

# TRADITIONAL, AGILE AND LEAN PROJECT MANAGEMENT

## A SYSTEMATIC LITERATURE REVIEW

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**Abstract:** This paper presents a systematic literature review about traditional, Agile and Lean Project Management methodologies. A general overview on the methodologies was also made, either on the perspective of the traditional based methodologies or the Lean and Agile methodologies. The systematic literature review (SLR) results revealed more than 3500 papers. After filtering and applying exclusion criteria, just 80 were analyzed. Main findings were that, in spite of some reserves, project management methodologies based on Lean are used. Nevertheless, Agile methodologies are the most used.

**KEYWORDS:** PROJECT MANAGEMENT; LEAN AND AGILE  
METHODOLOGIES; SYSTEMATIC LITERATURE REVIEW

### 1. INTRODUCTION

This study was conducted as part of a project whose scope was to develop a framework for project management on a project department of a company. Before the development of the framework, was important to understand which practices were used for projects management in this particular department of this company. At the same time, a review of others project management methodologies and practices becomes relevant, particularly, the ones that have been stimulating controversial such as Lean Thinking applied to project management.

To do this review, the authors decided to develop a systematic literature review (SLR) that involves a deep literature review and a systematic procedure (Danese et al., 2018). Therefore, developing a SLR on this theme would allow to these papers authors to gather, pinpoint and understand the different project management methodologies that have been used by different authors and companies. With this SLR, these paper authors also believe that it will help to develop the framework requested by the company.

Attending to these objectives for the SLR study, one of the first SLR steps is to define research questions. In this case, the research questions were: What is the relation between traditional, Agile and Lean Project Management? This study intended to understand the current different practices, methodologies and frameworks existent in the literature. Also, it was important to know how Lean thinking principles have been applied to the project management in a synergy called Lean Project Management. As so, the main goal of the SLR was to allow a proper answer to this research question.

This paper is structured into five sections. After this first introduction, the authors present a brief literature background about the topics that are mentioned. Then, the research methodology of the SLR is outlined in section three, and the main results of this study are presented in the section four. Finally, the conclusions are exhibited in section five.

### 2. BACKGROUND

This section presents some background definitions and terms that are related to the three main themes approached in this research: Project Management, Lean Thinking and Lean Project Management.

#### 2.1. Project management

This section presents the project management main definitions and concepts. First, it is important to define Project Management. Project Management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements (PMI, 2008). To manage a project, mainly a software development project, are used methodologies, being the most known the traditional methodologies and, more recent, the agile.

##### 2.2.1. Traditional methodologies

Traditional projects are clearly defined with well-documented and understood features, functions, and requirements (

Fernandez, Daniel & Fernandez, John, 2009). Traditional methodologies are known as "Heavy-weight" or Plan-driven methodologies. According to Ahimbisibwe et al. (2015) the traditional methodologies are essentially plan-driven approaches that follow the philosophies of PMBoK Guide, previously referred, or PRINCE2 manual (OGC - Office of Government Commerce, 2009).

The PMBoK, which is published by the Project Management Institute (PMI), has become a widely practice standard in many industries around the world. Since the PMBoK describes a set of generally accepted practices, the project management (PM) practitioners can use to manage all aspects in any types of projects. The PMBoK defines a project as "a temporary endeavor undertaken to create a unique product or service" (Hewagamage & Hewagamage, 2011). Aligned with PMBOK and based on that is ISO 21500:2012 (Varajão et al., 2017). This International Standard provides guidance on concepts and processes of project management that are important for, and have impact on, the performance of projects (ISO, 2012).

PRINCE2 is an acronym for Projects IN Controlled Environments. It is a standard used extensively in the United Kingdom and a registered trademark of Office of Government Commerce (OGC - Office of Government Commerce, 2009). It could be described as a project management method designed to provide a framework covering the wide variety of disciplines and activities required within a project. PRINCE2 is focused on a business case that describes the rationale and business justification for the project. It is a process-based method and the structure comprises five phases and eight high-level processes (Hewagamage & Hewagamage, 2011).

Other models were provided by other professional organizations such as International Projects Management Association (IPMA). IPMA is all about projects, programs and portfolios. In this category, IPMA have information regarding how to define excellent projects and programs, using our international renown standard, the IPMA Project Excellence Baseline (IPMA, 2015).

Also, others best practices are Rational Unified Process (RUP), Microsoft Solution Framework (MSF), Capability Maturity Model Integration (CMMI), among others. These are provided by the Rational Software Cooperation, Microsoft Cooperation, Software Engineering Institute (SEI), respectively (Hewagamage & Hewagamage, 2011).

The traditional approaches rely on what has been described as a linear or incremental project management life cycle model (Wysocki, 2014). They are characterized by a set of well-defined phases sequentially performed. Each phase should be concluded before to start the following phase in the sequence (Singhtto & Denwattana, 2016). There is no feedback from the following phases to the previous phases based on learning what is one of the disadvantages of this type of methodologies (Wysocki, 2014). According to Leau et al. (2012) Waterfall and V-Model are two models of such methodologies.

##### 2.2.2. Agile methodologies

Agile Project Management was the name that came out from a meeting that, in 2001, gathered 17 software developers to discuss differences and similarities among the project

development methodologies that they used to use. Some of those developers had created frameworks and methodologies like Extreme Programming, Crystal Methodologies, Scrum, Adaptive Software Development, Feature-Driven Development and Dynamic Systems Development Methodology. By the end of this gathering, the Agile Manifesto (The Agile Alliance, 2001) was created.

Normally used in software development projects, these agile methodologies are less planned which characterized many projects that take place in dynamic environments, requiring projects to adapt quickly to changes (Singh et al., 2012). They are based on an iterative or adaptive life cycle and are designed to accept and embrace change (Ahimbisibwe et al., 2015). To be agile, it must be able to adapt to changing priorities quickly. Working in short iterations gives a team this option, by including planning in each development cycle (Fowler & Highsmith, 2001). Agile and Lean software development are flexible approaches that have emerged to provide solutions to this situation (Dybå & Dingsøy, 2008; Nurdiani et al., 2016).

Agile projects discover the complete project requirements by doing the project in iterations and therefore reducing and eliminating uncertainty (Fernandez, Daniel & Fernandez, John, 2009). Agile Project Management is defined by Wysocki (2014) as a non-linear, iterative or adaptive approach to project management. According to this author, these methodologies are change-driven, contrarily to the plan-driven, referred above, because they cannot succeed without change.

Agile Methodologies are a promising new class of methodologies for software development proposed at the end of the 90's. They are particularly suited when it is difficult to understand the system functionalities during the early phase of the process, due to continuous requirements changing, mutable environmental factors or mutable market conditions (Angioni et al., 2006). Stevens and Lenz (2010) go even further saying that the Agile development process originated with humankind's evolution. With an agile state of mind, projects managers are constantly looking for opportunities to increase the value of your projects by changing scope.

## 2.2. Lean Thinking

According to Krafcik (1988), the word "Lean" represents a system that requires fewer inputs in order to create the same results as traditional mass production systems, while offering a wider range of products to the final customer. Lean Production is a management organizational model that implies "doing more with less" (Womack et al., 1990), having its roots in the Toyota Production System (TPS) (Monden, 1998; Ohno, 1988). TPS is supported by Just-in-Time and Jidoka technical pillars, flexible workforce and creative thinking (Monden, 1998). The main objectives of TPS are low lead-time and cost, high quality, moral and safety, by eliminating wastes.

Womack and Jones studied this system (Lean) and started calling the philosophy behind the system: Lean Thinking (Womack & Jones, 1996). These authors considered Lean Thinking as the antidote to waste that achieve more with less. Waste is referred to as any activity that does not add value to

the end customer point of view and that he/she is not willing to pay (Ohno, 1988). To be successfully in implementing Lean Thinking, the authors proposed five main principles: 1) Value; 2) Value stream; 3) Flow; 4) Pull production and 5) Pursuit perfection. The last means to search continuous improvement in every activity companies do.

The first principle is related to identifying the activities that adds value for the clients. There are three types of activities, the ones that create value, activities that do not create value, but are necessary and activities that do not create value and are unnecessary, i.e., waste. Waste spends resources but do not add value to the product. The main goal of each process improvement is eliminating the activities that are not necessary. To achieve this, it is needed a process mapping to identify the different types of activities and to find the value stream for the product or family that adds value to the client. This is the meaning of the second principle.

Recognized the value stream, all activities that do not adds value, necessary or unnecessary, must be reduced or eliminated because they are obstacles to the product flow, obstructing that it quickly is delivered to the client. Flow is the third principle that is achieved if the production is pulled from the client. Because when the client pulls production, only what the client needs will be produced and a batch-and-queue policy, characteristic of a push production, will be transformed in a one-piece-flow. Nevertheless, the establishment of all principles demands an iterative approach supported by continuous improvement to vision perfection.

These principles are valid to apply in any activity or process in goods and/or services companies or organizations, profit or non-profit. Hospitals, universities, airports, goods companies (e.g. furniture, computers), are fertile fields of wastes that need improvement to add real value to the products produced. Recent literature reviews, surveys, case studies published are testimony of that (Amaro et al., 2019; Bhamu & Sangwan, 2014; de Oliveira et al., 2019; Samuel et al., 2014; Sinha & Matharu, 2019).

Additionally, they could be applied to the direct area, i.e., production, or indirect areas in the companies (e.g. logistic, supply chain, quality, human resources, accountability, project management departments) addressing and transforming ways of design, manage and work in issues such as coaching, sustainability, accounting, among others (Alves et al., 2017).

## 2.3. Lean Project Management

Many authors have been discussing an approach that they called Lean project management (LPM) (Ballard & Howell, 2003; Moujib, 2007; Riis, 1993). Ballard and Howell (2003) contrasted Lean project management from traditional approaches. Considering projects as temporary production systems, this author defined "lean" projects as systems that are structured to deliver the product while maximizing value and minimizing waste. Also, this author distinguished Lean project management goals, phases structure, relationship between phases and the participants in each phase from traditional project management.

Moreover, Lean project management emerges as an approach to solve some problems of traditional project management processes: permanent environmental changes, lack of project management knowledge, lack of time management, lots of multitasking, projects delays and over budget, minimize paperwork and bureaucracy, among others (Lledó, 2011, 2014; Moujib, 2007; Pitagorsky, 2006). Additionally, Sohi et al (2016) considered that such an approach promises to cope with complexity and improve project performance.

Lean project management is the application of Lean Thinking principles to Project Management. As Lean production, Lean project management (LPM) pursuit the reduction of the time required to complete a project, by eliminating all wastes in the path to achieve this. This means adapting the Lean Thinking philosophy to project management context.

The important exercises within LPM are the identification of value-added and value-enabling activities. For instance, MacAdam (2009) adapted the three types of activities, defined earlier in section 2.1, to the projects context: 1) Value-Added are tasks advance the completion of the project, and the customer is willing to pay for them such as laying the foundation for a hotel construction project; 2) Enabler tasks that are required to complete the project, even not paid the customer, e.g. project planning or quality testing (if it is not specified as part of a customer deliverable); and 3) Waste tasks that not desired by the customer, e.g. attending a meeting at which you are not required or over-designing a component.

Continuous improvement of project management processes will ensure that it maintain an acceptable level of performance. At the same time, combining LPM with others approaches like Agile, Six-Sigma and Product Lifecycle Management (PLM) allows to reduce variation in workflow that reduces time and cost and increases agility (Burlereaux et al., 2013; Gubinelli et al., 2019; Pinel et al., 2013).

## 3. RESEARCH METHODOLOGY

To provide a robust overview on this project management research, a systematic literature review (SLR) approach was adopted. SLR is a well-known research methodology that has been used by many authors to deep their knowledge about different topics, namely, Distributed Software Development Project Management (Silva et al. 2010) and Software Engineering (Kitchenham et al., 2010).

A SLR is a specific methodology that locates studies, evaluates its contributions, synthesizes data, and reports evidences in a way that allows a good way of reach a conclusion (Denyer & Tranfield, 2009). It is a form of secondary study that uses a well-defined methodology to identify, analyze and interpret all available evidence related to a specific research question (Nurdiani et al., 2016). It aims to reduce bias in the selection of studies and to summarize them objectively (Fahimnia et al., 2015).

A systematic literature review combines discrete pieces and synthesizes results in an organized way, which allows a complete overview of the topic being researched (Cooper, 2008). Oates and Capper (2009) say that a SLR aim to provide

explicit, rigorous, reproducible, and auditable methodology for evaluating and interpreting all available research relating to a particular research question, topic area, or phenomenon of interest. By performing a SLR, researchers can summarize existing evidence about a phenomenon, identify gaps in current research, and provide a ground framework to position or support new ideas and hypotheses (Castelluccia & Visaggio, 2013) as cited in Silva, (2015).

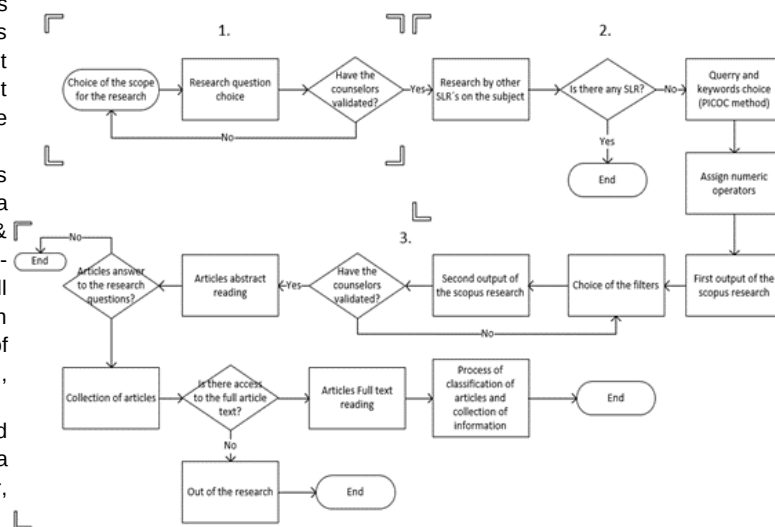
### 3.1. Three Step Procedure

The SLR methodology that was used consists of a three-step procedure for data collection, choice criteria and data selection, to provide whatever is necessary to achieve the main goal of this research. This three-step procedure is constituted by:

1. Defining the appropriate research questions: The process begun with the choice of the literature field, which was the target for this research. Since the scope was defined, the next action was the choice of adequate research questions. This was one of the most important steps, insofar as these questions act as success criteria for the screening that happened further ahead;
2. Defining appropriate search terms: Firstly, it was important to assure the inexistence of studies of this kind on the same scope, then a keyword assembly structure that aims to accommodate a broad range of search terms;
3. Process of screening and data selection: Using the success criteria, the last step consists in successive rounds of screening until the list of articles is complete. In the end, a statistical analysis is needed.

These three steps, as well as the sub-tasks of each, are described in a process diagram format on the **Figure 1**.

Figure 1: Systematic Literature Review procedure



3.2. Research Question

According to Tranfield et al. (2003) a SLR aims to map and evaluate the body of literature and identify potential research gaps highlighting the boundaries of knowledge. Hence, a research question was defined to assess the relationship between traditional, Agile and Lean Project Management. The research question presented above, have a strong relationship with the exclusion criteria, which is responsible for the process and of scanning the papers.

3.3. Keyword Search and Scope Definition

Although it is common to find these types of studies, at the time of this research, it was not found any SLR specifically within the scope of this study. It is important to say that uncountable SLR's about the addressed themes like "project management" or "agile methodologies" were found; however the scope of them was always different from this one.

The search terms were built in a multi-level keyword assembly structure that aims to accommodate a wide range of search terms and fields. This search was inspired by the PICOC structure (Population, Intervention, Context, Outcome and Comparison) as recommended by Schultz and Schultz (2014). The PICOC structure served as base for some fields of the keyword assembly, namely the Population, Intervention and Context. The main level called "Population" defines the search context (Project management), the second layer of research is divided in three different areas named as "context 1, 2 and 3". The purpose of the context is to allow a deep search on important areas that are attached to the search context. The final level was inspired by Silva et al. (2010), and it is the "Intervention" terms of research. The result of this process is in **Table 1**.

Another important aspect is the definition of the logic operators, which are important to define the scope of the research. Specifically, the logic behind this study is "Population AND (Context 1 OR Context 2 OR Context 3) AND Intervention" as it is possible to see on **Figure 2**.

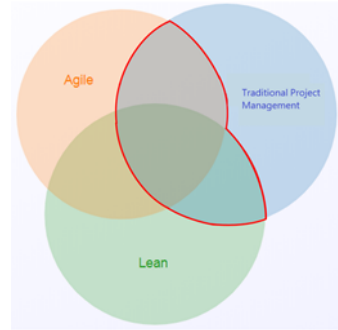


Figure 2: Literature scope

3.4. Database Output

The following step is the choice of filters for the keywords; otherwise the number of results of the research would not be reasonable. The first research had as output 3511 papers. Therefore, the research that was conducted in the Scopus database was made with the keywords presented on the Table 1, but using the "title, abstract" search, for articles from journals, that are written in English and with a time restriction (1st January 2000 to 28th January 2019). This reduced the raw data to 1085 papers, which served as a base for the literature analysis.

The filtering procedure that was used has four different and intercalated main steps. From the moment that the first sample, with 1085 papers, is on an excel file, the reviewing methodology has begun. The first step was to verify if there was any repeated paper. From that sample, it was necessary to read the abstracts of the papers and exclude the ones that fulfilled the exclusion criteria. The exclusion criteria follow the same line of thinking of the research questions, the articles that apparently seemed to answer, at least one of the questions, or even bring something innovative to the field of project management frameworks, was considered. At this time, the sample had 151 papers. Every article on that list of 151 was read, allowing to understand which articles had passed wrongly through the screening phase. Then, 80 articles had something relevant to add on the research.

Managed by Elsevier publishing, Scopus is the largest abstract and citation database of peer-reviewed research literature in the fields of science, technology, medicine, social sciences, and arts and humanities. It covers over 20,000 peer-reviewed journals including those published by Elsevier, Emerald, Informa, Taylor and Francis, Springer and Inderscience. The Scopus coverage details including access to tens of millions of peer reviewed journal. The Scopus database is more comprehensive than Web-of-Science database, which would include only ISI indexed journals, limited to 12,000 titles only. Since we are focusing on peer-reviewed journals, we found that the Scopus database would capture the most reputable international journals, some of which may be relatively new, but influential. For this reason, it was the only research database used.

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) methodology described in Moher et al. (2009) served as base to what was described above. On **Figure 3** it is possible to identify the procedure.

3.5 Bibliometric Analysis

A keywords-based bibliometric analysis on both the initial (1085 papers) and final (80 papers) samples were performed to better understand what keywords were used on this research. The bibliometric analysis performed to the initial sample reveals that, the main keyword by far is "project management"; however, the remaining keywords cover a wide range, which demonstrates the heterogeneity of the research. On the other hand, the analysis of the final sample gives an idea that the most important keywords previously, are the same at the end of the research, enabling the validation of the content analysis performed in order to refine the initial sample of 1085 (Figure 4) papers into 80 papers (Figure 5).

4. RESULTS ANALYSIS AND DISCUSSION

The main goal of this section is to give an overview, based on SLR results, about project management methodologies, mainly with the recent developments of Agile, Lean combined approaches of them and hybrid approaches.

The scholars in project management field enunciated over the years a kind of agility spectrum for project management methodologies, where it is possible to identify two different areas on the end of each side of it. The plan-driven methodologies /traditional /heavyweight from one side and the features-driven methodologies /agile in the other. A briefly description of them are presented in the sections 2.2.1 and 2.2.2, respectively, just like some examples of the different methodologies and practices of each. Now, a deep discussion based on the SLR is presented. Literature reviewed point out that authors have been concerned with the fail of projects. Also, it indicated many studies where the majority of the projects exceed their initial costs and deadlines or even remain incomplete. It was not possible to find a common answer to the causes. What is certain is that the causes of project failure are many.

For instance, some authors defended that traditional project management approaches can be counter-productive and inhibit innovation when the levels of uncertainty are high (Gonzalez, 2014; Utterback et al., 1992). Wysocki (2014) claimed that data gathered by him from 10,000 project managers, no more than 20 percent of all projects have the characteristics of traditional projects. However, according the same author, project managers continue to apply traditional methods to projects for which they were not suited. Other authors went further and said that current project management theory is obsolete in today's dynamic and globalized construction projects (Koskela, 1992; Koskela & Howell, 2002).

To bypass these and other problems referred in section 2.3., some authors have been proposing to apply Lean and Agile and combined approaches of them. Probably, one of the first applications of Lean Thinking to project management was in the construction field by Koskela (1992) that the author named Lean Construction. Though some authors follow the example, this was not achieved without some criticisms and concerns that are pointed out next.

As referred above, section 2.2., Lean was closely linked to the production environment, playing an important role in each production site. However, this philosophy has evolved into countless fields throughout the decades (Amaro et al., 2019). Lean, originally, arose in manufacturing as a way of producing products while minimizing waste in all of its forms. Due to this, some authors, such as Demir et al. (2013), opinioned that Lean is good at dealing with continuous flows, repeated tasks and low variety and high volume products and that, on an environment of uncertainty, like the project management environment, Lean cannot be easily applied. So, they decided to combine lean and agile, creating a new project methodology that they called AgileLean PM.

A decade before, in 2003, Poppendieck and Poppendieck (2003) defend the Lean Thinking principles applied to software development by publishing a book about Lean Software Development: an agile toolkit. They see this as a way to eliminate waste from the software development lifecycle by implementing lean principles through agile practices to tailored individual software development. Some case studies proved this success, namely, the one presented by Middleton and Joyce (2012) that improved software development and team performance by Lean ideas and methods including visual management, team-based problem solving, smaller batch sizes, and statistical process control.

Holweg and Maylor (2018) also posited that Lean Thinking can

Table 1: Research Keywords

Population	Project Management	Main Field
Context 1 - Lean	(lean OR "Process improv*" OR "Continuous improvement" OR kaizen OR kanban OR jit OR "5S" OR jidoka OR standardization OR heijunka OR pull OR "Visual system" OR triz OR "six sigma" OR "Lean green" OR "Lean green" OR tpm OR smed OR levelling OR leveling OR "Simultaneous lean" OR tqm OR "Lean manag*")	Keywords to cover the Lean thinking field
Context 2 - Agile	(agile OR agility OR scrum OR "XP" OR "extreme programming" OR FDD OR "feature-driven development" OR "feature-driven" OR "Dynamic Systems Development Method" OR DSDM OR "Adaptive Software Development" OR "ASD" OR "Crystal and Rational Unified Process" OR "RUP" OR TDD OR "test-driven development" OR "test-driven")	Keywords to cover the Agile field
Context 3 - Traditional PM fields	("Cost manag*" OR "Quality manag*" OR "Risk manag*" OR "Procurement manag*" OR "Stakeholder* manag*")	Keywords to cover the field
Intervention terms -	(model* OR process* OR framework* OR method* OR technique* OR methodology* OR tool* OR program* OR system* OR practice* OR adoption OR tailor* OR "Case stud*")	Intervention words

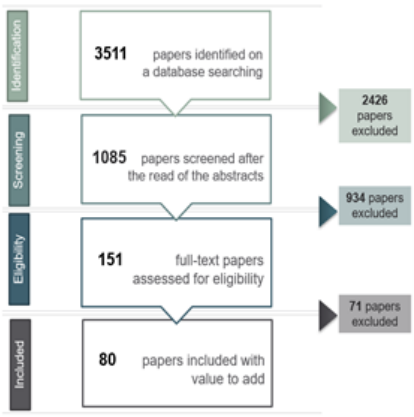


Figure 3: PRISMA Methodology

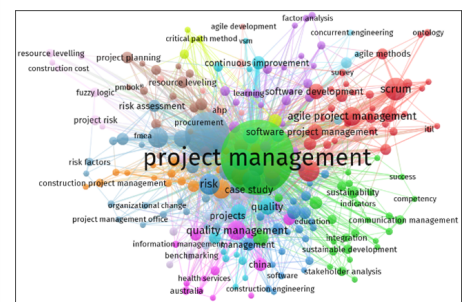


Figure 4: Bibliometric Analysis 1

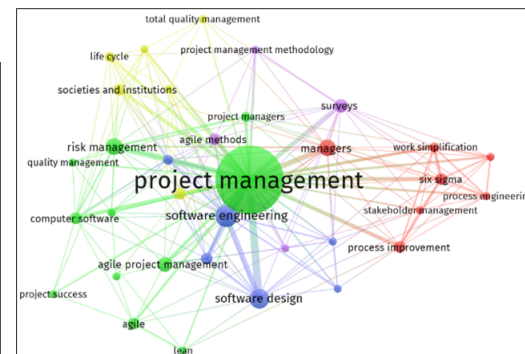


Figure 5: Bibliometric Analysis 2

equally be of value in a transient context where the overall system (project) is being designed and redesigned as the project progresses. The Lean approach to project management is made to involve everyone in the project, to design quality into the product, to solve root causes of problems rather than their symptoms, eliminate waste, strive for fast delivery, and maintain continuous improvement (Tripp & Armstrong, 2018). By this characteristic of continuous search for improvements, this implies an evolutionary, incremental approach.

New product and process development (NPPD) from which resulted in products such as constructions and/or software development implies processes suitable to apply the Lean principles. This application has been called Lean Product Development (Liker & Morgan, 2006; Mascitelli, 2007). Even in such application some reserves were made. For instance, Pons (2008) concluded that in areas involving uncertainty and innovation, project management, even with lean, is incomplete to manage NPD.

According to what was found in this research there are not a wide range of articles connecting the project management (the predictive approach) with Lean philosophies. This fact can be explained having in account the specific keyword search that was developed on the methodology strategy. Furthermore, it seems that authors just associate Lean production with controlled situations and repeated processes over time. Well, a project does not fit in this model of repetitiveness; it is all about uncertainty most of the times. However, the philosophy that is on the base of the Lean can be applied to the projects management. Nevertheless, even though Lean production is a field with credits signed in the literature, alignment with project management can be controversial for and generate distinct opinions among the researchers.

Contrarily, the evidences of interactions of Agile methodologies and Lean are in a higher number. There is a recent consensus among scholars that agility is a way of coping with external and internal changes, which are viewed as unpredictable and uncertain (Dyck & Majchrzak, 2012). According to Middleton and Joyce (2012) agile was mainly a reaction against the document heavy, plan driven software development approaches that were frequently not successful. Lean ideas provide a context and specific tools for the development of Agile, despite the fact that, the Agile Manifesto, which was produced in 2001 contains no references to Lean (Middleton & Joyce, 2012).

Nevertheless, Lean is recognized by Fowler (2005) as being inspiring many agile developers. There are a lot of examples of interactions, some are exposed along this text as the example provided by Middleton and Joyce (2012). They referred the "Scrumban" which was derived from Kanban. The scrum itself, one of the elements of agile promoted by Schwaber and Sutherland (2017), is similar to Toyota's small workgroups with their daily stand-up meetings (Middleton & Joyce, 2012). This shows evidences that Agile methodologies were inspired on the Toyota and Lean Thinking principles. Lean encourages teams to deliver fast by managing flow, limiting the amount of WIP (work-in-process) to reduce context switching and improve focus. Agile teams manage flow by working in cross-functional teams on delivering one iteration at a time. Also, Lean Thinking

encourages the elimination of waste and short feedback loops between agile developers and their stakeholders. In addition, it helps teams create a habit of eliminating processes, activities, and products that do not directly result in customer value.

The advantages of agile project management and, particularly, the Scrum-based approach is its simplicity (Cervone, 2011). Scrum is a method of agile development and it is an iterative, incremental framework for development. It put emphasis on the cross-functional teams working in short development bursts called "Sprints" to regularly produce a complete increment of the product (Anwar et al., 2014). It is also desirable that project plans are aimed at being flexible and to allow changes even late in the process (Petrillo et al., 2018).

One important methodology developed by Smalltalk community with collaboration of Kent Beck and Ward Cunningham in late 1980 that had the most part of attention under the agile development umbrella is Extreme Programming (XP) (Fowler, 2005; Beck & Fowler, 2000). XP is a software development methodology which does not rely on any particular tool, but rather is based on the common understanding of fundamental values and on a disciplined application of best practices (Angioni et al., 2006). The central idea of planning in XP is to plan features to implement rather than the development tasks necessary to implement these features (van Valkenhoef et al., 2011). These methodologies are highly used nowadays, mainly in software development projects, and are frameworks adapted by contexts with a high degree of agility.

Other methodologies and frameworks have been created throughout the times, with more or less agility, normally adapted to the context and needs of the users. The examples that were found were the Kanban, Dev Ops, Scrumban, Leagile, Agile UP\*, Safe\*, Less\*, Disciplined agile delivery (DAD), Scaled Agile Framework (SAFe) and Iterative & Visual Project Management Method (IVPM2).

Nonetheless, it is important to point out a relatively recent wave that can consider itself as standing somewhere between the two types of methodologies in the spectrum, called Hybrid methods, which are mainly methods that have characteristics of both the types. The newest member of the equation in this hybrid field, however, it seems that it is still a little confusing for the managers. The project management research community should further investigate how to develop "hybrid" management models, considering Agile project methodologies and traditional approaches, in order to balance the "agility" (Conforto et al., 2014).

Tripp and Armstrong (2018) referred that some studies have looked at the integration of agile methodologies with these "hybrid" approaches, such as product line engineering, plan-based requirements prioritization, documentation driven methodologies, service-oriented methodologies and, most recently, capability maturity, already referred in section 2.2.1, but without the effectiveness that is expected. They are included in this the Lean methodologies, already referred.

The words Agifall and Wagile are new to project management vocabulary, and they signify whether the approach moves towards waterfall or agile (Aramyan, 2020). Agifall is a hybrid type that adds agile practices to the waterfall process, referred

in section 2.2.1. It introduces more robust stages of research, strategy and planning phases into tasks and proceeds with sprints to complete them. So, it's basically an agile project with more information upfront.

Wagile brings agile practices to waterfall process such as short iterations and continuous integration, without changing it. It implies that some agile practices have been adopted but the project has been slipping back into waterfall. Such badly managed agile can transform eight 2-week sprints into a series of eight-time boxed waterfalls. Basically, Wagile is thought of as waterfall masquerading as agile through daily standups and short iterations, but without principally stepping away from the traditional model.

For now, it may be difficult to find a simple explanation for these approaches, however, the author suggests that the use of a hybrid framework can be built after an intensive study of the needs and characteristics of the environment in question. The procedure continues being plan first, executes second because this is the paradigm of traditional project management. Adapt to change as you iterate - this is the paradigm of agile project management. These competing methodologies represent two ends of a spectrum between linear (traditional) and non-linear (agile) project management processes (Baird & Riggins, 2012).

Other production methodologies bring to the project management context is based on Theory of Constrains (TOC) developed by Goldrat (1984) that he called Critical Chain Project Management (CCPM) (Goldrat, 1997). CCPM is an emerging scheduling method that relies on buffers for protecting schedules from overruns and requires resource leveling to develop feasible and competitive schedules (Gu et al., 2014). According to a case described by Trojanowska and Dostatni (2017), CCPM improved timeliness of order delivery, improved communication and standardization of processes related to ordering delivery.

From the above, in spite of some reservations of some authors about applying Lean Thinking to project management because of its production origins, these are unfunded. Highlighting the suitable role of such philosophy let's do a parallel with production: production means design and make things. Designing and making something for the first time is done through a project, which is, for that reason, arguably the fundamental form of production system. Projects are, indeed, a product of a production system with some peculiar characteristics such as being a temporary endeavor, one-of-a-kind products built in a fixed layout (e.g. construction projects) or virtual (e.g. software development) by a team in a non-repetitive environment (Carmo-Silva et al., 2006). This implies inputs, flows (e.g. materials, information, people, and money), processes, and outputs always subject to measurement and improvement.

Like in production, projects flow and development time will improve if one-piece-flow is used, against traditional batch-and-queue, what is achieved by "sprints", i.e., smaller work packages pulled through kanbans by the client and supported by daily coordination meetings "scrums". Sprints, scrums and kanbans are basilar elements of agile movement (Holweg & Maylor, 2018) promoted by the Agile Alliance. These elements

are inspired by Lean and Lean pillars, as the ones referred above, such as just-in-time planning models (Wysocki, 2014).

To conclude, more important than the name of the methodology, it is important to understand the context before the implementation of a new way of managing the projects. If it is right to say that there is no need to reinvent the wheel, it is also true that each case is different. Hence, it is required a diagnostic study with diagnostic tools (Agile suitability assessment charts, semi-structured interviews and so on) to implement a new framework, and this is the main conclusion that is possible to take from this research.

## 5. CONCLUSIONS

In this paper, a systematic literature review was performed, highlighting main project management methodologies with a focus on Lean and Agile methodologies. This is a topic of growing interest for academics and users. From the SLR, 80 articles from different areas and methodologies were reviewed for this research, ones more relevant than others.

The SLR methodology consisted, in a succinct way, in choosing the research question to work on, then choosing the appropriate keywords and searching the Scopus database. The next step consisted on successive screening processes starting with a sample of 3511 articles and ending up with 80 articles to analyze.

It was possible to conclude that the incorporation of the Lean Thinking principles seems important for most of the authors, in spite of some concerns. Additionally, more than 30 methodologies were found; however, it is important to understand the context before the implementation of a new way of managing the projects. Also, this research helps the researcher to develop a framework for a company combining elements from Lean and Agile methodologies. Combining both brings the best of two worlds, it was one of the lessons learned from this research. Important tools as assessment studies and other Lean tools are fundamental in order to understand the context characterization that allows the application of the right methodology. This research brings the user a rich database for existing methodologies to manage projects.

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