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Hybrid Project Management Model Based on Lean and Agile Approach

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***Abstract*—**Excellence and Success are the ultimate goal for any project and in order to achieve it, every project manager looks for the convenient tools and methods. This work proposes a framework that seeks an efficient management of general project through a lean and agile approach. In order to get this objective, the article was divided in two stages, the first one was emphasized on exploring and analyzing the existing project management models and then in the second one the desired framework was created, beginning by focusing on seven existing models and then proposing for each phase of the framework the convenient lean and agile tools.

***Keywords*—**Agility, hybrid project management, lean, scrum.

I. Introduction

IN the era of globalization, in the face of a very challenging environment and in order to overcome the difficulties caused by competition, companies have resorted to effective management methods to improve their organization and their performance [1]. Among these methods, we find lean project management, which can be defined as the management of temporary production systems while maximizing value and minimizing waste [2]. Reference [3] introduced lean project management as the comprehensive adaption of other lean concepts like lean construction, lean manufacturing and lean thinking into the project management context. Many other authors have been interested in this topic in different sectors, such as electricity sectors [4], textile [5], aviation sector [6], health sector [7], construction sector [8]. Based on our research, many authors have proposed different lean project management models [9], [1], [3], [10], etc. Furthermore, the choice of the appropriate lean management tools is an important factor to avoid the failure of any project. Therefore, we decided to revise a specialized literature in order to compare lean-agile Project Management models existing until now.

The paper is structured as follows: in the next section, we present our literature review related to project management and lean philosophy. This is followed by the illustration of the results issued from our analyze; namely, descriptive analysis and a comparison of the relevant papers in the field. And also, a detailed discussion about this literature is presented. In the last section, finally, a framework for project management is proposed based on this research and on different information about the project coordination as in [38]. Thereafter, possible future research avenues are suggested.

II. Literature Review

A. Project Management

Project management is defined as "the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. It is achieved through the appropriate application and integration of the project management processes" [37]. Several project management guidelines exist in the literature for a better management. It has been published by several organizations worldwide such as the International Organization for Standardization (ISO), Project Management Institute (PMI), Office of Government Commerce (OGC) in the United Kingdom (PRINCE2 guidelines), among others [4]. We also found in the literature project management guidelines associated with the "lean" philosophy; lean project management.

B. Lean Philosophy

The lean philosophy is defined as a concept that effectively eliminates or at least reduces waste [11] in order to improve the quality and reducing the cost and the lead time [12]. Waste is always present in some way, but with the help of certain tools it can be minimized [13]. Different tools are used in the literature to cover this issue, but the answer to the question what's the most effective lean tool that will contribute to the success of the organization is not clear until now, and it depends to several criteria such as « environment », « sector », « material resources », « financial resources », « human resources »… [14]. Lean methodology is considered one of the most used components in project management models [9].

C. Lean Principles

As mentioned by [15], there are six lean principles:

1- Respect for people: In order to have a good product, the working environment must be encouraging and the workers must be helped to address their problems and obstacles.
2- Value: The value needed by the final customer must be defined correctly.
3- Value Stream: This principle aims to define the entire value stream in order to identify and eliminate the non-value-adding activities, to eliminate the redundant actions during the value-adding activities, and to minimize all the necessary but non value adding activities.
4- Flow: This principle aims to ensure a perfect flow without

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any waste related to time.

5- Pull: This principle aims to ensure a pull system that allows only production that responds to a customer's demand.

6- Perfection: This principle aims to ensure good products and processes that meet the value needed by the customer.

III. Lean Project Management Models

A. Descriptive Analysis

The main role of lean project management is to apply the lean thinking principles in order to improve the project management processes and their interactions and reducing waste within the organization. Because of the difficulties that companies face when integrating and implementing lean in project management, various frameworks have been proposed to support organizations. The present study identifies seven frameworks through an extensive and critical review of the academic literature (Tables I and II).

TABLE I
Classification of Models

Reference	Year	Country	Research Stream	Sector	Case Study	Source Type
[9]	2020	Peru-Spain	Lean Project Management	Construction	Yes	Conference
[3]	2011	Australia	Lean Project Management	Heavy industry	No	Journal
[12]	2007	Hungary	Lean Project Management	--	No	Conference
[16]	2018	India	Lean Six Sigma Project Management	Automotive sector	Yes	Journal
[17]	2018	Portugal	Lean Project Management	Innovation	Yes	Conference
[18]	2013	Germany	Lean Project Management	--	No	Conference
[19]	2010	Italy	Lean Project Management	--	No	Conference

TABLE II
Analysis of Models

Reference	Key Contribution	Limitations
[9]	Proposes a model by adapting Project Management Body of Knowledge (PMBOK) processes and integrating some lean and agile tools in different processes in order to improve the Base Station Telecom construction.	The model takes into consideration mostly the aspect of time in their KPI, different others aspects must be taken into account.
[3]	Proposes to integrate the concept of Standardization to different aspects of projects in Large Scale Industrial & Infrastructure.	The framework requires additional validation in a real-world environment.
[12]	Proposes a flowchart for Lean Project Management, it reconciles ToolBox of lean tools integrated with project management process group model (PMBOK).	The framework is conceived for general type of project, and is not validated in a real-world environment.
[16]	Proposes a novel approach concerning the Lean Six Sigma project management by bridging the gap existing in the LSS DMAIC and validates it application in automotive industry.	The framework is developed only for automotive industry.
[17]	Aims to implement the project management good practices and lean methodologies to improve the global performance of a Portuguese innovation company through a customized model based on business process management and lean principles.	The framework is tailored just for one SME innovation company.
[18]	Focuses on development of lean project management in the context of project management standards.	The paper talks about general types of projects, does not propose an exact framework for lean project management.
[19]	Proposes a methodology of project management named « Lean & Digitize », that aims to improving business process based on Lean Thinking, Six sigma and digitization.	The model proposed is focused only on business process improvement and do not provide details about the application of this model in a real-world environment.

This section discusses some of these frameworks.

Reference [9] proposed a framework for integrating lean and agile tools in different project management processes inspired from PMBOK in the Base telecom construction industry. Its structure is divided into five stages: Stage 1: Diagnosis and Implementation, Stage 2: Planning, Stage 3: Execution, Stage 4: Closing and Stage 5: Monitoring and Control using Kanban daily meetings. The first stage Diagnosis and Implementation is applied directly on the organization and it uses the 5S tool for its versatility and low cost. Stage 2 Planning aims to avoid possible reprocessing in the construction and to identify in advance all necessary tools and information needed. In Stage 3: Execution, they propose to use a checklist that aims to identify problems during operation and allowing immediate decisions to be made. Stage 4 Closing aims to verify the compliance of the project through the Key Performance Indicators (KPI) and then elaborate the lessons learned. Finally, in stage 5 Monitoring and Control, they aim to guarantee the application of the project with closure indicator goals and solving problems at the right time.

Reference [16] conceptualizes a novel Lean Six Sigma (LSS) project management framework. The proposed framework is the SDMMAICS framework that comprises eight stages: (1) Selection, (2) Define, (3) Measure, (4) Map, (5) Analyze, (6) Improve, (7) Control, and (8) Sustain. Stage 1 aims to select the right LSS projects to be work in on the basis of different criteria such as the availability of resources, process risk, the estimated ROI (Return on Investment), etc. Stage 2 aims to define all the details regarding the business problem and then to create the project charter. Stage 3 aims to elaborate a data collection plan in order to validate the business problem with process-specific data and then calculate the process capability using the data collected. Stage 4 helps to better identify and understand different types of wastes within and between processes using several lean tools like Value Stream Mapping (VSM), process mapping, flowcharting, etc. and using some process metrics like lead time, takt time, etc. Stage 5 aims to analyze the different information gathered from the previous phases at both data and

process perspectives with the use of some recommended analytics tools like Cause-Effect Analysis and Value Analysis. Stage 6 aims to determine the solutions for the identified causes of the problem addressed, then prioritizing these solutions based on different parameters. To-be map and To-be processes maps are some recommended tools at this stage. Stage 7 consists of monitoring the results of the agreed improvement actions with the use of control charts and visual dashboards and standardizing. The last stage aims to prolongate the phase of post-control for more monitoring and creating aids to control the process for stability with the help of dashboards or Andon and Jidoka or control charts.

Reference [17] proposes a tailored model for a Portuguese innovation company based on the guidelines of project management and lean principles. The research methodology used is Action research methodology that includes: process mapping (diagnosing), process reengineering (planning and taking action), testing and results evaluation (evaluating). Five steps were defined and only three of them were implemented in this paper: Step 1: Training the project team, Step 2: Build the As-Is model, Step 3: Build the To-Be model, Step 4: Test the model in the pilot project, Step 5: Closing the gap.

Reference [18] focuses on development of lean project management in the context of project management standards following these steps: 1- Identification of requirements, 2- Derivation and analysis of values and wastes, 3- Redesign the existing processes (PMBOK) by for example introducing the process « requirements prioritization process » and extending the existing processes to support lean management and avoid waste.

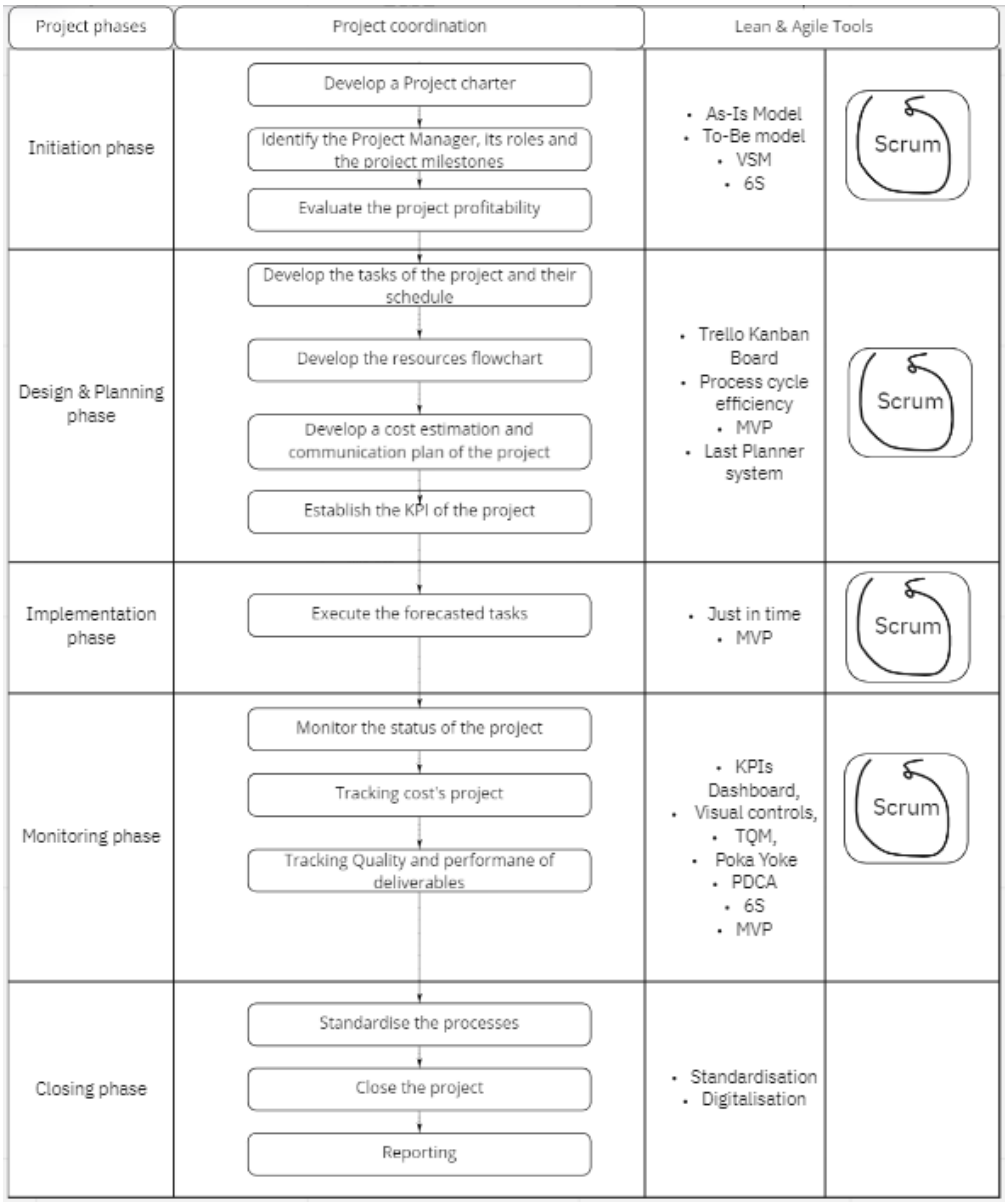


Fig. 1 The proposed framework

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TABLE III
TOOLS OF THE PROPOSED MODEL

	Initiation Phase
As-Is Model	This model aims to understand how processes are executed in the current system and serves analysts as an important model for understanding and improvement of business processes [20].
VSM	This tool aims to represent graphically how value in order to identify waste in processes towards the future value stream state that could be an answer to customer expectations for new products or services and change requests [12].
To-Be Model	Aims to model the desired future state with waste removed, putting the desired customer value first and finally looking for project excellence.
6S (Sort, Set in order, Shine, Safety)	6S is a technique that aims to create a clean, efficient and safe working area, it is composed of 6 basic steps (Sort, Set in order, Shine, Standardize, Sustain and Safety), in the initiation phase we choose 4 basic steps (Sort, Set in order, Shine and Standardize) and the two others (Sustain and Safety) in the monitoring phase [21].
Scrum	It is the only agile tool that is considered suitable for project management [22]-[24]. This tool allows to involve the customer's opinion for each deliverable of each phase i.e., project charter, etc. and thus have at the end a deliverable validated by the customer since the beginning.
	Design & Planning Phase
Trello Kanban board	It is a web-based project management application, that allows sharing, printing, copying of documents and desired information between project teams, Trello allows the sharing of information and progress to the entire team with the provision of details of each task e.g., due dates, attachments, comments, etc. The synchronization and collaboration of teams located in multiple sites also represent an important advantage for this tool [25]-[27].
Process cycle efficiency	It aims to improve the efficiency of the process cycle time. It's represented by the customer Value Add time divided on the process lead time.
MVP (Learn)	This technique is used essentially for innovation projects; it is one of the Lean Startup techniques that essentially relies on Feed-Back loops that are part of a continuous cycle starting with a minimum viable product (MVP1) that should offer enough value to interest the final customer. This approach maximizes the accuracy of the test, reduces its cost and saves time. This approach is based on a short iterative process, centered on experimentation, and structured by three operations: Build, Measure and Learn [28].
Last planner system (LPS)	This method is used essentially for construction projects, aims to improve workflow and variability and control of the uncertainty in the building work [29].
Scrum	As mentioned in the initiation phase, this tool allows the validation of deliverables in the earlier steps i.e., project schedule, cost estimation and communication plan.
	Implementation Phase
Just in time	This tool guarantees a reduction in flow times, it aims to optimize the chain of value and so the products are sold before being produced. It gives priority to delivering just the required amount of materials when needed [30]-[32].
MVP (Build)	The cycle of this technique is composed of 3 steps, Build, Measure and Learn, each step occurs in a phase of an innovative project, Build in the implementation phase, Measure in the Monitoring phase and finally Learn in the Design & planning phase.
Scrum	In this phase, this tool aims to validate the forecasted tasks of the project with the client.
	Monitoring Phase
KPIs dashboard	This dashboard aims to gather the essentials metrics capable of measuring the actions executed with reference to the main objectives and results.
Visual controls	It is a lean tool that makes important information visible to all. It shows the information through visual signals instead of texts which makes easier to understand for every stakeholder involved in the project. Its principal goal is to enhance the extensive flow of information within the workplace and removing the barriers in the flow of information. The visual control board may be considered as a dynamic measurement system as they provide instant feedback [33], [34].
TQM	TQM is a management approach that seeks to apply quality principles to the whole organization. Its fundamental principles are focused on the client, the people, the continuous improvement and the suppliers [35], [30], [36].
Poka Yoke	It is a mechatronics device operating as a mistake-proofing that aims to automatically prevent defects from flowing through the process [30].
MVP (Measure)	As mentioned in the implementation phase, the step « Measure » is the most appropriate to be used in the monitoring phase for innovative projects.
PDCA	This technique is used to improve the first executions, composed of 4 steps plan do check and act it aims to review the methods of tasks and propose further improvements [30].
6S (Standardize, Sustain)	As mentioned in the initiation phase, this tool aims to create a safe working area, two steps from 6S were chosen in this monitoring phase (Standardize and Sustain).
	Closing Phase
Standardization	This technique refers to all activities which makes two projects most identical by means of standardization of design, reducing output variability, strategic planning, standardization of procurement and construction. It can be described as a set of analysis tools that lead to a set of Standard Operating Procedures and standards of good practices for example in construction projects Prefabrication is an innovative technology that provides standardized construction components [3], [30].
Digitization	Digitization is a technique that aims to reengineered and digitized all the optimized processes (only value-added activities for the users and the organization). It is more effective technique in the organizations that use intensively Information Technology and Communication (ICT) Systems [19]

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Reference [19] proposes a methodology for a successful process improvement based on lean thinking, six sigma and digitization, which includes several macro phases: Macro phase 0: Preliminary; Macro phase 1: Define and Measure; Macro phase 2: Analyze and Process Design; Macro phase 3: Architecture Design; Macro phase 4: Build, Test and Deploy; Macro phase 5: Verify; Possible Macro Phase 6: Replicate. This methodology was proposed based on qualitative research, mainly exploratory of multiple case studies (interviews, analysis of company records and direct observations). The case studies chosen were in service industries, engineering and logistics operating worldwide.

B. Synthesis

This analysis revealed commonalities among the different frameworks, such as, they all ensure to apply the lean principles and to measure the effectiveness of their frameworks in terms of cost, time and quality. In general, these papers begin the

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proposition of their frameworks with an assessment of the current state of wastes before selecting the appropriate lean tools & techniques to integrate to their frameworks toward the project excellence. The most applied lean tools are the 5S, the VSM, the visual management and the metrics. Table I shows that only 3/7 of the existing frameworks were tested and validated in a real-world environment. These frameworks must be tested in order to encourage the organizations to implement it. Three of these contributions are based on the directives of PMBOK to ensure a good project management base. Based on this literature review, and on all information about the project coordination as in [38], we thought of combining all these models to bridge the gap between them and to propose a lean and agile framework that aims to guide a project manager on different phases of a general project.

IV. The Proposed Model

The proposed model is shown in Fig. 1; it is a hybrid model that illustrates the combination of project management phases, Scrum tool and different lean tools.

A. Description of the Model

The framework proposed is based on the standard project management phases; in the first phase, which is "Initiation", the responsible must ensure the definition of customer value and describe the actual situation of this organization. The lean tools suggested for this step are: Value stream map, 6S, As-Is model and To-Be model. Then, in the next step; Design & Planning phase, we suggest the use of Process cycle efficiency, Minimum Viable Product (MVP) (Learn) for innovation projects, Last Planner System (LPS) for construction project and the Trello Kanban Board to ensure a good communication and good planification. In the Implementation phase, we suggest to use the tool Just in time to ensure the deliverability of just what is demanded without any waste and MVP (Build) for innovation projects. In The following phase "Monitoring" the suggested tools are: KPIs, Visual controls, Total Quality Management (TQM), Poka Yoke, Plan-Do-Check-Act (PDCA), 6S and finally in the last phase, "Closing" the responsible may use two important techniques: Standardization and Digitization.

The agile tool Scrum may be used in different phases to ensure the customer involvement on different deliverables of the project, also the Trello Kanban board even if it is initiated on the Design and planning phase, it is used on different next phases. Table III represents the description of these different lean and agile tools suggested.

V. Conclusion

Referring to the literature review, this paper aimed to find the best lean and agile tools that target the increase of the project's success. We also proposed a hybrid project management model. Regarding future development, we envision to apply this proposed framework and demonstrate its efficiency through an application case.

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