LEAN AND AGILE PROJECT MANAGEMENT:

AN OVERVIEW OF THE LITERATURE EXPLORING COMPLEMENTARITIES

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Abstract: This study approaches the scenario of the literature on Lean an Agile Project Management, exploring synergies and complementarities, tools, and practices. It is a literature review, applying bibliometric analysis of networks generated using VOSViewer Software and content analysis that explores a coding schema, draw through an in-depth analysis of the selected papers. The results show that Agile Project Management is becoming spreadably used; however, Lean Project Management still faces diffusion difficulties beyond the construction sector. For theory, it provides an overview of the literature, exploring methods, tools, and values of both approaches, pointing out the research opportunities and gaps. For practice, it identifies the main tools and the organizational contexts for applying Agile and Lean Project Management, helping in decision-making.

KEYWORDS: LEAN; AGILE; PROJECT MANAGEMENT; BIBLIOMETRICS

1. INTRODUCTION

There is an increasing interest in Project Management literature on innovative approaches, more aligned to the current context dynamics (Conforto, Amaral, da Silva, Di Felippo, & Kamikawachi, 2016), in constant evolution (Bredillet, Tywoniak, & Tootoonchy, 2018).
Thus, the approaches under the umbrella of the so-called """agile""" (Serrador & Pinto, 2015), considered highly adaptable with short iterations of planning and execution (PMI, 2017), continuous feedback from stakeholders, and easy-to-manage changes (Sixsmith, Mooney, & Freeburn, 2014) has received attention from academics and practitioners.
The evolutionary cycles of continuous improvement in agile methods are grounded on the PDCA cycle (Measey & Radtac, 2015, Pernstål, Feldt, & Gorschek, 2013) and in the principles and practices of lean approaches (Liker, 2004). Both lean and agile approaches focus on delivering value (Womack, Jones, Roos, Korytowski, & Ferro, 2004, Nurdiani, Börstler, & Fricker, 2016), and on visual management tools (Nurdiani, Börstler, & Fricker, 2016; Pernstål, Feldt, & Gorschek, 2013).
However, there is a lack of studies on lean project management, still focusing on the execution of construction projects (Rosenbaum et al., 2013). The similar genesis and aims suggest that both approaches could benefit from each other, seeking cross-fertilization, as suggested by Wang, Conboy, & Cawley (2012), that propose the joint adoption - """leagile""" for software development.
In this context, this study aims at identifying the scenario of the literature on Lean an Agile Project Management, exploring complementarities between them. For achieving the research objective, we proposed two research questions: RQ1 - How are the themes Agile Project Management and Lean Project Management addressed in the current literature? RQ2: Which are the tools and practices applied in Agile and Lean project management?
The research design is a literature review combining quantitative and qualitative strategies through bibliometric and content analysis. This study aims to contribute to a greater understanding of the theme Lean and Agile Project Management, in the current literature.
This article presents a brief review of the literature in the next section, followed by the research methods, detailing the sampling process, and how the data will be analyzed. Then, it presents the research results, discussions, and conclusions.

2. LITERATURE REVIEW

Project management methodologies can differ from organization to organization, from team to team, according to culture, internal synergy, contractual and business needs, choosing and combining tools that best contribute for management to occur in the best possible way (Karrbom Gustavsson & Hallin, 2014). However, project management is a crucial competence to obtain results from projects that are increasingly better and more aligned with the strategic goals of organizations (Brones et al., 2014).
To be successful in dealing with different approaches and managerial needs, "the project manager will need to be familiar with the tools and techniques to understand how to apply them effectively" (PMI, 2017, p. 178).

2.1. LEAN PROJECT MANAGEMENT

The Lean approach emerges from the Toyota Production System focusing on "specifying a value, aligning actions that create value in the best sequence, performing those activities without interruption" (Womack et al., 2004, p. 3), aiming at eliminating all forms of waste and activity that does not add value.
In Lean philosophy, the processes approach that maximizes value for the client (Lapinski et al., 2006) is pulled by the customer's demand (Womack & Jones, 2004).
The application of Lean in product and project development can also provide many benefits (Baines et al., 2006).
The use of Visual Management, tools, and fail-safe methods (Poka-yoke), among others, also constitute this large Lean toolbox, always focusing on eliminating waste and optimizing resources to increase value-adding to processes and products (Lean Institute Brasil, 2020; Yu et al., 2009). An example is the use of the same room for the main actors involved during the execution of a project, in order to promote face-to-face communication (Koenigsaecker, 2011).
Schedule, scope, quality and cost in the project environment can be managed from Lean concepts to achieve better results in the activities of the project process, or so that the final product is designed more effectively, or for better meeting the expectations of customers and users (Hansen & Olsson, 2011).
Lean project management (LPM) """differs from traditional project management not only in the goals it pursues but also in the structure of its phases, the relationship between phases and the participants in each phase" (Ballard & Howell, 2003, p. 119).

2.2. AGILE PROJECT MANAGEMENT

The Agile Manifesto in February 2001 influenced the dissemination of the Agile methodology when professionals involved in software development understood the need to define values and to establish principles that would base their ideas for software development. The proposed values were directed to individuals and interactions, operating software, customer collaboration and change response, and less focused on processes, tools, comprehensive documentation, contract negotiations, and plans (Agile Manifesto, 2020).

The manifesto proposed twelve principles at that time, focusing on customer satisfaction. The 'customer's active participation occurs in an agile process of sustainable development open to change, and that generates constant and operational deliveries. Thereunto, it established a self-organized, motivated, and efficient team, using the best architectures, requirements, and designs. They pursue excellence and simplicity, through the reflection of the increasingly effective ways of working and adjusting behavior (Agile Manifesto, 2020).

Agile Project Management (APM) is characterized by highly adaptable life cycles, with the progressive construction of requirements, from short iterations of planning and execution (PMI, 2017).

The agility construct is related to the project team's ability to rapidly change the project plan in response to customer or stakeholder needs, market or technology, to achieve better design and product (Conforto et al., 2016). The information transits freely, and team members benefit from the available knowledge from various sources (Augustine et al., 2005).

Some characteristics that define the structuring of agile project management are Self-Management, Vision, and Iteration. Self-management directs the members of the project teams towards having more responsibilities added to the specialties already identified in the traditional project management model. Vision replaces scope, bringing all the concepts that make them synonymous but additionally having to be challenging, motivating, concise, and to anticipate the design of the product. The iteration proposes the short-term planning that leads to short cycles of development setting tests so that the control and visualization of the activities planned are continuously possible throughout the project (Amaral et al., 2011).

One of the best-known tools that support the application of agile principles and all the philosophy that surrounds it is Scrum, which determines roles and responsibilities, moments of iteration, monitoring methods, and evolution of the project (Alqudah & Razali, 2016). This tool focuses on managing requirements and their unexpected changes, promoting better communication among all project participants, including customer representatives and team members (Lei et al., 2017).

There are also many references to the use of Extreme Programming, very common in the software project environment, for promoting teamwork through peer programming, integration, communication, simplicity, and focus on testing and small releases. Other tools that are less cited, but that have agile traits in their structure are DSDM (Dynamic Systems Development Method), Agile Modeling (AM) and Crystal Clear (Alqudah & Razali, 2016)..

3. RESEARCH METHODS

3.1. SAMPLING PROCESS

For relevant information and reliable sources, we selected two of the main academic databases -ISI Web of Science and Scopus, "including titles from Emerald, Elsevier, Springer, Willey, Taylor & Francis, JStor, among others" (Morioka & Carvalho, 2016, p.135). Also note that ISI Web of Science offers a wide range of metadata that allows performing the bibliometric analysis (Carvalho et al., 2013).

Using the terms "Project Management" AND ("Lean" OR "Agile"), and filtering only articles and reviews, it was possible to obtain the first sample. Thus, the ISI Web of Science database presented 293 references, and the Scopus database presented 287 references, whose theme filter "Business, Management and Accounting" was also applied. Of this sample of 580 references, 86 were duplicated, generating a base of 494 titles to be analyzed. From the analysis of titles and abstracts, 294 articles were selected to compose the sample for this study. For the content analysis, we prioritized full reading of the articles that accounted for 80% of the total citations in the sample. The research flowchart is presented in **Figure 1**.

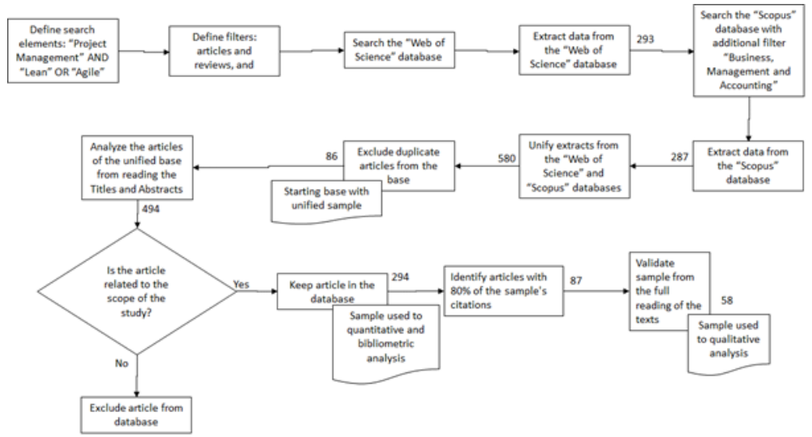

Figure 1 – Research Flow (Source: Authors).

3.2. DATA ANALYSIS

3.2.1. Bibliometric analysis

Bibliometric analysis is used to identify relationships between essential factors contained in the bibliography that make up the selected sample, because """the study of references, publications and citations are important for tracing the intellectual growth of a certain application or method""." (Teichert & Shehu, 2010, p. 50). Thus, in order to understand how the themes behave, the occurrence of publications in the leading journals, the most cited authors, among others, there are the most diverse correlation analyses. For this purpose, the tool used herein was VOSViewer because it has tools that enable such analyses (Eck & Waltman, 2010).

Through bibliometrics, we performed analyses of co-occurrence of keywords and their evolution in time, the co-occurrence of words of titles and abstracts of articles, co-citation of documents, which are the journals with the highest number of publications and which articles have the highest number of citations in the sample.

We performed a statistical analysis of the data to identify the most cited articles, the leading journals, and other demographic information.

3.2.2. Content analysis

We performed the content analysis by reading the full texts in the final sample, exploring the developed coding schema in the analysis. Among the 294 articles composing the final sample, 87 presented the highest number of citations/year, representing approximately 80% of the citations of the articles of the entire sample. Considering that the representativeness of the sample was significant, the 87 texts underwent full reading to perform the content analysis. Of this selection, 38 address the Lean philosophy, while 44 deal with the Agile methodology and 5 approach the two themes concomitantly, generating a very balanced sampling among the themes discussed here.

The full reading of the most cited articles enabled the identification of 29 texts that did not adequately address Project Management in their content, 27 on lean methodology and concepts, and two on agile methodology. We highlight those related to the application of Lean tools and concepts in civil construction, which are 15 out of the27. Although these studies are related to project management, in some cases, they focused on the execution activities, such as waste management in the construction project, and not on management activities, similarly to lean thinking applications in manufacturing, automotive, banking, among others.

Table 1 shows the codes used for analyzing the sample. The coding schema was initially drawn from the literature review and then updated during the content analysis. The five agile variables (T1 –T5) of Conforto et al. (2016), and Agile Methods and Tools (T6 – T11), explored in articles by Kettunen (2009), Mahnic (2012) and McAvoy & Butler (2009). We also identified Lean Principles (T12 – T16) presented by Womack & Jones (2004) and Lean tools (T17 – T29) referenced in articles by Pavnaskar et al. (2003); Rosenbaumet et al. (2014), and also found in Lean Institute Brasil (2020) and Alsehaimi et al. (2014).

4. RESULTS

4.1. SAMPLE DEMOGRAPHICS

The Journals with the highest number of publications among the selected articles are the Journal of Construction Engineering and Management, followed by the International Journal of Project Management, the Project Management Journal, the Journal of Modern Project Management, and the Journal of Systems and Software **(see table 2**).

Code	Approach
AG	Agile
LE	Lean
Code	**Agile Characteristics**
T1	Project Plan Update Time
T2	Decision Time
T3	Interaction between customers and teams
T4	Delivery frequency
T5	Customer validation
Code	**Agile Methods and Tools**
T6	Scrum
T7	Extreme Programming
T8	Sprint
T9	Planning poker
T10	Feature-Driven Development
T11	Dynamic Systems Development Method
Code	**Lean Principles**
T12	Value
T13	Value Stream
T14	Flow
T15	Pull
T16	Perfection
Code	**Lean/ Six Sigma Tools**
T17	Kanban
T18	Value Stream Mapping
T19	Kaizen
T20	5S
T21	A3
T22	Poka yoke
T23	Heijunka
T24	Jidoka
T25	Plan, Do, Check, Act (PDCA)
T26	Quality circles
T27	Define, Measure, Act, Improve, Check (DMAIC)
T28	Visual management
T29	Last Planned System (LPS)

Table 1 - Article analysis codes

4.2. BIBLIOMETRIC ANALYSIS

The bibliometric analysis contributed to analyzing questions RQ1 and RQ2 of this study.

Figure 2 shows a chronological analysis of the topics of publications, using the keywords of the sample used herein. It is possible to identify the current themes related to agile and lean six sigma methodology (circle 1 and 2), while Lean linked to civil construction has a greater focus on articles from the past decade (circle 3).

We also verified the association of these methodologies of Project Management with studies on performance, success factors, improvement, and productivity.

Figure 3 presents the terms of titles and abstracts, separating them into three clusters, distinguished as the blue cluster, or number 1, relating terms linked to Lean Six Sigma, Design Methodology, and Success. The red cluster, or number 2, concentrates on terms related to Software Development, Agile Project Management, their tools and methods, team, and company. Therefore, the green cluster, or number 3, brings terms linked to Lean in Construction, Techniques, and relationships with Efficiency, Effectiveness, and Performance.

4.3. CONTENT ANALYSIS

The 58 articles referring to the theme of this article, Project Management, were separated into 43 that address Agile Project Management, 12 that deal with Lean Project Management, and three that cover the two methodologies. Software Development Environment is the central theme of more than half of the sample (30 articles), all related to Agile Management, but three simultaneously address Lean. The Civil Construction environment was addressed in six articles, all of which are about Lean Management (see **Table 3**).

Table 2 – Main journals in the sample

Journal	Number of articles in the sample
Journal of Construction Engineering and Management	16
International Journal of Project Management	12
Project Management Journal	12
Journal of Modern Project Management	9
Journal of Systems and Software	8
Engineering, Construction and Architectural Management	7
International Journal of Lean Six Sigma	6
Journal of Management in Engineering	6
Lecture Notes in Business Information Processing	6
Construction Management and Economics	5
Empirical Software Engineering	5
International Journal of Managing Projects in Business	5

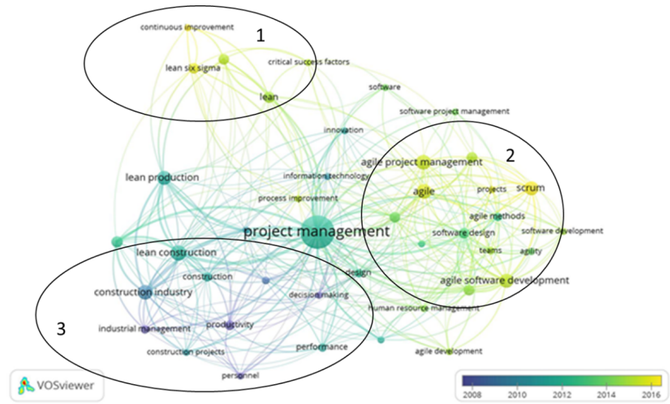

Figure 2 – Keywords network
Source: Based on content analysis data using the VOSviewer software

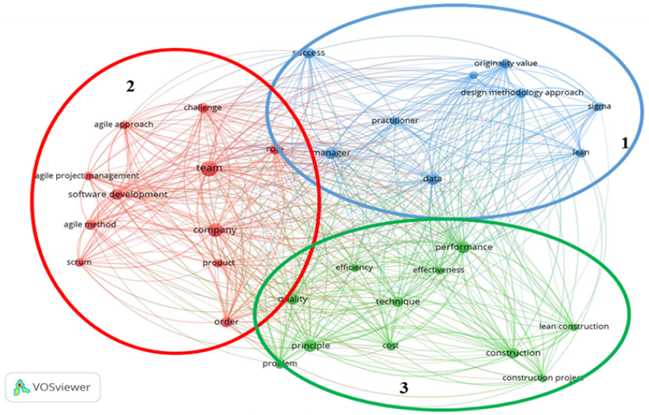

Figure 3 - Words network considering titles and abstracts
Source: Based on content analysis data using the VOSviewer software

Approach	Code	References	# ref	%*
Agile	AG	Ahimbisibwe, et al. (2015); Augustine, et al. (2005); Azanha, et al. (2017); Cao, et al. (2010); Ceschi, et al. (2005); Conforto & Amaral (2010); Conforto & Amaral (2016); Conforto, et al. (2016); Conforto, et al. (2014); Cooper & Sommer (2018); Daneva, et al. (2013); Dingsøyr & Moe (2014); Dingsøyr, et al. (2018); Drury, et al. (2012); Drury-Grogan (2014); Eklund, et al. (2014); Fernandez & Fernandez (2008); Hobbs & Petit (2017); Hoda & Murugesan (2016); Hodgson & Briand (2013); Kannan, et al. (2017); Karlstrom & Runeson (2005); Karlstrom & Runeson (2006); Karrbom Gustavsson & Hallin (2014); Kettunen (2009); Law & Larusdottir (2015); Lee & Xia (2010); Lee & Yong (2010); Lei, et al. (2017); Levardy & Browning (2009); Leybourne (2009); Lindsjorn, et al. (2016); Machado, et al. (2015); Mahnic (2012); Maruping, et al. (2009); McAvoy & Butler (2009); Middleton & Joyce (2012); Misra, et al. (2009); Nurdiani, et al. (2016); Persson, et al. (2012); Petersen & Wohlin (2010); Schatz & Abdelshafi (2005); Serrador & Pinto (2015); Sheffield & Lemétayer (2013); Stettina & Horz (2015); Tripp, et al. (2016)	46	79%
Lean	LE	Alsehaimi. et al. (2014); Ballard & Howell (2003); Gao & Low (2014); Karlsson & Åhlström (1996); Laureani & Antony (2018); Law & Larusdottir (2015); McLean & Antony (2014); Middleton & Joyce (2012); Nurdiani, et al. (2016); Sacks (2016); Salem, et al. (2006); Sreedharan & Sunder (2018); Sunder (2016); Winch (2006); Zimina, et al. (2012)	15	26%

Table 3 – Approach: Agile and Lean Project Management (* % in 58 articles)

4.3.1. Agile Project Management

The increasing search for management methods that allow dealing with creative and technical environments at the same time, with challenging aspects of control (Hodgson & Briand, 2013), lead companies to apply flexible and more adaptive alternatives to project changes (Cooper & Sommer, 2018).
Companies need forms of management that provide answers to the questions inherent to traditional project management, such as in planning management (Ceschi et al., 2005), in the relationship with the client (Azanha et al., 2017) and the reduction of project costs (Cao et al., 2010). New methodologies must allow the fastest and most efficient reaction to project changes, often arising from market changes, company strategy, or gradual understanding of the requirements established at the beginning of the project.
The "soft" concept applies to methodologies that emphasize the interaction between team and customers, communication, and relationship as forms of project management (Karrbom Gustavsson & Hallin, 2014). **Table 4** summarizes the main agile characteristics discussed in the articles surveyed.

Item	Code	References	# ref	%*
Project Plan Update Time	T1	Ahimbisibwe, et al. (2015); Augustine, et al. (2005); Azanha, et al. (2017); Cao, et al. (2010); Ceschi, et al. (2005); Conforto & Amaral (2010); Conforto & Amaral (2016); Conforto, et al. (2016); Conforto, et al. (2014); Cooper & Sommer (2018); Daneva, et al. (2013); Dingsøyr & Moe (2014); Dingsøyr, et al. (2018); Drury-Grogan (2014); Eklund, et al. (2014); Fernandez & Fernandez (2008); Hobbs & Petit (2017); Hoda & Murugesan (2016); Hodgson & Briand (2013); Kannan, et al. (2017); Karlstrom & Runeson (2005); Karlstrom & Runeson (2006); Karrbom Gustavsson & Hallin (2014); Kettunen (2009); Law & Larusdottir (2015); Lee & Xia (2010); Lee & Yong (2010); Lei, et al. (2017); Levardy & Browning (2009); Leybourne (2009); Lindsjorn, et al. (2016); Machado, et al. (2015); Mahnic (2012); Maruping, et al. (2009); Middleton & Joyce (2012); Misra, et al. (2009); Nurdiani, et al. (2016); Persson, et al. (2012); Petersen & Wohlin (2010); Schatz & Abdelshafi (2005); Serrador & Pinto (2015); Stettina & Horz (2015); Tripp, et al. (2016)	43	93%
Decision Time	T2	Augustine, et al. (2005); Azanha, et al. (2017); Cao, et al. (2010); Conforto & Amaral (2010); Conforto & Amaral (2016); Conforto, et al. (2016); Cooper & Sommer (2018); Daneva, et al. (2013); Drury, et al. (2012); Drury-Grogan (2014); Eklund, et al. (2014); Fernandez & Fernandez (2008); Hoda & Murugesan (2016); Kannan, et al. (2017); Karlstrom & Runeson (2005); Karlstrom & Runeson (2006); Kettunen (2009); Law & Larusdottir (2015); Lee & Xia (2010); Lee & Yong (2010); Levardy & Browning (2009); Leybourne (2009); Machado, et al. (2015); Mahnic (2012); McAvoy & Butler (2009); Misra, et al. (2009); Persson, et al. (2012); Petersen & Wohlin (2010); Schatz & Abdelshafi (2005); Serrador & Pinto (2015); Stettina & Horz (2015); Tripp, et al. (2016)	32	70%
Interaction between customers and teams	T3	Augustine, et al. (2005); Azanha, et al. (2017); Cao, et al. (2010); Ceschi, et al. (2005); Conforto & Amaral (2010); Conforto, et al. (2016); Conforto, et al. (2014); Cooper & Sommer (2018); Daneva, et al. (2013); Drury, et al. (2012); Drury-Grogan (2014); Eklund, et al. (2014); Fernandez & Fernandez (2008); Hoda & Murugesan (2016); Kannan, et al. (2017); Karlstrom & Runeson (2005); Karlstrom & Runeson (2006); Karrbom Gustavsson & Hallin (2014); Kettunen (2009); Law & Larusdottir (2015); Lee & Yong (2010); Lei, et al. (2017); Mahnic (2012); Misra, et al. (2009); Schatz & Abdelshafi (2005); Serrador & Pinto (2015); Sheffield & Lemétayer (2013); Stettina & Horz (2015); Tripp, et al. (2016)	29	63%
Delivery frequency	T4	Augustine, et al. (2005); Azanha, et al. (2017); Cao, et al. (2010); Ceschi, et al. (2005); Conforto & Amaral (2010); Conforto & Amaral (2016); Conforto, et al. (2016); Conforto, et al. (2014); Daneva, et al. (2013); Dingsøyr, et al. (2018); Drury-Grogan (2014); Eklund, et al. (2014); Fernandez & Fernandez (2008); Hoda & Murugesan (2016); Hodgson & Briand (2013); Kannan, et al. (2017); Karlstrom & Runeson (2005); Karlstrom & Runeson (2006); Karrbom Gustavsson & Hallin (2014); Kettunen (2009); Law & Larusdottir (2015); Lee & Xia (2010); Lee & Yong (2010); Lei, et al. (2017); Levardy & Browning (2009); Leybourne (2009); Lindsjorn, et al. (2016); Machado, et al. (2015); Mahnic (2012); Middleton & Joyce (2012); Misra, et al. (2009); Nurdiani, et al. (2016); Persson, et al. (2012); Petersen & Wohlin (2010); Schatz & Abdelshafi (2005); Serrador & Pinto (2015); Sheffield & Lemétayer (2013); Stettina & Horz (2015); Tripp, et al. (2016)	39	85%

Table 4 – Agile Characteristics. (* % in 46 articles)

Thus, the focus of the research on the principles and techniques involving Agile Project Management, compared to traditional methodologies, such as Stage-Gate, becomes increasingly comprehensive. The interest regards the impacts on teams, processes, communication, leadership, and numerous aspects related to management activities in face of the challenges of change (Conforto & Amaral, 2010; Fernandez & Fernandez, 2008; Serrador & Pinto, 2015).
However, within Agile Management, it is essential to analyze some points, verify issues so that its implementation meets the expectations of the company and those involved because what is a strong point in an environment can be weak for another (Law & Larusdottir, 2015). Sometimes, it is necessary to apply some adjustments to the methodology adopted for it to meet the environment that will receive it. It can be more appropriate to combine two or more approaches so that positive results are obtained for the organization through the action of the strengths of one technique on the weaknesses of another and vice versa (Cooper & Sommer, 2018).
During the transition to Agile Project Management, hard work is required, without illusions of miraculous solutions, with the support of senior management and focusing on teamwork to promote integration and communication APM principles that emphasize the self-organization of teams, face-to-face communication and constant feedback and iterations with the client contributes to better management (Schatz & Abdelshafi, 2005).
The attention paid to the structuring format of agile teams, their autonomy in planning and decision-making (Drury et al., 2012; McAvoy & Butler, 2009), employee satisfaction and success care (Tripp et al., 2016; Lindsjorn et al., 2016) are relevant. Changes in delegation and searching for the best performance require the attention of project managers (Schatz & Abdelshafi, 2005) and can generate significant impacts on aspects of roles and responsibilities and even on the ' 'team's quality of life.
Such issues become even more critical when the organization is interested in applying the Agile methodology on a large scale. In this case, the perspective of a restricted group of employees becomes relevant within the scope of multiple teams, requiring greater coordination from the project manager (Dingsøyr et al., 2018). It is important to maintain the synergy promoted by this type of methodology, even when the teams working together are located in different countries (Persson et al., 2012; Lee & Yong, 2010).
During the implementation of Large Scale Agile Management, numerous issues, not verified in self-organized and small teams, arise. Organizations often start thinking about how to deal with multiple clients (Daneva et al., 2013), the development and production of complete products, involving embedded systems, hardware, and software (Eklund et al., 2014). So many other challenges can emerge and affect organizational culture, shake known hierarchical structures, generate apprehensions, doubts, and difficulties in adaptation. The relationship with customers and supply chain requires attention to the logistics of communication and interaction, the role of leadership, the motivation of employees, among other points.
Table 5 presents the summary of the content analysis concerning the agile methods and tools.

4.3.2. Lean Project Management

In his study into the construction environment, Sacks (2016) focuses on proposing a model that allows better fluidity within the entire process of a project. Thus, the role of the project manager is addressed together with production management and supplier management, whose attribution involves all project deliveries, care with planning and its interfaces, and critical paths, linked to contractual issues with suppliers and subcontractors. The breadth of the manager's role is essential to the flows of information that coordinate transformations, unlike the base managers responsible for the transformations themselves, so that the project as a whole creates value to the customer (Winch, 2006). **Table 6** explores the lean principles in the articles surveyed.

Item	Code	References	# ref	%*
Scrum	T6	Ahimbisibwe, et al. (2015); Azanha, et al. (2017); Cao, et al. (2010); Ceschi, et al. (2005); Conforto & Amaral (2016); Cooper & Sommer (2018); Daneva, et al. (2013); Dingsøyr & Moe (2014); Dingsøyr, et al. (2018); Drury-Grogan (2014); Eklund, et al. (2014); Hobbs & Petit (2017); Hoda & Murugesan (2016); Hodgson & Briand (2013); Kettunen (2009); Law & Larusdottir (2015); Lee & Yong (2010); Lei, et al. (2017); Lindsjorn, et al. (2016); Machado, et al. (2015); Mahnic (2012); Middleton & Joyce (2012); Nurdiani, et al. (2016); Persson, et al. (2012); Petersen & Wohlin (2010); Schatz & Abdelshafi (2005); Stettina & Horz (2015); Tripp, et al. (2016)	28	61%
Extreme Programming	T7	Augustine, et al. (2005); Cao, et al. (2010); Ceschi, et al. (2005); Dingsøyr & Moe (2014); Drury-Grogan (2014); Eklund, et al. (2014); Hoda & Murugesan (2016); Karlstrom & Runeson (2005); Karlstrom & Runeson (2006); Kettunen (2009); Lee & Yong (2010); Lindsjorn, et al. (2016); Maruping, et al. (2009); McAvoy & Butler (2009); Persson, et al. (2012); Petersen & Wohlin (2010); Stettina & Horz (2015); Tripp, et al. (2016)	18	39%
Sprint	T8	Ahimbisibwe, et al. (2015); Azanha, et al. (2017); Conforto & Amaral (2016); Cooper & Sommer (2018); Daneva, et al. (2013); Dingsøyr, et al. (2018); Drury-Grogan (2014); Eklund, et al. (2014); Hobbs & Petit (2017); Hoda & Murugesan (2016); Hodgson & Briand (2013); Kannan, et al. (2017); Law & Larusdottir (2015); Lee & Yong (2010); Lei, et al. (2017); Machado, et al. (2015); Mahnic (2012); Persson, et al. (2012); Schatz & Abdelshafi (2005)	19	41%
Planning poker	T9	Hodgson & Briand (2013); Mahnic (2012); Nurdiani, et al. (2016)	3	7%
Feature-Driven Development	T10	Kettunen (2009); Tripp, et al. (2016)	2	4%
Dynamic Systems Development	T11	McAvoy & Butler (2009)	1	2%

Table 5 – Agile Methods and Tools. (* % in 46 articles)

The interest in Voice of Customer (VoC) of Lean Six Sigma projects directs the initial steps managed by the DMAIC methodology (Sunder, 2016; Sreedharan & Sunder, 2018). It is helpful for project managers in the planning phase to guide the following stages. The manager must negotiate the support of the areas, establish the measurements to be performed and promote root cause analysis, corroborate the suggested improvements, and control the results of the entire project to generate the expected values.
The overall performance of the project manager, with the use of the PDCA cycle, is suggested (Salem et al., 2006), including cost management, commonly administered in the context of project management, with significant improvements due to the application of lean concepts in its management (Zimina et al., 2012).
Leadership is seen as a critical success factor in Lean Six Sigma projects (Laureani & Antony, 2018), as successful projects depend on understanding stakeholders' interests through their interaction, intervention, and involvement with the leader of the project (Sunder, 2016).
However, Project Management can become a possible cause of failure of continuous improvement initiatives in the organizational environment, if the wrong choice of projects occurs, with distorted focuses, misguided objectives, pre-defined solutions. Poor sizing of the scope, planned time, expected results, and lack of support to project execution are also harmful factors (McLean & Antony, 2014).
In order to reduce the risks of occurrence of some of these factors, especially concerning project planning, we study the use of the Last Planner System (LPS), a tool commonly applied in Lean Construction (Alsehaimi et al., 2014; Gao & Low, 2014). The application of this tool can generate improvement in planning and teamwork, providing a more effective organization of work, which promotes the focus on continuous improvement (Alsehaimi et al., 2014). However, the lack of training and trust between project managers and leaders, the high level of customer demand, the lack of interest in exposing problems, and maintaining communication and updated indicators can sabotage the use of LPS in projects (Gao & Low, 2014).

Item	Code	References	# ref	%*
Value	T12	Ballard & Howell (2003); Middleton & Joyce (2012); Salem, et al. (2006); Winch (2006); Zimina, et al. (2012)	5	33%
Value Stream	T13	Ballard & Howell (2003); Salem, et al. (2006); Zimina, et al. (2012)	3	20%
Continuous flow	T14	Salem, et al. (2006)	1	7%
Pull system	T15	Middleton & Joyce (2012); Salem, et al. (2006)	2	13%
Perfection	T16	Salem, et al. (2006)	1	7%

Table 6 – Lean Principles. (* % in 15 articles)

However, the use of some tools or techniques linked to the Lean philosophy may not characterize the development of a lean project in its entirety. Isolated initiatives are not enough to supply the concept behind the techniques. The coherence and attention to the whole (Karlsson & Åhlström, 1996) is vital to the objectives of the project, as well as in structuring its phases (Ballard & Howell, 2003).
Lean project management needs to consider the design, the project of the production line, the necessary supplies, the assembly process, until the product reaches the customer's hands (Ballard & Howell, 2003). For this, suppliers must be involved, and project teams need to be multifunctional in order to integrate their knowledge through project management that promotes communication, commitment to the project, and a focus on problem-solving (Karlsson & Åhlström, 1996).
Table 7 presents the summary of the content analysis concerning the lean methods and tools.

4.3.3. Lean and Agile Project Management

Lean and Agile methodologies appear in the literature in the umbrella of "soft" or lightweight methodologies of project management. This definition refers to their ways of addressing some design characteristics, such as goals, time, customer engagement, documentation and change management, progress measurement, among others (Karrbom Gustavsson & Hallin, 2014). Besides, both approaches are known for focusing on the client and the rapid response to their needs (Nurdiani et al., 2016).

However, the joint discussion on both approaches is barely addressed in the surveyed literature, only in a few articles. There is a potential room for exploring the """leagile""", a term coined by Wang, Conboy, & Cawley (2012) for the joint adoption with agile and lean management in software development.
The differences between both methods, pointed out in the surveyed sample, are related to conceptual differences. For instance, by comparing scrum and kanban techniques, the pulled versus pushed characteristic is highlighted. While Kanban promotes the "pulled" execution of activities, Scrum works "pushed" through a cadence of releases. One handles data for process analysis and improvement; the other uses it to monitor people's work (Middleton & Joyce, 2012).
Furthermore, the monitoring of continuous improvement in Agile is not by process indicators, and is not promoted as part of the job. The focus on bottlenecks directs the team to fulfill tasks as quickly as possible, leaving the improvements found in the background (Middleton & Joyce, 2012), making Lean, through Kanban, seen with higher affinity with the experiences of users (User Experience) than Agile through Scrum, based on control characteristics, team, and tools (Law & Larusdottir, 2015).
However, the size of the company or project, customer involvement, contractual obligations, the lack of metrics based on market interest, and the actual confrontation of methodologies with culture and organizational structure are points of attention that affect the user experience in both techniques.

Table 7 – Lean and Lean Six Sigma Methods and Tools (* % in 15 articles)

Item	Code	References	# ref	%*
Kanban	T17	Dingsøyr & Moe (2014); Law & Larusdottir (2015); Lei, et al. (2017); Lindsjorn, et al. (2016); Middleton & Joyce (2012); Nurdiani, et al. (2016); Stettina & Horz (2015)	7	47%
Value Stream Mapping	T18	Nurdiani, et al. (2016); Sacks (2016); Winch (2006)	3	20%
Kaizen	T19	Middleton & Joyce (2012); Salem, et al. (2006)	2	13%
5S	T20	Salem, et al. (2006)	1	7%
A3	T21	Zimina, et al. (2012)	1	7%
Poka yoke	T22	Salem, et al. (2006)	1	7%
Heijunka	T23	Middleton & Joyce (2012); Salem, et al. (2006)	2	13%
Jidoka	T24	Middleton & Joyce (2012); Salem, et al. (2006)	2	13%
PDCA	T25	Salem, et al. (2006); Zimina, et al. (2012)	2	13%
Quality circles	T26	Salem, et al. (2006)	1	7%
DMAIC	T27	Sreedharan & Sunder (2018); Sunder (2016)	2	13%
Visual management	T28	Middleton & Joyce (2012)	1	7%
Last Planned System (LPS)	T29	Alsehaimi. et al. (2014); Ballard & Howell (2003); Gao & Low (2014); Sacks (2016); Winch (2006)	5	33%

From these analyses, it is visible that there are at least some conceptual differences between Lean and Agile. Nevertheless, it is not uncommon to identify studies on Agile methodologies that consider Kanban as a tool of this methodology, and do not address its origin in lean philosophy. In the sample studied, four articles fit in this case and are treated in the following session.

5. CONCLUSIONS, LIMITATIONS AND FUTURE RESEARCH

This study carries out an in-depth content analysis of 58 articles dealing with lean and agile project management in the context of projects. This study contributes to the literature in addressing two research questions (RQs) proposed here based on this analysis. First, RQ1 explores the core topics in the literature of both approaches Agile and Lean in a project management context. Besides, it shows that there is still a gap in the literature on Lean Project Management. Finally, it identifies that the joint discussion of both approaches is barely addressed.
It is possible to identify that there is still a concentration of study on Agile Project Management in software development activities; however, it has become more widely used in different sectors recently. The Civil Construction environment is the focus of the literature when it comes to Lean Project Management with few articles in the software industry, lacking to be used in other sectors. There is an opportunity to roll out the lean project management beyond the construction and software sectors.
Considering the RQ2, we observed that the toolkit explored in the Lean Project Management literature is less varied than the manufacturing literature, with a strong focus on Kanban use. In the literature analyzed, it was recently possible to identify a higher interest in the LPS (Last Planner System) tool linked with the BIM (Building Information Modeling), the application in the civil construction environment. The conceptual discussions of philosophy related to the reduction of waste, value stream, lean processes, and continuous improvement were present, but in a few articles. There is still room for new research approaching LPS tools. The studies on Agile Project Management provided greater depth to the theme, more consistency in references to tools and principles. Agile method has deeply been ground in the project management environment in the last 20 years. Lean, on the other hand, originated on the shop floor, discussing waste and processes usually visible and often tangible, and its results fostered the approach in less concrete and management-oriented environments. There is still a lack of discussion on lean thinking in the project management area.
Due to the methodological choice, some limitations need to be acknowledged. First, the surveyed sample has limitations due to the databases, search strings, and filters adopted. Besides, in the content analysis, 'researchers' judgment on 'papers' exclusion can bring some bias, although the selection criteria and the redundancy in the analysis minimize this issue. Therefore, relevant studies may not have been considered in the search. Second, the inherent subjectivity of the analysis process by researchers concerning content analysis selected codes, and interpretation must be acknowledged.
As a future research agenda, we suggest further studies exploring the complementarities between Lean and Agile for cross-fertilization. Besides, the differences, mainly how the pulled versus the pushed characteristic can affect project management and project performance. We also perceived as a fertile field for studies the barriers to applying Agile Methodology to Large-Scale Project Management, addressed in some surveyed articles. The challenges encountered in organizations trying to expand the use of the methodology and the benefits obtained by such an expansion can shed light on more profound and more complex management issues.

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