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Synergy between Traditional, Agile and Lean management approaches in construction projects: bibliometric analysis

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Abstract

This research aims to contribute to the development of knowledge in project management, by searching for management approaches that can be useful in construction projects. A bibliometric approach based on quantitative analysis methods was applied to investigate the synergy between Traditional, Agile, and Lean management approaches. This study also evaluates the status of the three different approaches using a visualization analysis of journal articles. The bibliometric study was developed with a portfolio of 200 papers around "synergy between Traditional, Agile and Lean approaches" collected at the Web of Science database, covering the evolution of this topic over the last ten years (from 2011 to 2020). The retrieved records were analyzed in terms of year of publication, country, subject, and keywords. The analysis of the original articles revealed that the total number of publications has continuously increased over the last few years. The country producing more papers on this theme was the United States followed by England and Germany. Few studies in the literature have discussed this theme in the construction industry, which means that the concept of combining Traditional, Agile, and Lean approaches is a new concept in construction projects.

Keywords: Agile approach; Traditional project management approach; Lean approach; Synergy; Construction projects; Bibliometric analysis

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1. Introduction

Choosing the right project management approach is critical for the success of construction projects [1]. Project management approaches can be Traditional, Agile, or Hybrid [2,3] . The Project management approach is here defined as a high-level outline of guiding principles, perspectives, and characteristics of how a project is managed and governed [1].

A Hybrid approach emerged from the desire to realize the benefits of the Agile approach while retaining part of the structure of Traditional approaches. In a Traditional approach, also referred as predictive or waterfall, the project scope, time, and cost are determined in the early phases of the life cycle, and any changes to the scope are carefully managed [2]. The Agile approach is based on the Agile Manifesto [4] values for software development and has been expanding for all segments that require a more Agile perspective of project management. The Agile Manifesto has identified four values: individuals and interactions more important than processes and tools; software in operation rather than in-depth documentation; customer collaboration over contract negotiation; and responding to changes more than following a plan. To use an Agile approach, it requires that the product, process, or service resulting from the project can be developed incrementally, and there is a high involvement of the client in the project development Papadakis and Tsironis [2].

We can consider a Hybrid approach not only for the combination of the two above mentioned approaches but also for three approaches, in this paper the notion of Hybrid concerns the Traditional, Agile, and Lean approaches. Lean is an approach that aims to reduce waste by eliminating all unprofitable activities. This research study hypothesized that a Hybrid project management, using Traditional, Agile, and Lean approaches might increase the chances of successful construction projects. The synergy of these three approaches can offer us a more robust methodology for managing construction projects by using the most beneficial practices of each approach. When we have complexity and uncertainty [3], as well as the often rigid cost or time requirements of a large construction projects, a Hybrid approach between these three approaches may be the best way forward [1,5] . Papadakis and Tsironis [2] explain that an Agile Hybrid model in the context of services will be based on specific values and cultural aspects and should aim to provide a faster and more adaptive response to changing customer needs, better integrate the voice of the customer, improve team communication, improve productivity, and change our way of thinking. Germino [6] found that the practitioners suggest the combination of Traditional and Agile practices and believe that Hybrid is a leading project management approach. Although, there are Hybrid models in the literature that propose combinations of Traditional and Agile approaches, there are no studies that address the impact of the adoption of these combined approaches in organizations in practice [7].

The search for a Hybrid project management methodology considering the combination of Traditional and Agile has been primarily focused on software and information technology (IT) projects [7]. However, construction projects might also benefit from some Agile principles to improve the chances of success through high level customer involvement and reduce waste and non-value added by Lean construction. Miller [8] explains that the Agile approach is best when there is high uncertainty, while the Traditional approach is best when it is clear the stakeholders' expectations on the project, and Lean construction is best used to avoid the types of waste at the construction sites. Therefore, in this research, a bibliometric analysis, focusing the Web of Science database, has been conducted to analyze if there is an interdependence between the above-mentioned approaches to exploit the combination practices in a Hybrid project management methodology, by leveraging the strengths of each other, which might lead to an increase in the chances of construction project success.

The paper starts with this introduction to the topic of the synergy on Traditional, Agile, and Lean management approaches in construction projects, then the research methodology section explains the steps of data collection and the way the bibliometric analysis was conducted, followed by the presentation and discussion of the main results. It concludes with a proposition that there is a need for using a Hybrid approach for managing construction projects, which combines Traditional, Agile, and Lean management approaches.

2. Research methodology

This research conducted a bibliometric study, developed into four phases: definition of keywords, definition of databases, article search, and data analysis [9]. The definition of the keywords is considered the first step to the

realization of a bibliometric study, which were used in the databases to find articles mainly related to the measured subject, in this case, we used the following keywords: “Traditional”, “Agile”, and “Lean”. The choice of keywords was based on popularity, which primarily uses the frequency of keywords that are generally identified as important search topics for bibliometric analysis. A frequency threshold is generally used to filter the keywords. One database was chosen to develop this study – Web of Science.

So, the bibliometric data was collected from the Web of Science and processed by the VOSViewer software. We chose the Web of Science database as it allows the identification of several measures such as the analysis of research based on the number and patterns of citations, the identification of trends in research patterns, and the quantitative evaluation of research results [10].

This database contains more than 21,100 high-quality peer-reviewed scientific journals published worldwide in over 250 disciplines. The definition of the study database has the ability to determine the limits of the research, since the entire portfolio of articles, after being examined, can be built through the results obtained in the defined database.

The research was conducted taking into account some specific parameters, namely the results were limited to articles published between 2011 and 2020. The search was not limited in relation to the language of the publications. The software used in this bibliometric analysis is the VOSViewer. It has the advantage of using a new and proven relationship measure (Visualization of similarities [VOS] mapping) and then having an easy to use interface, despite it presents less advanced options [10]. The VOSviewer uses the distance approach and an association strength normalization to visualize networks.

3. Bibliometric analysis of the combination of Traditional, Agile, and Lean approaches

3.1. Research growth: evolution of interdependencies between Traditional, Agile, and Lean approaches

To build the dataset, we used the default search methods in the consulted database Web of Science – search by subject. This method to access the results uses distinct paths: free vocabulary (title, abstract, keywords) and controlled vocabulary (subject). Fig. 1 shows the number of publications per year that the topic has received. It can be observed that the number of published studies on Traditional, Agile, and Lean approaches from 2011 to 2020 has increased. It shows two phases in the publication trend. Phase one represents the period between 2011 and 2015, with few studies per year. Phase two includes the period between 2016 and 2020, where the number of studies for this period has increased with a peak of 18 studies in 2018. There is a reduced number of publications in 2020, as the data collection period was in June 2020. Fig. 1 shows the total number of publications on Traditional, Agile, and Lean approaches from 2011 to 2020.

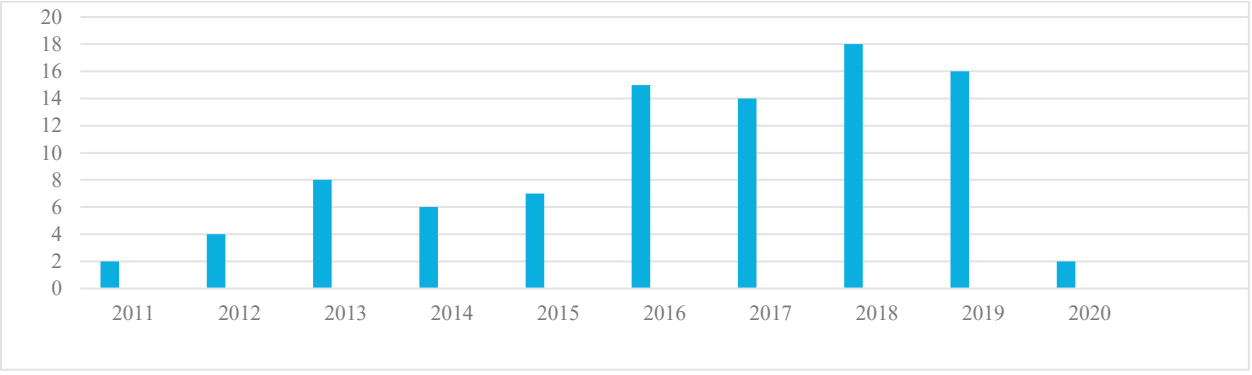

Fig. 1. Total publications on Traditional, Agile, and Lean approaches from 2011 to 2020.

3.2. Subject of Traditional, Agile, and Lean Approaches

This study proposes a list of articles divided into several disciplines such as computer science software engineering, engineering industrial, management, etc. published in the Web of Science database on Traditional, Agile, and Lean management approaches, as summarized in Fig. 2. This analysis was conducted to determine the distribution of areas in which the synergy of Traditional, Agile, and Lean approaches has been addressed. These results also showed the diversity of academic disciplines in which Traditional, Agile, and Lean approaches are discussed. Overall, the distribution indicates that research on Traditional, Agile, and Lean approaches is emerging in a variety of fields ranging from engineering, computer science, operations research management, business economics, automation control systems, environmental science,...etc. As indicated in the reviewed papers, the scientific papers related to Traditional, Agile, and Lean management approaches are best presented from the point of view of IT as Agile is created in software development, management, and business domain. We can notice that the number of publications in IT exceeds the number of publications in business and management, because it is only in the last decade that Agile approaches have been introduced and have been steadily gaining popularity in this domain. The values defined in these approaches and their results have motivated many software producers to use these approaches. Since the migration from Traditional to Agile, software development approaches are growing rapidly, as well as the application of lean practices in the industrial sector.

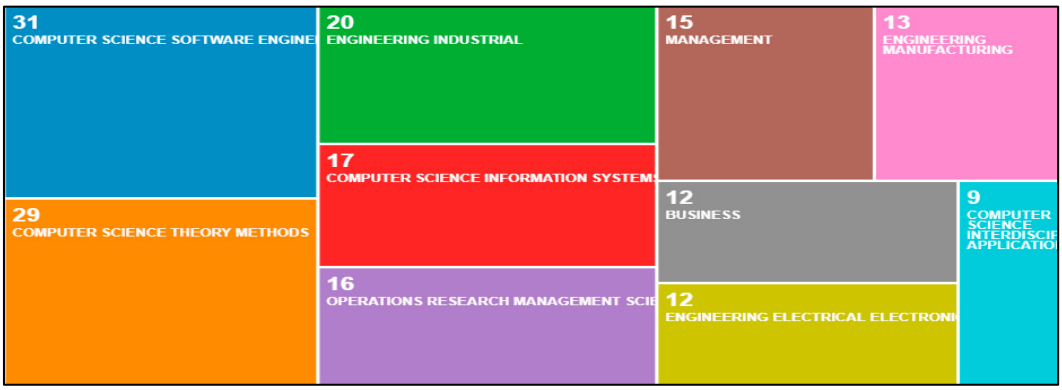

Fig. 2. Top 10 most used domains in publishing.

3.3 Geographical distribution of publications on Traditional, Agile, and Lean approaches

We see that the distribution of publications around the world is uneven (Fig. 3). The set of circles represent the number of publications in this subject by country, a circle with a large diameter represents the country with more publications. At the top of the list is United States (USA), then England followed by Germany, and finally Sweden and Brazil. It can also be seen that Canada, Finland, and Switzerland have limited contributed to the productivity in this research topic. The countries dominate because they have a more developed industrial history and infrastructure than other parts of the world. Americans were among the first in the world to get involved in the area of Lean management [11]. The center of research on Lean management is located in the USA [11]. The globalization of the USA and European economies has probably sparked an interest in Lean management and it is expected that this trend will continue to grow. For years, producers and manufacturers operating in the world's two fastest growing economies had to find ways to work smarter to reduce costs and continue to attract business [12], harnessing these good practices in the construction industry could also provide benefits in the reduction of waste.

Fig. 3. Geographical distribution of publications.

3.4 Analysis of the bibliographic network

Based on the Web of Science data, a network citation analysis was conducted to identify the links and research topics cited in the 200 articles analyzed, but only 89 articles were retained in this research, which are close to the synergy of the three approaches. For the Citation Network Analysis (CNA), the authors mapped the keywords provided for each article using the VOS Visualization Software. Table 1 shows the citations of the authors' papers. The articles selected in the table are those which contains some practices that can help us to better understand the synergy of the three management approaches in the construction industry.

Table 1. Authors' citations.

Document	Title	Citations
Middleton [13]	Lean software management: BBC worldwide case study	33
Villar-fidalgo [14]	Applying kaizen to the schedule in a concurrent environment	2
Alahyari [15]	An exploratory study of waste in software development organizations using agile or lean approaches: A multiple case study at 14 organizations	5
Kasims [16]	Applying Lean to Improve Quality in Software Development Projects	0
Zimmermann [17]	An empirical analysis of the relationship between supply chain strategies, product characteristics, environmental uncertainty and performance	10
Majchrzak [18]	Factors Influencing User Story Estimations In Large Agile Engagements: An Industrial Interview and a Conceptual Model	0
Van heesch [19]	Software specification and documentation in continuous software development: a focus group report	8
Svejvig [20]	The Danish agenda for rethinking project management	9
Lemieux [21]	Development of a leagile transformation methodology for product development	18
Khurum [22]	Extending value stream mapping through waste definition beyond customer perspective	50
Škrabálek [23]	Why modern mobile and web-based development need a lean agile web approach (LAWA)	6
Turner [24]	Agile-Lean Software Engineering (ALSE) Evaluating Kanban in Systems Engineering	5
Gosling [25]	Engineer-to-order supply chain management: A literature review and research agenda	410
Sanderson [26]	The challenges of supply strategy selection in a project environment: evidence from UK naval shipbuilding	74
Morien [27]	Agile management and the Toyota way for software project management	40
Fecher [28]	Innovation labs from a participants' perspective	28
Albuquerque [29]	Lean product development and agile project management in the construction industry	1

For the keyword analysis, the authors mapped the keywords provided for each article using the VOSViewer software (Fig. 4). In the first ranking, the most frequently cited words were divided into several groups: Agile, Lean, and Kanban. The second ranking shows the keywords that were related to Project management, performance, framework, flexibility, innovation, and product development. Another ranking shows that Lean development, scrum, Agile project management, design, and software engineering are related. The set of keywords that appeared in the research presents concepts and practices of the approaches; some of these keywords are common in two or three approaches. The use of the practices of the three approaches in a new Hybrid approach can create a new more robust approach.

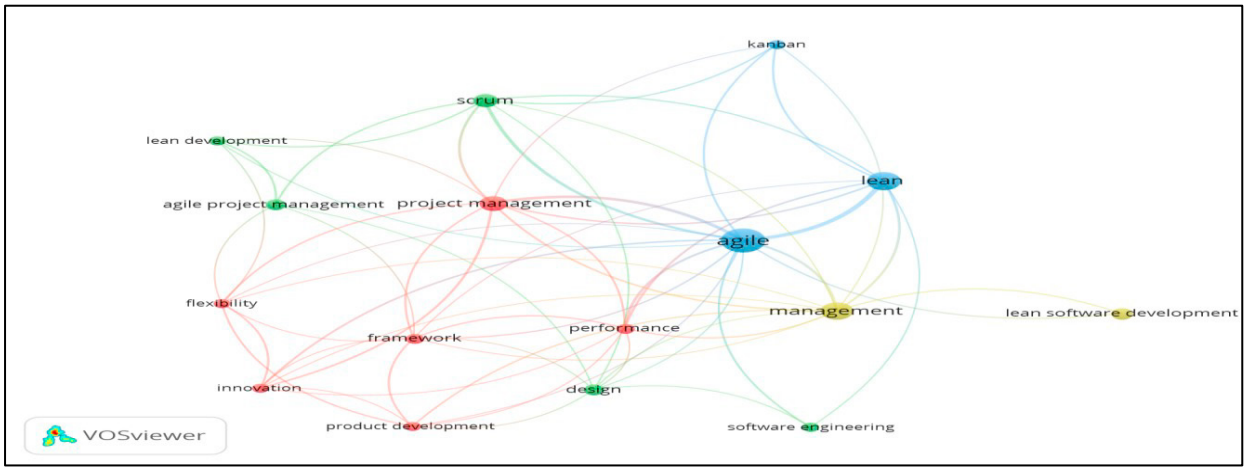

Fig. 4. Keywords analysis, source VOS.

4. Conclusion

The bibliometric analysis on the synergy between Traditional, Agile, and Lean approaches studies over the last few years has revealed that the total number of papers has increased steadily over this period. This analysis allowed us to examine the set of articles in the Web of Science database and to understand the relationship between the different keywords as well as the geographic distribution. As a result of this analysis, the synergy of the approaches in the construction sector is slightly emphasized, which means that the interdependence between these three approaches is a rather new concept in the construction industry.

Organizations need adaptable and flexible project management approaches, capable of handling projects of different sizes and complexities in a constantly changing environment [17, 18]. As argued by Highsmith [32] nothing is perfect – including Agile project management. All Traditional, Agile, or Lean approaches have something to offer, which can be combined to include the best of each other. Thus, the overall Hybrid approach will be stronger than a single approach as its components will be the best of the different approaches adopted.

In the search for alternative management approaches to manage construction projects, two different management approaches have been promoted by the construction industry, Agile and Lean; however, their use has still been immature. On the one hand, there is Lean construction, and on the other hand, Agile project management. Lean construction is good for dealing with static or predictable environments [11]. Agile project management is more focused on managing dynamic and uncertain environments [20, 21].

A project, however, faces different environmental characteristics during its life cycle. Sidwell [35] found that in construction, the dynamics of the project decrease towards the end of its life cycle. Thus, a construction project faces two environmental typologies at the same time, namely predictable and uncertain environments. Additionally, construction projects must become more strategic [36]. This potentially draws on elements of each approach for its effective management. For example, LeAgile combines Agile and Lean using the decoupling point model, where the transition from one approach to the other occurs sequentially [24, 25].

In fact, the right adoption of a project management methodology may be the first and most important choice that a project manager can make [15]. There may not be a specific methodology that meets the needs of all construction projects, in which case a Hybrid between several approaches may be the most beneficial path to take. A Hybrid methodology is intended to provide a blend between several project management approaches to allow a project to benefit from the best guiding principles, perspectives, and characteristics aspects of one another.

Therefore, future research is needed to combine the three here mentioned approaches in the construction sector, but also in other sectors of activity. It is here hypothesized that the combination of Traditional, Agile, and Lean approaches in a single methodology for managing construction projects will be able to better react to changes and to eliminate waste in the processes. This new innovative methodology might be the best way to cope with the complexity of construction projects and to achieve a maximum performance in the future.

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