where the word "strategy" appeared only once in the text
3^0 filter	Papers in which the authors didn't have access to the complete text

After applying the three filters, the analysis of the work began in order to answer the research question**.** Figure 1 summarizes all of the stages.

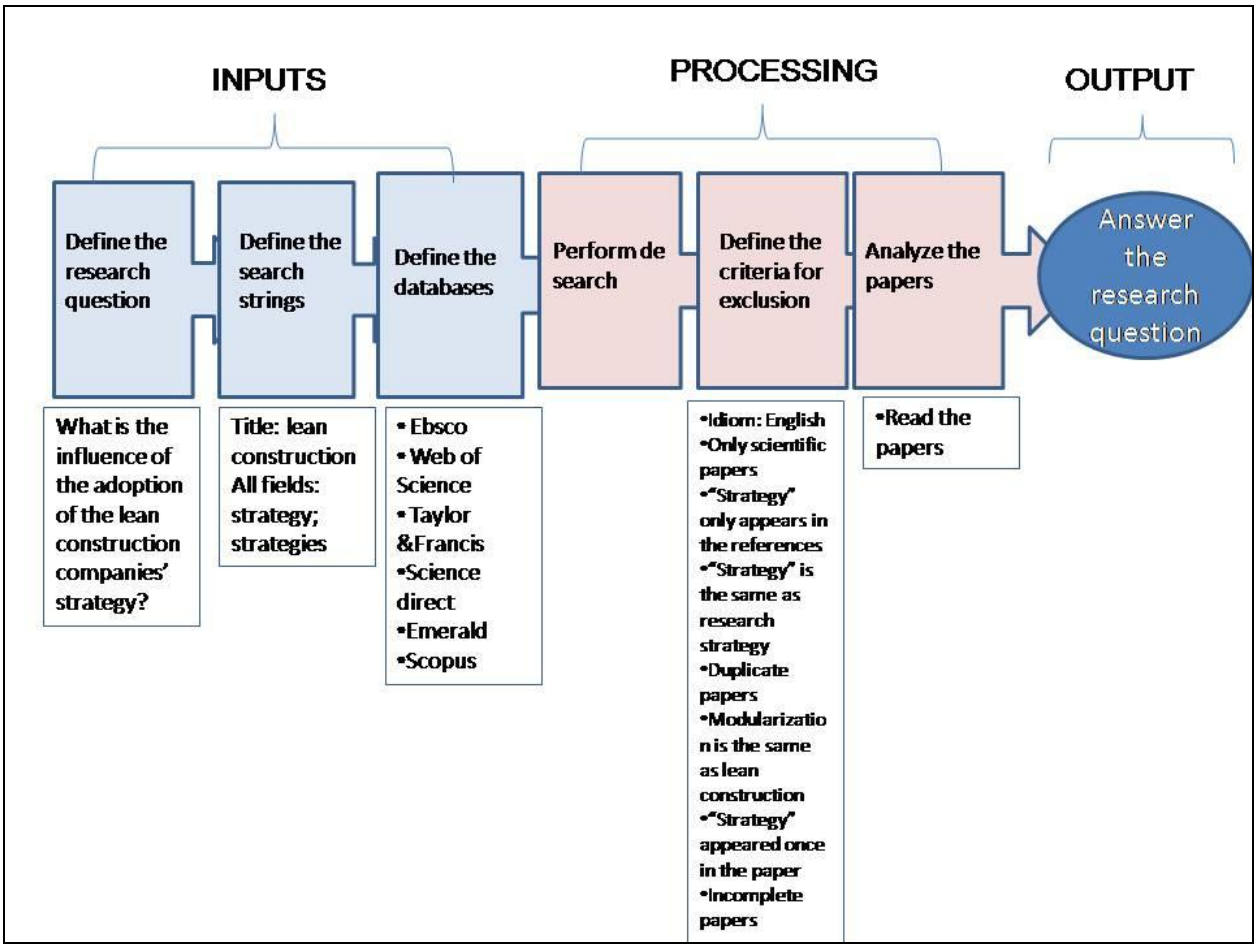

Figure 1: Research Strategy

The result of the systematic review and analysis of the selected articles will be presented.

Description of results

The initial search in the databases returned 176 works, and after the first filter based on the reading of the title, abstract**,** and the conclusion using the criteria already described, 63 articles remained. After the second evaluation round with the reading of the introduction and a thorough search of the text by checking the number of times that the word "strategy" appeared, 38 articles remained, and after the third round, in which the main goal was to have full access to the texts for reading, 34 articles remained. By the end of the third round, all articles were read in full in order to answer the initial question. The analysis of the content is presented in the next section.

CONTENT ANALYSIS

Through the analysis of the full text of the 34 articles that met all the criteria previously described, it was found that the influence of LC in the construction sector strategy appears especially when it is treated as an organizational strategy, followed by productivity and sustainability, as can be seen in Figure 2.

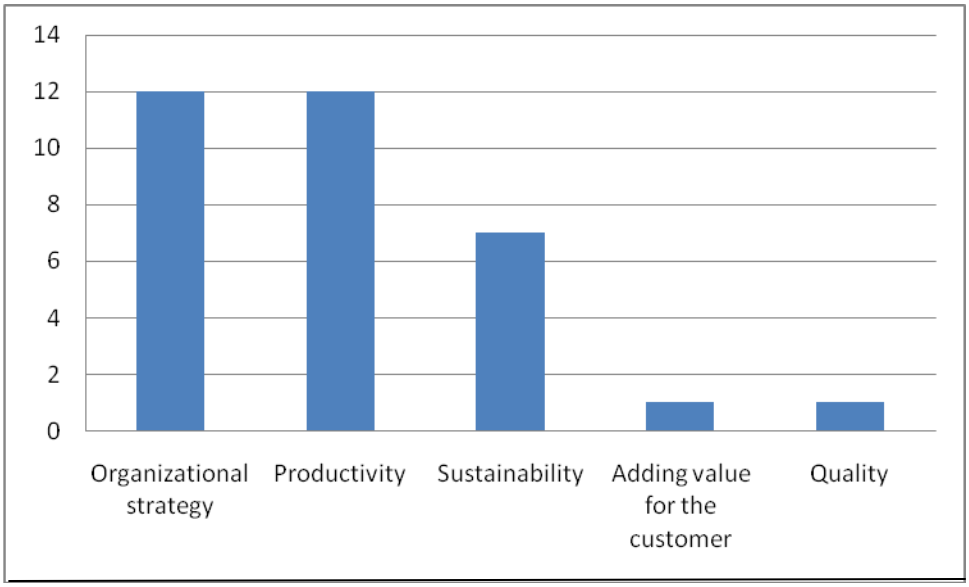

Figure 2: Strategy concept graph

Based on the main occurrences regarding the concept of strategy and LC in the databases**,** the following topics explore the research question by trying to understand the implications of LC in organizational strategy, productivity**,** and sustainability.

Lean Construction and Organizational Strategy

According to Sage et al. (2012), the adoption of LC leads to changes in companies' strategy in order to significantly increase the development of the processes. As stated by the authors, Lean in civil construction has emerged as a strategy to assist in the reduction of project costs, the predictability of completion, and in the final quality of the enterprise as well as improvement in the relations of the supply chain and in the relationship with customers.

Miranda Filho et al. (2001), points out that the failure in the implementation of Lean Construction is often related to isolated implementation practices, as it is common for the civil construction managers to have difficulty in understanding that it takes several adjustments in production strategy for the productive system to be successful. So, this fact has a direct impact on the LC performance as often its implementation comes down to adopting some tools, and they end up not changing the company's strategy as it should be. For Kim and Park (2006), the LC has the ability to improve human relations across all organizational boundaries, becoming an important component of corporate strategy. Arising from this, functions and responsibilities should be reviewed and redefined at all levels in the organization.

Zimina and Pasquire (2011) defend that the Lean implementation in the building industry is a strategic decision with a commercial purpose and to succeed there is a need of this strategic change to reflect the way that the company operates. According to the authors, the influence of Lean on company strategy will depend not only on the leadership, but also on what they intend for the new system, as long as all the decisions come from the top of the organization. When implementing Lean Construction, it has to be clear to the company that this is a long-term planning system and that not all of its benefits will be a tangible asset, requiring, in many situations, to work with all its chains both upstream and downstream. The authors still highlight

that construction companies normally depend on the coordination between their business and the executed projects and that both of them must be aligned. Nevertheless, it is not enough to have results in just one of them, because the outcome depends on the good performance of the whole.

New management thinking, when it comes to Lean production**,** suggests that performance increase and the decrease in costs can be reached through the improvement in the reliability of the flow (RANDOLPH et al. 2003). One of Lean principles reveals that flows that are more reliable lead to better work performance. In this sense, the authors affirm that little effort is being made to support the occurrence of reliable workflow. Flexible capacity strategies in relation to the project resources are an important part of achieving a reliable flow and enhance building performance. The flow control helps the project manager to control the workflow and is a great strategy to create alliances with its suppliers. Therefore it is possible to improve negotiations with the supplier by providing more flexibility in terms of delivery and possible changes in the orders.(PHENG and FANG, 2004).

For Barros Neto and Alves (2007), it is necessary to define the strategic objectives before the implementation of Lean Construction in construction companies. As stated by the authors, there is evidence that companies have implemented Lean in the operational level from tools and a low level of complexity principles without any association with strategic goals. Some companies in the civil construction sector have a long-term vision for defining the goals they want to achieve through the implementation of Lean and which path they should take to achieve these goals. Without an adequate strategic orientation, the implementation of Lean may fail**,** as other initiatives have, to improve the companies' performances.

Implications of Lean Construction (LC) in Sustainability

In general, building causes considerable impact on the environment, society**,** and the economy and it can be reduced through the implementation of LC (SALEM et al. 2014). According to Song and Liang (2011), the implementation of Lean concepts requires a re-thinking of the processes and practices of conventional construction, and a change of culture and the introduction of new tools being necessary. Yet**,** considering these researchers, besides improving time and cost performance of the project, LC might have a positive impact on sustainability, mainly by reducing the environmental impact of the construction due to the reduction of waste in construction projects.

Huovila and Koskela (1998) have recommended Lean Construction as a conceptual basis for sustainable development in the building life cycle process, by reducing waste and pollution, resource depletion, the search for adding greater value for the customer**,** and achieving environmental excellence. For Marhani et al. (2013), the implementation of LC management processes in construction projects has a great chance to provide a more sustainable future, since the introduction of concepts of health and safety enables the management of risk at the construction site. In addition, the application of techniques and LC tools provides the reduction of the job duration, promoting the quality and sustainability of the project as a whole.

The main goal of Lean production is to deliver value to the interested stakeholders, including internal and external customers, and to pursue waste elimination (NAHMENS et al. 2012), creating a culture of continuous in-company improvement. Koskela (1993) has emphasized the importance of the production process flow and the conversion of raw materials into finished products as important elements in creating value over the life of a project. The implementation of

LC tends to establish a healthier and more organized workplace, ensuring staff welfare and reducing safety risks (KOSKELA 1992, 2000).

Productivity and Added Value for the Customer

Understanding productivity and performance in civil construction is essential to the implementation of successful improvement strategies. For Issa (2013), LC can be defined as a production management strategy to ensure significant continuous improvement in business process performance by eliminating time wasting and other resources that do not add value to the product or service delivered to the customer. According to the author, LC is a new proposal aimed at the productive construction management.

The Lean Construction Institute (2012) has referenced that the Lean objectives are to maximize value and minimize waste using specific techniques applied to the project. Thus, LC can be considered a continuous improvement in the construction process, reducing the waste of resources and adding value to the client's project. The customer is the one who defines the value. In the Lean Construction context, wasting refers to all resources consumed by activities that do not add value to meet the needs of a customer (SONG, 2011). As stated by Dulaimi and Tanamas (2001), the application of Lean techniques to construction eliminates steps that do not add value, meets the requirements of the project**,** and thus improves the architecture, engineering**,** and construction processes.

Koskela (1992) has stated that one of the fundamental principles of Lean Thinking is to reduce the share of activities that do not add value, i.e., activities that consume time, resources, and space**,** but do not add value, unlike the activities that convert materials or information direction to what is required by the customer. In this same sense, the author states the importance of increasing the output value through a systematic analysis of customer needs.

CONCLUSION

This study aimed to explore the influence of the adoption of lean construction in company strategy through a systematic review of literature. By the end of the analysis of the articles, they were classified according to the strategy approach and it was realized that LC influences it mainly on issues related to organizational strategy, productivity**,** sustainability, and added value to the customer**.**

By analyzing the aspects of LC that affect organizational strategy, it was realized that the successful implementation of this system is directly connected to the way it is embedded in organizational strategy, pointing out that in civil construction, a serious mistake when trying to implement the LC is to consider changes only at the operational level, without associating them with strategic planning. Another important issue, explored in some studies, refers to the change in the organizational structure that the LC requires, since it is essential that the roles are well defined, which often ends up requiring a functional remodeling that does not always happen, especially by misunderstanding the necessity need of this strategic change.

As for productivity and added value, what was found confirms the classic lean theory that ensures this system facilitates the understanding of how the customer defines value, and assists the organization in identifying and reducing their waste in the production system. This same waste**,** in the civil construction context**,** contributes to reducing environmental impacts, as it aids in reducing discards and waste generated by this industry.

In short, it was possible to find out that LC influences the organization's strategy and its success is directly linked to the understanding of this interface. However, it was also verified that this influence is little explored even in scientific articles. It is worthwhile to point out that there weren't any case studies to present the changes that LC might have brought to the company's strategy**;** most papers pointed to the fact that if it wasn't considered the company's strategy in the decision to implement LC it would most likely be problematic.

Facing the scarcity of publications that address this interface, and the importance of it to the successful implementation of LC, it is suggested as a future work, to explore the conduction of empirical works to check the actual changes that the adoption of –LC brought about in the strategy of civil construction companies.

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