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Characterising project management of lean initiatives in industrial companies — crossing perspectives based on case studies

Rui M. Lima
Ingrid Souza
Eduarda Pereira
Ana Cristina Belém
Cátia Marlene Pinto
Joana Lazzaris
Pedro Fonseca

Rui M. Lima
School of Engineering
of University of Minho, Portugal
ORCID 0000-0002-7991-0132
Corresponding author:
e-mail: rml@dps.uminho.pt

Ingrid Souza
School of Engineering
of University of Minho, Portugal
ORCID 0000-0001-7144-6366

Eduarda Pereira
School of Engineering
of University of Minho, Portugal
ORCID 0000-0002-6139-4942

Ana Cristina Belém
School of Engineering
of University of Minho, Portugal
ORCID 0000-0003-1880-4085

Cátia Marlene Pinto
School of Engineering
of University of Minho, Portugal
ORCID 0000-0002-1182-0114

Joana Lazzaris
School of Engineering
of University of Minho, Portugal
ORCID 0000-0001-7328-708X

Pedro Fonseca
School of Engineering of
University of Minho, Portugal
ORCID 0000-0001-8181-6519

ABSTRACT
The paper mainly aims to characterise project management (PM) practices of industrial Lean initiatives by analysing and comparing three main topics: PM approaches, PM teams, and project alignment with the company's strategy. This research encompasses two exploratory industrial case studies with an extensive literature review. Key professionals were interviewed to obtain an in-depth vision of the field. The study results allowed characterising project management practices of industrial Lean initiatives in industrial companies based on the following dimensions: 1. Understand the needs; 2. Find a suitable team; 3. Use visual tools; 4. Apply a continuous improvement (CI) approach; 5. Identify KPIs for the context; 6. Get support from the top management. This work fills a gap related to studying the PM practices applied during the implementation of Lean initiatives, proposing a schematic representation of PM variables and actors in industrial Lean initiatives. Identifying the main variables and actors that industrial companies use to develop Lean initiatives can be insightful for Lean practitioners in the context of project management.

KEY WORDS
project management, project management characterisation, lean manufacturing, continuous improvement, multiple case studies

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Introduction

Doing more with less and respect for people is aligned with the Toyota practices mainly applied in the industry but spreading to many other types of organisations worldwide, under such designations as Lean Thinking (Jones & Womack, 2011), Toyota Way (Liker, 2004) or Shingo Model (Plenert, 2017). This way of thinking about production started in the 1950s with the development of the Toyota Production System and then gradually transferred to other companies from the end of the 1980s. Lean initiatives have been widely explored and applied in many business

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areas, such as automotive, aerospace, healthcare, pharmaceutical, shipbuilding and public services (Ishak et al., 2018). Companies involved in such initiatives aim to overcome challenges, reduce waste and improve the performance of the production systems, delivering superior value to the client (Chiarini, 2015; Czabke et al., 2008; Romero et al., 2019). Bortolotti et al. (2015) and Bhamu and Sangwan (2014) described the following types of Lean initiatives developed in business environments: setup time reduction and Single Minute Exchange of Die (SMED); Just-in-Time (JIT) deliveries by suppliers; waste reduction; reorganisation of layout; improvement of the production flow, using Value Stream Mapping (VSM); pull systems and Kanban; standardised work and 5S; statistical process control; autonomous maintenance (TPM); multifunctional teams, employee involvement and small group problem solving; training employees; top management leadership for quality; supplier partnership; customer involvement; continuous improvement and kaizen; cellular manufacturing; Total Quality Management (TQM); production levelling (Heijunka); visual management, visual control (Andon) and Poke Yoke; automation and autonomation (Jidoka); and simulation.

Many studies were conducted, on the one hand, to examine the positive results of the Lean tools' applications (Ishak et al., 2018; Li et al., 2008; Middleton et al., 2007; Rosenbaum et al., 2014) and, on the other hand, to identify the challenges of its implementation (McLean et al., 2017), as well as subsequent success (Czabke et al., 2008). Notwithstanding the nature of the project per se and the methodology adopted, successful implementation of Lean requires the involvement and commitment of the employees, aligned with the company's strategy (Anholon & Sano, 2016; Backlund & Sundqvist, 2018).

Even though there are many works related to the success and difficulties of implementation of Lean, there is a lack of studies related to project management approaches of Lean initiatives in an industrial context. A previous work characterised eight main failure themes for continuous improvement Lean initiatives: "Motives & Expectations, Culture & Environment, Management Leadership, Implementation Approach, Training, Project Management, Employee Involvement Levels, and Feedback & Results" (McLean et al., 2017, p. 219). Challenges identified under these themes have not yet been completely overcome as this is mainly a contextual organisational issue, where different approaches may not have the same results in different initiatives. Considering research resources limitations and opportunities, this study team decided to focus on some of those themes, exploring the following questions: what are the main project management approaches applied in Lean initiatives? How are the project teams formed and managed? How is the top management aligned with the projects? Such questions are worthwhile to explore considering the importance of Lean to the performance improvement of business companies, highlighted and explored over the years in accountable contexts (Abideen & Mohamad, 2021; Gupta et al., 2020; Li et al., 2020; Lima et al., 2021; Miqueo et al., 2020; Ramya & Janani, 2020; Salentijn et al., 2021; Scheller et al., 2021; Singh et al., 2020; Wojtkowiak & Cyplik, 2020), and that project management is pointed out as being one of the main failure factors of continuous improvement initiatives (McLean et al., 2017).

Hence, this work aims to characterise project management practices when implementing Lean initiatives in industrial contexts. The research is based on the development of two exploratory case studies in two large industrial companies that have been systematically applying Lean principles and concepts through dedicated teams. Even though the type of project is an important factor in project management, the intention of this work is not focused on Lean initiatives and their results but, instead, is focused on project management applied to those initiatives, which is not being thoroughly addressed in previous articles. Moreover, these case studies will be cross related with a detailed analysis of the literature on Lean project management, contributing to a schematic model of approaches that have been used in industrial Lean contexts.

1. Literature review

The numerous benefits of implementing Lean, which nowadays represents the Toyota Production System (TPS) approach, have become globally acknowledged. Currently, standards and approaches are vastly applied beyond the automotive context (Ishak et al., 2018), thus, impelling the creation of innovative approaches within organisations (Singh et al., 2020).

From the point of view of project management, Lean approaches have been continuously expanding since the 1970s and, in both practice and research,

became known as Lean and Agile project management (Middleton & Joyce, 2012; Modranský et al., 2020; Tripp & Armstrong, 2018; Žužek et al., 2020).

This section presents a vast literature review focused on the project management approaches in the implementation of Lean initiatives, on project team management and, finally, on the alignment with the company's strategy.

1.1. Alignment with the company's strategy

In general, all companies would argue that there is an alignment between top management and projects being developed. But is that always true? Deming stated that "the problem is at the top. Management is the problem" (Dombrowski, Uwe & Mielke, 2014). Thus, according to these authors, behaviour change starts with the top management's commitment to project objectives.

How is the top management aligned with the projects?

The alignment should be noted at different organisational levels, and the understanding of project goals is crucial for achieving individual commitment to continuous improvement; therefore, there is a need for commitment and information transparency across all levels of the organisation (Holtskog, 2013). According to Ikuma et al. (2011), project promoters meet with upper-level management (president, vice president, and plant supervisor) to explain the project goals and the timeline for completion. Ishak et al. (2018) referred to the project approval dependency on top management and the importance of their support and cooperation during the project timeline.

Another example of the importance of top management alignment comes from the CEO of a Suzuki plant in Hungary. Knowing the importance of commitment as a key factor for booming change perception, the CEO walked around the workshop twice a week. This behaviour led to increased motivation in workers and became an integrator of Lean culture change (Elizondo et al., 2016). Holweg and Maylor (2018) approached the specific cases of major projects, referring that the main driver of projects is the top management. Major projects are problematic, with failure rates as high as 70 per cent, for the organisations that run them, their stakeholders and those involved in their delivery. The authors also referred that due to their inherent complexity, these projects could not rely solely on traditional project management approaches (Beecham et al., 2021; Towill & Christopher, 2002).

This allows for reinforcing the idea that projects that are more complex, transformative and vital to the organisation require more involvement in their management from the top leaders.

What are the main challenges of continuous improvement projects?

Productivity is one of the goals of continuous improvement projects, and it is all about the man–machine binomial (Jones & Womack, 2011). The machine is designed to respond to the man's desires, and the man needs to adapt to other introduced functions. The success of continuous improvement projects strongly needs interaction between humans and business goals (Elizondo et al., 2016). A well-nurtured balance between technical Lean aspects and activities relying on the relationship between the companies' persons has been identified as a fundamental cultural success factor of Lean initiatives (Bortolotti et al., 2015; Piwowar-Sulej & Podsiadły, 2022).

Holtskog (2013) referred to the relevance of counting with people to easily promote a change in the company — to incite a continuous improvement state of mind. This relates to the cultural aspects of organisational transformation, which must consider the commitment of employees to change, mostly when continuous improvement programmes are started and at different stages of such programmes (Jeunon, 2020). Otherwise, they may feel that they do not belong to a change process which could undermine the project goals. Holtskog (2013) described a way around the problem, which "was to take the standardised tools as guidelines and let the operators together make small changes to them". Hence, the condition of autonomous work is stimulated, also promoting team engagement, as well as the impassioned feeling of collaboration towards understandable goals. However, the challenges of continuous improvement projects do not change how people think. Significant and persistent challenges in continuous improvement projects include time pressure, sharing knowledge/findings, bureaucracy and time-consuming reporting/process routine, healthy work environment and communication (Backlund & Sundqvist, 2018).

1.2. Project management approaches/ tools

Organisations are continually faced with developing complex products, services and processes with

very short time-to-market combined with the need for cross-functional expertise (Tenera & Pinto, 2014). If the 1980s were about quality, and the 1990s were about globalisation, the 2000s are about velocity (Bennett et al., 2007; Moujib, 2007). The velocity requires management. According to Moujib (2007), Lean project management, as the application of Lean manufacturing principles to the project management process, intends to maximise value while minimising waste. Velocity is all about minimising waste in terms of management and maximising value by choosing the right team for the right project with the right methodologies as well (Anholon & Sano, 2016; Moujib, 2007). So, this section aims to identify some approaches, methodologies, frameworks, and tools applied in the literature to project management in developing Lean initiatives in industrial companies.

What are the main approaches to managing a project?

Despite the existence of several methodologies to manage a project or project phases, there are two main approaches — waterfall and agile — based on the interaction between the phases (Modranský, Jakabová, Hanák et al., 2020). In the waterfall approach, the project phases flow downwards, moving from one phase to another only once that phase has been successfully completed. The agile approach is characterised by frequent cyclic iterations between phases to promote improvements with high value and is mostly used to deliver results where the uncertainty is high (Cvetkovic et al., 2017).

The searched literature is not clear about the main management approaches. However, the agile approach is successfully applied to manufacturing, which reveals a constant need for adding value and time-to-market in a more complex and uncertain world (Hamerski et al., 2019; Modranský, Jakabová, Hanák et al., 2020).

How are projects initiated, monitored, and controlled?

Project monitoring is crucial to achieving expected results in terms of costs, time, and results. The results interfere with both costs and time, so it is important to have a clear view of desired project outputs and how to measure them, which may be translated to key project indicators (KPIs) (Stechert & Balzerkiewitz, 2020; Villazón et al., 2020). Chiarini (2015) referred to the application of a measuring process for three months after the operational change to evaluate the efficacy of the improvement. In the Indian construction industry (Kovvuri et al., 2016), the Last Planner System was used to manage a project, which was monitored through the Percent Planned Complete indicator.

Modranský et al. (2020) explained that in a project using the Scrum agile framework, the Scrum board is used, but it can be modified or adjusted to fit the needs of the project. They highlighted the initial idea where every team member had their colour stickers with tasks on the board. The tasks with an overall duration of two to four weeks are placed on the board, but each of these tasks is divided into smaller subtasks on a daily basis. Their Scrum board has six columns: task description, product backlog, to do, in progress, to check and done. This approach helps to facilitate the work and create flow, as referred to in other works (Hamerski et al., 2019; Ribeiro et al., 2019).

The Scrum framework proposes three roles: the Scrum master, the product owner, and the team members. The deliveries of features are performed incrementally in each sprint, i.e., in each cycle of development. The events to create such features are sprint planning, daily Scrum, sprint review and sprint retrospective. Additionally, the Scrum pillars are transparency, adaptation and inspection, which are in line with Lean thinking approaches (Hidalgo, 2019; Lei et al., 2017; Schwaber & Sutherland, 2020).

A common tool used for supporting project management initiation, and later for monitoring, is A3. It is a management process expressed in an A3 sheet of paper. In general, it is divided into two parts: the left side serves to identify the problem or challenge to be treated, and the right side contains possible countermeasures (Chen & Cox, 2012; McLean et al., 2017; Tenera & Pinto, 2014). This tool is commonly used in Lean initiatives for problem-solving and, consequently, for project initiation. It helps to define the reason for developing the project, including key measures of the problem, followed by possible solutions, actions and desired or expected key measures.

Another tool useful for problem-solving is the Ishikawa diagram, which is a visual diagram in a fishbone form that helps to find the root cause of the problem and work this cause by understanding situations related to man, machine, material, measurements, environment, and method. It aims to help the team to find the real causes of problems that affect the organisational processes of a company. That is, its purpose is to discover the factors that result in an unwanted situation in the organisation (Chiarini, 2015; McLean et al., 2017; Rodgers & Oppenheim, 2019).

1.3. Project team management

A project is an ecosystem that depends on project complexity, resources, and time. The project complexity is the result of an equation in which the project management approach, business area, bureaucracy, legal procedures, level of innovation, and human context are relevant variables (Gonzalez et al., 2011; Hamerski et al., 2019; Hidalgo, 2019; Schwaber & Sutherland, 2020).

Project teams are a fundamental part of project management, and there may be different approaches to team formation, development, management, and monitoring.

How are the project teams formed?

Modranský, Jakabová, Hanák et al. (2020) highlighted that in a lean project management environment, the team responsible for delivering the service or product must clearly understand the customers' requirements and translate those requirements into feasible projects. It follows the lean principles of value and value stream (Jones & Womack, 2011).

Even though it was not possible to find much information about team formation, it is possible to use information related to Scrum, as this approach follows Lean principles. Thus, according to the Scrum Guide developed by Schwaber and Sutherland (2020), an ideal team to perform an agile project must not have more than ten elements to ensure the quality of communication and avoid hierarchies. Such a team is composed of team members, a Scrum master, and a product owner who represents the customer. The Scrum master may be viewed as the project manager. The team focus must be the development of the expected result. Their experience demonstrated that a team should be "small enough to remain nimble and large enough to complete significant work" (Schwaber & Sutherland, 2020).

Do the teams manage their work autonomously?

Lean-agile teams are cross-functional, which means that members have all the skills necessary to create and deliver value at each step of work (Alahyari et al., 2019). This type of team is self-managing, which means they internally decide who does what, when, and how. "They are structured and empowered by the organisation to manage their work" (Schwaber & Sutherland, 2020). Thus, each member has a particular objective towards a common goal. Moreover, the entire team is accountable for creating valuable and useful increments at every step of their work.

In the software area where the agile approach is well spread, Middleton et al. (2007) stated that quality and productivity were achieved by breaking major parts of the product into stories made up of 3–5 features, which in turn were made up of 3–5 units of work.

Each unit of work would be developed for 2–5 days and have multiple work types within it. Additionally, teams could only work on a maximum of two features or feature-level integration at any one time. This also stopped teams from "cherry-picking features" they wanted to develop at the expense of the whole product. Modranský, Jakabová, Hanák et al. (2020) corroborates the division of the project into smaller tasks (sprints) and its distribution among the team members in which each sprint takes two months at maximum.

In traditional projects, it is usual to have a team leader who creates the team according to project necessities and guides the people through the deliverables. This team leader, which can be the project manager, helps to design the requirements, the milestones, the prioritisation, manage the risks and define the product or service quality. The teams are guided by his knowledge and leadership (Hamerski et al., 2019; Hidalgo, 2019; Modranský et al., 2020).

Lean and agile project teams require a high degree of flexibility and autonomy, which provide long-term success (Beecham et al., 2021). A clear objective of the company strategy is required to ensure that the different prospects of success, as the team structure, processes and culture, are aligned with strategy to deliver the best solution for the improvement, product or anything for the project goal (Rasnacis & Berzisa, 2017). The collaboration occurs on all lower levels, and additionally, an exchange of collaboration must take place between the team, for which shared visions, values and culture are essential as an in-depth corporate identity (Scholz et al., 2020).

2. Research methods

According to Freitas and Jabbour (2011), a case study is an empirical study that investigates a certain phenomenon, usually contemporary, within a real context of life. It is an in-depth analysis of one or more objects (cases) to allow a broad and detailed understanding of a phenomenon. Case studies can be classified according to their content and final objective, as exploratory, explanatory or descriptive, or according to the number of cases, as a single case or multiple cases (Voss et al., 2002). The main trend in

all types of case studies is that they try to clarify why a decision or set of decisions was made, how they were implemented and what results were achieved.

2.1. Process

For this study, some steps were followed: definition of the research topic; literature review; preparation of the research tool (interview protocol); selection of key informants at two companies in the study; data collection, analysis, and discussion; and conclusions. These methodological processes, represented in Fig. 1, followed the best practices of case studies presented by different authors (Freitas & Jabbour, 2011; Miguel, 2007).

As the main goal of this work is to analyse different approaches to project management in the implementation of Lean industrial projects, focusing on companies implementing continuous improvement projects, the research team decided to develop two exploratory case studies of industrial companies. The development of these case studies should be able to deepen the understanding of three main themes: project management characterisation of Lean industrial initiatives, project team management, and identification of the alignment of projects with the company's strategy. To define the research topic, besides defining the objective and the three main themes referred to above, the research team defined a set of research questions related to each topic (Table 1).

Answering these research questions required a deep literature review, followed by case studies with interviews of key informants in each company. The literature review phase aims to create the conceptual background for understanding and relating the studies. The result of the literature review made it possible to develop semi-structured interviews performed with people occupying different roles in the Lean structure at the companies where the case studies were developed.

The bibliographic search was done through an extensive investigation and selection of journal papers using Scopus, Web of Science and Google Scholar databases, focusing on project management and case studies of implementation of Lean initiatives. The main keywords used during the paper search were: "case study" or "project management" ("Lean manufacturing", "Lean thinking", "Lean Production", "Lean system", "Toyota production system" or "Lean management").

According to Cassell and Symon (2004), in semi-structured interviews, the researcher selects the main themes to be researched and defines the interview questions. Before the appointment sessions, a semi-structured interview protocol, as recommended by Saunders et al. (2009), was developed and validated by the research team. The questions were divided into four block questions, each relating to the research themes referred to in Table 1. The sessions were recorded during virtual meetings due to the pandemic restrictions.

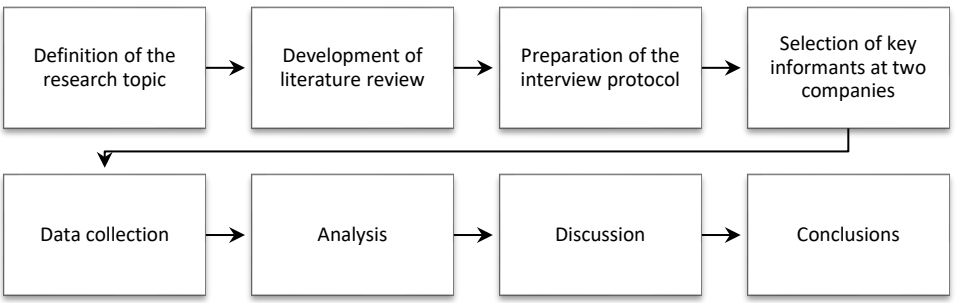

Fig. 1. Research process flow chart

Tab. 1. Research questions

Research themes	Research questions
Project management approaches/tools	What are the main approaches to managing a project? How are the projects monitored and controlled?
Project team management	How are the project teams formed? Do the teams manage their work autonomously?
Alignment with the company's strategy	How is the top management aligned with the projects? What are the main challenges of continuous improvement projects?

2.2. Context

Two industrial case studies were developed to analyse the project management approaches of continuous improvement Lean initiatives in different companies. The study was developed in two large companies, one from Portugal and the other from Brazil. Following a recommendation by the European Commission for micro, small and medium-sized enterprises (SMEs), the Portuguese law (Certificação de PME Online, 2007) defines SMEs as companies with less than 250 employees, with an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet not exceeding EUR 43 million. Thus, large companies are the ones not included in this definition. A company in Brazil is classified as large if the annual income is higher than BRL 300 million (BNDES, 2021), i.e., more than EUR 48.5 million (converted on 16 August 2021), or has more than 500 employees (CONUBE, 2018).

The company identified as Company 1 is located in the southeastern region of Brazil, operates in the field of iron ore exploration and has approx. 4100 employees. This company has an extensive background in Lean, from exploring machine maintenance for waste reduction to developments on production variability improvement to reduce costs. They have teams dedicated to the development of Lean initiatives and the implementation of continuous improvement. Even though the company has been applying Lean concepts for a while, the formal Lean initiative implementation first occurred in 2014 with the sponsorship of the corporate director. Then, the knowledge generated by the pilot project was replicated in other areas. Nowadays, this approach to Lean initiatives focuses on working at the operational level, raising awareness of basic concepts, and transforming the way of thinking: seeing what does not add value to the process, i.e., waste, and then improving processes.

Company 2 is in the north of Portugal, operates in the production of components for the automotive industry, and the number of employees is about 4500 people. They have a department dedicated to the development of Lean initiatives. The continuous improvement process follows a roadmap pre-established every year and aligned with the company strategy. Their Lean specialists work disseminating Lean thinking in the whole company, applying the methods and tools through the line production to the supply chain. The implementation of Lean initiatives started in 2002 with the main objective of fulfilling customer orders and avoiding waste from the product development phase to its delivery. Currently, the strategy is to make small improvement sprints until reaching the goal of 2022 to have the production plan levelling implemented throughout the factory. The focus is on working at the base to consolidate knowledge and then implement level plans, production controlling tools and a full pull system.

3. Research results

Although the companies belong to different business areas, a similarity is observed in the approaches used in their continuous improvement projects. As aforementioned before (Chapter 2), qualitative data were collected through semi-structured interviews with the key informants of both companies. We have used a general inductive approach (Thomas, 2006) to provide assumptions and present findings based on summaries of the data collected through interviews. Hence, endowing relevant links between the findings and the proposed research. The results obtained are summarised in Table 2.

The summary of the data presented in Table 2 allows for establishing a parallel between the companies regarding the description of the applied methods, tools and frameworks. The use of tools, such as A3, was observed, as well as methods, such as PDCA and Kanban, and roles, such as project manager and value stream manager. While most of the methods and tools may be associated with Lean approaches, there is also the application of the waterfall method in some cases. Nevertheless, in the cases where this approach

Tab. 2. Characterisation of project management approaches in both case studies

Topic	Company 1	Company 2
Project management approaches/tools	Scrum; A3; Waterfall; QCC (Quality Control Circles); PDCA.	A3; Waterfall; KPIs; PDCA; Small cycles
Project team management	Multidisciplinary teams; Hierarchical; Autonomous for task development	Multidisciplinary teams; Hierarchical; Autonomous for task development
Alignment with the company's strategy	Weekly report; Monthly meeting of alignment	Quarterly meetings of alignment; Steering Committees to share experiences and promote benchmarking

is used, it is incorporated in hybrid approaches for a general overview of the main phases being the operational management done using agile approaches.

Moreover, the operational teams defined the KPIs that best reflected their performance; hence those can be monitored and improved throughout the project. Haug (2011) maintained that the best way to directly involve employees in improvement projects is through the creation of work teams by sharing common goals and performance targets. Scrum approaches were also implemented in both companies as an agile, flexible, adaptive, and iterative way to manage Lean initiatives.

This framework defends a continuous planning process based on self-organised and empowered teams that work together to achieve a common goal (Sutherland & Sutherland, 2014). Both companies reported using multidisciplinary autonomous teams and continuous feedback to some extent.

The main concepts of the Lean philosophy are applied in projects of both companies, aiming to reduce waste, obtain better results and deliver value to their clients. Authors Hussain (2019) and Ishak et al. (2018) reported similar objectives and proved the benefits of applying lean tools (5S, VSM) and principles to save energy and damage to the environment or to maximise profits and minimise costs, respectively.

There is the objective of aligning the Lean implementation projects in this case study with the company strategy, which aims to increase the competitiveness of the company in its business market. Thus, it is important to highlight that these projects are developed looking for real, measurable outcomes, i.e., improvements in the production system, looking for a positive impact on the business, employees' life, top management results and even the local environment where the company is established.

3.1. Alignment with the company's strategy

Company 1 top management does not define the projects to be executed; instead, the employees composing the project team are motivated to align kaizen activities with the company's strategic goals. A kaizen board is available at the Gemba so that everyone may follow the current state of the projects and perform the updates. During these updates, the team checks the performed activities and looks for tasks that need to be concluded. Once a task is considered done, it opens a space for a new task that can be a new necessity of the project or a previously planned task.

"(...) we brought the challenge to the team to try to understand what can be done through Lean to reduce waste and improve the routine for increased productivity. Even kaizens were designed in this direction. To reach this capacity, I need to spend half an hour on this activity; what kaizen can I perform in this regard? So, we were able to deploy a goal there at the activity level." C1

The outcomes of Company 1 projects may vary, but after the QCC and the simple see-and-act to discover the needs of some departments or some production lines, the continuous improvement project begins. As an example, using the PDCA methodology, the company could reduce the time expended in a process, reduce the number of defective parts, and increase productivity using the same number of resources. Other outcomes from these projects are the qualification of team members through training. To deal with the complexity regarding the kind of projects, people receive training in 5S and seven wastes, which spread the knowledge and competencies of people.

In Company 2, the projects come from the company's strategy that is designed and updated every year according to business goals, market change and customer requirements. Considering that information, the lean department looks for a possibility to improve all their value streams and starts developing projects. The projects' outcomes may be to establish a pull system in a specific department, stabilise the performance indicators, create standards for JIT, implement the 5S philosophy in a particular area, or even improve the short cycles of PDCA regarding specific projects. Thus, Company 2 has an extensive engagement of the top management, promoting steering committees for benchmarking between departments and other production plants. Additionally, there are monthly events to acknowledge team projects which achieved higher recognised contributions for the objectives of the company. Company 1 promotes a different kind of engagement, delegating the alignment with the strategy to the project teams. The responsibility to promote this alignment is one of the team's commitments, promoting employee understanding and continuously looking for strategic goals.

At the interview in Company 2, the Lean Department Coordinator explained that their projects are simple and tangible, with focused KPIs and very clear objectives. Ideally, they should generate only one

standard, always considering the Value Stream vision strategy. The goal is to have short project development cycles to deliver incremental results. When a standard is concluded and stabilised, the team may move to the next improvement. For that, projects must be focused, with the indicators well defined and generating short and fast PDCA cycles. The focus is continuous improvement, i.e., to obtain incremental improvements until reaching an overall higher goal. The next excerpt reflects this approach.

"In the last years, we have shown fantastic results in terms of factory indicators, in terms of gains, and productivity increases. (...) So, it (projects) can be derived from the company's strategy and business requirements, or it can be derived from the Value Stream and the vision we have for this Value Stream. So, imagine we have a vision for three years from now to have a pull system implemented, and we will create projects so that this reality can happen within the stipulated period. So, we look at the Value Stream and say: three years from now, I want to have the pull system on this product. So, let's create projects and run PDCA cycles so that this can be a reality on the date that was predicted". C2

A common practice at Company 1 is to demonstrate strategy alignment with continuous improvement projects. During the semester of corporate kaizen conventions, each executive area is represented by one team. The best one is recognised and awarded. Additionally, each month, the best projects in the following categories are chosen: the number of kaizens identified and executed, health and safety, and administrative.

At the interview, the Lean Department Coordinator of Company 1 said that projects were fully supported by senior management and considered part of the company's policies. Moreover, the local manager was fully involved with the projects and participated in kaizens presentations and recognition meetings. Each project had its indicators related to working conditions, safety, and standardisation. To assess the Lean evolution in the area, the number of kaizens (continuous improvement projects) executed, the number of kaizens per employee and the number of replicated kaizens were monitored.

"Currently, top management is focused on stability and has the minimum deviations from the standard, with the equipment in adequate conditions. (…) Even in the management's annual strategic planning, we started to focus on the customer and what the customer expects from our management in terms of service, quality, and cost. Top management promotes, as recognition, every month what we call the vote of the people, where in each supervision, the team votes on the best kaizens. Those elected go to a leadership committee, where another vote is taken with predefined criteria. From there come the kaizen's highlights of the month in management, which are awarded prominence in health and safety, administration, the number of kaizens identified and executed (…), and at the end of the year, the best project is elected at the kaizen corporate conference". C1

In the Company 2 interview, the Lean Department Coordinator narrated that the plant production top management was closely linked to the development of projects. Biweekly, a Value Stream Manager was recognised with a symbolic prize, but the recognition process was very much appreciated. Additionally, the teams participated in weekly recognition activities and biweekly project presentations. This involvement helped to motivate and engage the team that worked on continuous improvement because they felt that their work was valuable to the company. Additionally, there were steering committees, which ensured that projects were done according to the Lean principles. There were also meetings involving other company plants, where team leaders presented best practices, project results and main difficulties. In these meetings, the plant was visited by top management to acknowledge the work.

Another evidence of this strategic involvement is that the system used to run the projects is available to the top management. They can follow what is being developed and in what phase the project is, and every month, a general meeting is called between the project team, value stream managers, project owners and top management to keep projects aligned with the company's strategy. The projects use indicators related to the following dimensions as a starting point: delivery of the finished product, the level of stock, the quality of the product, and the cost.

"In the case of our production plant, which I know best, the top management is fundamentally linked to the development of improvement projects. They participate in all weekly activities that we have, both in recognition of good projects and in the common presentation of projects. We have weekly activities with presentations of completed projects, and project development and management representatives are always present in these activities. So, they have perfect knowledge of projects created, validate them, validate the development process and validate the closure of the projects and even the recognition of a good project. They are present, and they deliver the

prizes we deliver for the different projects that have the best development." Company 2 Lean Department Coordinator.

Regarding the testimony of the companies, acknowledgement of the work done by the project teams is very important, and both companies have implemented meetings to discuss the best practices of projects, contributing in this way to promote benchmarking, improve processes, and elevate employee motivation. It is an opportunity to share knowledge with other subsidiaries of the company and to be recognised as an expert in the area.

3.2. Project management approaches

Projects can be managed using different tools and will always include the development of documentation with lessons learned for the next projects. In the case of Company 2, for example, project management is organised using an internal tool to manage continuous improvement. The developed tool even includes the PDCA cycle. The tool establishes the project flow in a visual form using A3, enabling the PDCA application and allowing for the application of different lean tools, such as the Ishikawa diagram, 5W2H, 5 Whys, and Kanban boards.

Company 1 uses agile approaches for project management, including elements of Scrum. These approaches are used because they help increase the speed and analyse the performance of projects. The company highlights that they are not tied to a model and that the concepts are applied practically, even without naming them.

They are not applied to all projects, as the company started the framework application some time ago to perform experimentations within agility, and after that, if the entire framework fits well, to expand it to other projects.

"Since last year (2019), we have been bringing agile methods to help us in project management. For example, in some projects, we started using Scrum to augment speed. We put the board with the post-it in the area (factory circulation environment), showing what we must deliver for that week and what we need to do to trigger the sprints. Now we are starting the phase of designing strategic/project, A3 and the proposal is that these A3 transform themselves visually through a Scrum in the workshops". C1

It is possible to highlight that both Companies use visual management approaches to follow the progress of projects. Company 1 uses A3 panels in the department, which allows for monitoring the stages of the project until that moment. Company 2 uses A3 in an online tool developed internally where they can perform the follow-up of each project. The focus of Company 1 with A3 panels is to share the developed kaizens and make it visible to all team projects to collect insights about the improvement. The focus of Company 2 is unifying all information in the same tool, to which all people involved in the project process have access. Both companies have a standard way of representing the project, which contains all the information about the project.

According to what was said by the Lean Department Coordinator of Company 1, there is no strict definition of the project life cycle. For example, they are defined as problems and challenges that arise, which are observed as improvement opportunities by the team. Because they call these projects kaizens, it is a way of promoting improvement. Those kaizens (projects) may emerge from:

- Routine problems: they deal with the impacts of daily delivery. Indicated by employees in visual management charts in the area.
- Management strategic goals: which are deployed and managed by A3. From these A3s, several kaizens appear.

The dimension and complexity of the projects may vary according to the project type. The Lean Department Coordinator argued that the projects were designed to have short cycles but were aligned with the value stream goal. Integrating small projects would contribute to a great impact at the end of a year, for example. The duration of the projects is variable and depends on the complexity of the project; there is no predefined duration. The team's dimension may also vary according to project complexity and needs but is between four to ten persons in a multidisciplinary team.

"(...) and with the multidisciplinary of the team and their involvement (performance as a team), the number of kaizens that were performed by the working groups grew as they began to understand the concept. In the beginning, it was very kaizen focused on the area organisation, normal and abnormal conditions, and approach to resource". C1

Similar to Company 1, the dimension of lean initiatives developed by Company 2 may vary according to complexity and project type. The Lean Department Coordinator argued that the projects are designed to reach the goal of the Value Stream vision, which is defined to be achieved in three to five years. Then, it is fragmented into small projects with short cycles of development running a PDCA, and the

project team may vary between three to ten members. Nevertheless, the company wants projects to reach the stabilisation phase in three months, one month for planning and creating a standard and two months for stabilisation.

All projects are always developed using the improvement cycle (PDCA) method, and monitoring is performed by the A3 tool. They also use other supporting tools, such as a digital system that was developed for project management and execution (all project information is recorded in the tool according to the PDCA). This tool assists owners and value stream managers in monitoring projects. The project manager or product owners have an approach to defining projects that are linked to business requirements, the company's strategy and customer needs. Aligned with this vision, a quarterly meeting is held with the Value Stream Managers, the department heads, and the production plant direction, where projects are defined based on strategies or problems arising from the line.

"We must be realistic in continuous improvement. I cannot reach the specialist for the screwing machine and say that I want him to solve everything in three months and that I want zero defects in the screwing machines; it is not possible. We cannot set goals unattainable because we are going to discourage the team from the beginning. So, we must give simple projects with very clear objectives that are tangible; if they are not tangible, we will lose the project. (…) for that, we must work on project derivation very focused on a very straight result and small steps for continuous improvement, very short and fast PDCA cycles; this is step by step". C2

Project monitoring is performed frequently by the project owner using internal tools. The updates are performed weekly to see what tasks were concluded and which require to be developed. If someone has a problem to solve or an issue with task completion, the project owner provides the needed support. Included in this monitoring process, the team undertakes related activities, i.e., checks for the predefined action plans, feeds performance indicators, puts new tasks in A3, or advances to the next step of PDCA.

3.3. Project team management

During the interview at Company 1, the Lean Department Coordinator explained that the project's complexity was variable, ranging from problems treated as see-and-act to more complex problems treated in groups of specialists or QCC (Quality Control Circles) using the PDCA. Romero et al. (2019) explained QCCs as small groups of workers, collaborating in a project context or not and periodically meeting to discuss production, quality, and issues related to the production system.

"There was a project where we delivered training related to 5S and seven wastes. Then we delivered a problem-solving training, using the A3 for problem-solving and QCC. Initially, we have done this training with the leadership, as they are the motivators to give the guidelines to the operational team. We created a problem management routine and visual management tools in the production area, using post-its and flip chart sheets, so the team could easily identify problems and manage the projects". C1

During the development of Company 1 projects, the project team may have no autonomy over decisions, needing to involve other areas or higher hierarchical levels. This happens in projects with a hierarchical organisation, which may cause some delays. Hamerski et al. (2019) argued that providing autonomy for the teams may contribute to avoiding the waste of "asking for permission" to solve an issue. The Head of the Lean System also argued that the team members had the autonomy to develop their daily work. The kaizens can be developed individually or in groups; it depends on the project approach and needs. But the project team manages their work to solve issues that appear in the daily routine.

"We have three fundamental roles in project teams. First, the Lean Department Coordinator. Second, the lean specialist will help establish the Lean concepts, give the pace of implementation, and take (people) out of their comfort zone. Third, the area team leader, who is the person leading the project, creates a bridge between the lean specialist and the good process practices." C1

According to the current context, the team allocated to a project is not full-time dedicated, and the level of dedication will vary depending on the project's characteristics. The two most important roles considered by Company 1 to manage the projects successfully are the Lean system specialist and the team leader. The Lean system specialist helps to establish the concepts in the area and gives the pace of implementation. All supervisors have access to a Lean system specialist. The team leader will make the bridge between the Lean system specialist and the production practice. He/she is on the factory floor (Gemba) supporting other employees.

Regarding project team management at Company 2, the team may be fully dedicated to the project,

which varies depending on specific phases or the project's urgency. In some projects, it is determined a priori how much time each element will dedicate. In other projects, the owner manages the required workload according to the activities and availability of the team members. The product owner may be chosen according to the problem that needs to be addressed and is chosen by the Value Stream Manager. This product owner should have project management skills and technical knowledge related to the problem, which is helpful for developing the project. He/she is also responsible for managing the difficulties and for choosing the team members, which may vary throughout the project and the phase of work. Regular meetings are performed by the team to monitor the development of each stage of the project.

Company 2 referred to one example where a project was carried out by a team working fully autonomously with no need to explain what needed to be done or to coach them, but that is very uncommon. That team could identify problems and propose projects by themselves, and they worked very well.

"The Value Stream Manager keeps the project and chooses an owner according to the problem or type of project, and these people must have know-how both in project management and in the problem itself. (We will look for) Someone who is an expert and who knows how to manage a project. The team elements can come and go, depending on the development of the problem. (...) Just in very specific cases, we had an autonomous team, but it is not common. It happens when the team members know each other for a long time and have total expertise in the work". C2.

4. Discussion of the results

The analysed case studies allowed for confirming a significant number of concepts, ideas, approaches, and methods reported by the literature regarding the characterisation of project management in industrial Lean initiatives (Chiarini, 2015; Czabke et al., 2008; Romero et al., 2019). As referred by Bortolotti et al. (2015), the developed types of projects are related to the identification of needs for the improvement of internal processes or customer service. The identification of these needs may come from continuous improvement of formal processes and departments or the opportunities for the reduction of wastes identified by the employees. Thus, measurements based on predefined KPIs are a strong source for this identification. But selecting the next project is a result of an alignment between needs and strategic goals, which may also be a source for those needs. In a continuum, as represented in Fig. 2, "needs" originate initiatives, which are developed by a project team using visual management and project KPIs for monitoring the state of the project. Previous sections described the industrial case study details regarding the specific types of initiatives, how the teams are formed and managed, the visual tools and the project KPIs.

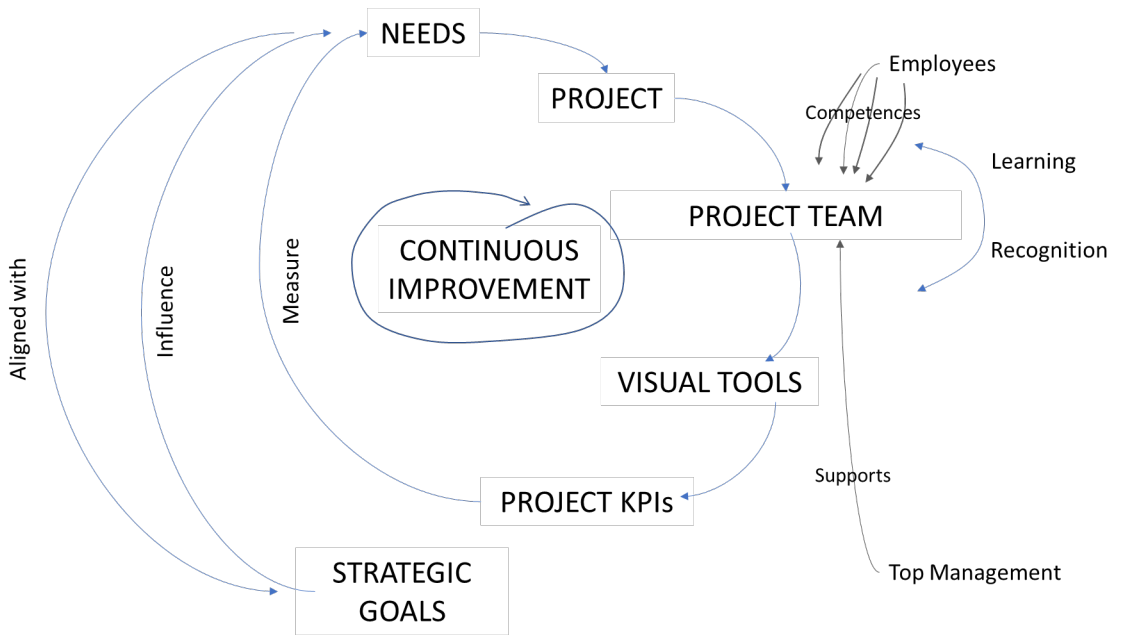

Fig. 2. Schematic representation of project management in industrial Lean initiatives

A distinct feature of these case studies is a strong notion that people are at the centre of the development of initiatives, and as Lean principles' advocates, both companies intentionally created ways to recognise (Chiarini & Brunetti, 2019) and take the most from those project teams (Tortorella et al., 2021). This is one of the most explicit results of these studies, which showed that Lean initiatives need small multidisciplinary project teams and that these teams need to continuously evolve and help other teams to evolve. Support and recognition by top management are also in place for both companies, with small awards, presentations, and the identification of successful teams each month.

Finally, based on the characterisation that was developed in this work, it is possible to present a set of recommendations for the management of industrial Lean initiatives:

- Understand the needs: needs may be set by strategic goals or must be aligned with those strategic goals. This may be put in place by more structured ways of relating different levels of KPIs or may result from bottom-up with employees understanding and establishing the alignment.
- Find a suitable team: small multidisciplinary teams should be put in place, mixing technical, Lean and project management competences. In most cases, these teams are hierarchical, with explicit leadership but with strong individual autonomy for developing the tasks.
- Use visual tools: the main tools used by the case studies companies are the A3 and Kanban boards. These tools may be implemented physically or with electronic tools, allowing for the facilitation of daily work, assignment of tasks, monitoring, communication, and transparency.
- Apply a continuous improvement (CI) approach: both companies referred to the PDCA methodology, which is a well-known tool for CI. Another tool to promote continuous improvement is DMAIC, as was exposed in the literature review section.
- Identify KPIs for your context: seeking effective opportunities for improvement needs to be based on relevant measurement, which may be related to customer satisfaction, internal processes improvement or the CI projects themselves, associated with the number of improvement proposals.
- Get support from top management: top management must be supporting Lean initiatives, personally monitoring some of the projects and creating recognition instruments.

Conclusions

This paper presented a parallel between the literature and two industrial case studies. Using the case studies developed in two large industrial companies, one in Brazil and another in Portugal, this work contributed to a better understanding of the best practices of lean project management that are currently being developed. The exposure to these practical contexts, showing the Lean application, enlarges the knowledge of Lean and contributes to further research and practice.

The case studies revealed the following points of convergence between the companies:

- The Lean initiatives are strongly supported by top managers.
- Teams have levels of autonomy that contribute to empowering them, which, together with the recognition instruments, contribute to motivation and share best practices.
- Visual management with A3 and Kanban boards and KPIs monitoring, geared by PDCA methodology, support the project management approaches.
- Both companies recognise the best practices with rewards.

This article is innovative by pointing to project management approaches in the context of Lean initiatives. This is supported by the identification of types of projects, project management, project teams and alignment with the company's strategies. Additionally, schemes and recommendations based on case studies and the literature may support new studies and their application to other companies striving to develop Lean initiatives. This will support a company's strategy as guidance to identify needs, start a project, develop a team, and manage the project using visual tools and KPIs.

This work suffers from the limitations imposed by case studies, which may not be generalised. Nevertheless, the deep and vast literature review and two case studies contributed to reducing this limitation and showed that different companies in different countries have comparable approaches. Nevertheless, these are both large companies and making these ideas applicable to small and medium companies will need deeper studies and identification of main constraints. Although the vision of the interviewees,

namely, Lean System Heads and Lean Department Coordinators, is quite in-depth, future work could provide different perspectives from employees involved in the projects. Thus, an opportunity for future research is the application of questionnaires or semi-structured interviews at different levels of the organisations and in a larger number of organisations.

Another point that is important to highlight in this study as a reflection is the current pandemic times. The COVID-19 pandemic forced many businesses to take a pause and reflect on the possibilities of new unthinkable challenges. Although production improvement projects may be disregarded in such struggling times, it is also in such times that a company may benefit from the opportunity that Lean and continuous improvement projects bring. A continuous improvement mindset looks for integrated improvements in a flexible and agile approach, capable of dealing with fast needed changes and adaptations. This is done by listening to people truly from the Gemba up to top management, providing training if needed and making the information and communication transparent. Thus, companies with such mindsets are better prepared for the needed changes and adaptations.

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