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An integrated project management methodology under a social perspective in industrialisation projects

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Abstract: This paper presents an integrated methodology for managing industrialisation projects combining know-how, abilities, instruments, and project management tools and techniques to fulfil more efficiently and effectively industrialisation requirements. Different research methods were used during an in-depth case study involving seven researchers over three years at an automotive industry company. Firstly, internal documents related to the organisation's specific set of rules for project management were analysed. Secondly, the organisation project managers' activities were observed. Thirdly, unstructured interviews were conducted to assess the organisation's project management awareness and the actual usage of tools and techniques. Finally, workflows were designed to represent the AS-IS model and the proposed TO-BE model. The methodology integrates a social project management approach, with social media tools, to improve communication between the industrialisation project management teams. Social project management is used to smoothly increase the projects' awareness and management within the global social ecosystem of the organisation.

Keywords: project management; industrialisation projects; social media; automotive industry.

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1 Introduction

Project Management (PM) is in continuous development and has been a hot topic in recent years in the automotive industry, one of the most competitive ones, where innovations are continually developing and rapidly succeeding (Margineanu et al., 2015). Developing new products has always been a challenging task and, surprisingly, every organisation considers it as a primary tool to surpass the competition (Tyagi et al., 2015). However, enhancing quality and reducing time-to-market for long-term success and sustainable competitive advantage, made new product development (NPD) PM an increasingly difficult task endeavour has continuously been emerged as an area of research for both industry and academia (Dröge et al., 2000; Tyagi et al., 2013).

Before presenting the focus of this paper, some important concepts are defined to provide basic comprehension of project, process, and PM. According to PMI (2021) a project is a temporary endeavour undertaken to create a unique product, service, or result. It allows the achievement of a set of outcomes, and has well-defined start and end dates. To achieve the outcomes, different processes are used where each of them consumes company resources and need to be managed. So, PM is the application of knowledge, skills, tools, and techniques to project activities to meet project requirements (PMI, 2021). The term PM can be understood as a set of steering tasks, following a method of how a project is managed. Besides, PM is about assigning work tasks, monitoring the processes, and steering deviations towards the required objectives (Johansson and

Kamenjas, 2016). It is well recognised by literature that PM has the potential to bring more than the tangible value that can be measured by ROI and that it can also be impactful on a wide variety of other values defined by different stakeholders in different project types, e.g., improve stakeholders' satisfaction; encourage continuous development; enhance collaboration culture (Fernandes et al., 2020; Thomas and Mullaly, 2007).

Commonly, NPD projects comprise three sub-projects – conception projects, industrialisation projects, and production projects (Fixson and Marion, 2012; Tyagi et al., 2015; Ulrich and Eppinger, 2016). This paper focuses on the specific context of industrialisation projects.

Industrialisation projects are described as projects that precede and leverage mass production systems. This type of projects are undertaken to design a manufacturing line to produce a product or several products from the same 'family' (Nazarian et al., 2010), with the goal to reduce production costs and increase manufacturing efficiency and efficacy. They have specific management needs, encompassing projects that can vary in terms of complexity, innovation, budget, and level of uncertainty (Perrotta, et al., 2017a).

Throughout the industrialisation process, the product quality is constantly assessed, and one way of doing that is to follow the stage-gate (SG) system (Cooper, 1990), commonly applied in NPD projects. Gates are events in time where several quality indicators for the product and the process are evaluated, preventing the project from moving on to the next phase (or stage) if the project fails to meet the gate requirements (Cooper, 2008). This SG system, despite of having been published about 30 years ago, is still a relevant approach in managing several kinds of projects, especially NPD ones. Only in 2014 Cooper tried to answer the question 'What's Next?: after stage-gate' where he talks about idea-to-launch systems still not in place by that time (Cooper, 2014). The tendencies point out to using the SG system in a more flexible way, incorporating agile ideas in the process, like the Agile–SG hybrid model presented in 2016 (Cooper and Sommer, 2016). In fact, PM has been evolving toward more hybrid approaches involving both traditional and agile practices (Copola Azenha et al., 2021; Gemino et al., 2021; Špundak, 2014).

The SG system is a settled approach within the automotive industry because it ensures the required high product and process quality (related to the project's efficacy) (Ettlie and Elsenbach, 2007). On the other hand, increasing competition, with a special focus on the time-to-market, forces companies to adopt, additionally, PM practices to improve their efficiency (Barczak et al., 2009), which means that they cannot afford not using them or poorly using them. As such, the SG system is focused on product and project effectiveness in the realisation of gates, the PM practices are focused on better management of the project itself and to make it as efficient as possible in achieving dead-lines and delivering the defined scope.

This paper focuses on this integration, proposing a PM methodology that integrates the product industrialisation lifecycle with the PM lifecycle. Among the several definitions provided for integration, we adopt the definition suggested by Child (2005, p.79): integration 'signifies coordination, cohesion and synergy between different roles or units in an organisation whose activities are different but interdependent in the process of creating value'. In this study, the envisioned integration of the product's industrialisation lifecycle with the PM lifecycle will be achieved with the implementation of a methodology that facilitates coordination, cohesion, and synergy between PM activities and technical activities related to the product's industrialisation.

The development of the proposed methodology was based on the contingency theory. The contingency approach in PM investigates the extent of fit or misfit between project characteristics and the PM approach adopted (Sauser et al., 2009). Thus, organisations and project managers (PjMs) should choose the set of PM practices (tools and techniques) according to the context of the projects and the organisation, to integrate them as a way to build a strategic asset (Besner and Hobbs, 2006). Industrialisation projects when compared with NPD or R&D projects commonly have lower uncertainty and risk, less pressure in terms of creativity and innovativeness, and project members often are resident in the same location, which facilitates the communication among team members.

PM methodologies can be applied to improve the probability of meeting the project goals, regardless of the industrial sector or size of the project. It is also widely agreed by researchers that the use of a suitable PM methodology will increase the probability of project success (Charvat, 2003; Resch, 2011). Ngacho and Das (2016) proposed a performance evaluation framework of development projects based on relevant measures of performance, namely time, cost, quality, safety, site disputes, and environmental impact. These measures are known as key performance indicators (KPIs). The authors argue that the identification of these factors, also known as critical success factors (CSFs), is very important for ensuring the success of any project because it enables project managers to commit resources to specific factors.

Grounded on the literature review, a PM methodology could be defined as a comprehensive set of best practices, tools, and techniques that are dynamic, flexible, adaptive, and customisable to different projects within a specific environment (Chin and Spowage, 2010). In addition, this methodology focuses on communication as a strategic tool, especially regarding its implications in leveraging cross-functional teams, knowledge exchange, collaborative work, and innovation development. In fact, as stated before, industrialisation projects integrate social processes with some level of unpredictability, happening in volatile and competitive environments, which increases the need for implementing flexible and dynamic collaborative interaction systems between its various participants (Winter et al., 2006). Commonly, as well as in the presented case study, industrialisation project teams are international, intercultural, geographically dispersed and increasingly self-organised. Therefore, industrialisation PjMs need to increase their communication skills to maximise the performance of the project team in complex environments (Hans and Mnkandla, 2019).

As so, within the proposed methodology, communication is enhanced through a social PM (SPM) perspective. Social PM is a current trend in the communication approach to project management, bringing a pragmatic view to the field to facilitate the traditional PM process by the use of social media tools (Daemi et al., 2020; Hysa and Spalek, 2019). ‘Social media usage has shown to improve information sharing, engagement and relationships’ [Manzoor, (2016), p.61]. This approach emerged as a solution to deal with the complexity of communication management in an industrialisation project by improving the traditional PM practices through the use of social media channels. These channels facilitate the integration of project stakeholders, the segmentation of information according to different needs, and instant information sharing, particularly among project teams (Van der Merwe, 2016).

As a way of addressing the questions mentioned above, this work aimed to answer the following research question: ‘How to manage industrialisation projects in the automotive industry?’. To answer this question, empirical research was developed to operationalise

the integration of a new PM methodology and a social approach for managing industrialisation projects in the sector, achieving the following research objectives (Obj.):

Obj. 1 Integrate the PM lifecycle with the product's industrialisation lifecycle

Obj. 2 Identify the key PM practices in industrialisation projects

Obj. 3 Improve industrialisation projects communication functioning through the use of Social PM.

One important issue in PM is that it is highly contingent on the organisational context (Cooke-Davies et al., 2009; Thomas and Mullaly, 2008). For this reason, the methodology was developed based on an in-depth case study research strategy. The selected case was a large automotive company, responsible for the development and manufacture of integrated solutions for navigation, telematics, and entertainment, for motor vehicles, according to clients' requests. More specifically, the case study presented is held in a plant belonging to one of this company's divisions, being the industrialization projects the scope of this study.

The rest of the paper is organised as follows: Section 2 (literature review) presents an overview of industrialisation projects and the relevance of the communication in these types of projects. Section 3 describes the methodological approach used in this research. Section 4 presents the answer to the research question and the integrated approach for managing industrialisation projects. Finally, Section 5 summarises the major conclusions and gives some hints for future research.

2 Literature review

In this section, we present an overview of the literature review concerning industrialisation projects and their management and the relevance of the communication in this type of projects.

2.1 Project management in industrialisation context

Developing new products is one of the fundamental activities in the automotive industry, so developing an efficient product industrialisation process is very relevant to this industry.

The most common approach to manage NPD projects is a linear process model with decision points that separate sequential phases in the project lifecycle, such as the SG system created by Cooper in the 1980s. Over the years, the SG system has evolved and incorporated many new practices (Cooper, 1990, 2008, 2014). Recent developments are modelled towards incorporating agile practices with the SG system (Bianchi et al., 2020; Cooper and Sommer, 2018; Klingebiel and Esser, 2020).

The SG system applies process-management methodologies to the product innovation process, which are divided by decision points (or gates). Assuming there is an idea for a new product, there are usually five stages to follow: preliminary assessment or scoping, business case preparation, development, testing and validation, and launch. Each stage is cross-functional, involving many areas, and is separated by a gate, which assesses the product (or process) to evaluate if it has all conditions satisfied to move to the next stage (Cooper, 1990, 2008).

The industrialisation projects are part of the NPD process, more specifically, stages 3 (Development) and 4 (Validation) (Cooper, 1990). When a new project arrives at the industrialisation phase, it is assumed that the product concept was already defined and the market assessed, so there is no need to have any stages or gates related to go/no-go decisions for continuing with the project. Therefore, the industrialisation project starts on stage 3. While stage 3, for NPD, is related to the development of the product, for industrialisation projects it concerns the refinement of the product's characteristics, reviewing requirements and plans, and the definition of tests to be performed. Additionally, the manufacturing line concept starts to be developed. Once the post-development review gate is approved, the industrialisation project then follows to the validation stage, where tests to the product are made, involving prototyping, the manufacturing line is finalised and tests to series production are also performed. Finally, the industrialisation project passes through its last gate. Here, the validation process is assessed, and there is a handover to the department responsible for production, while in NPD projects, it is more related to a final assessment before commercialisation (Cooper, 1990). The main difference between the SG system and PM lies in the objectives they are supposed to achieve. The SG system has as main objective to reach the NPD strategic goals of the company and to ensure the overall efficacy of the NPD project. SG system is not worried about project efficiencies, such as timing and costs, but in passing the gates that determine the company's/client's standards. In contrast, PM is more focused on project efficiency, micro-controlling the activities and deliverables at the individual level (Schultz et al., 2013). That is why Cooper (2008) believes they can both work together, complementing each other. Nicholas and Steyn (2017) also corroborate Copper's statement, arguing that project efficiency can be improved by implementing PM standards. Therefore, a new PM approach especially devoted to the NPD subproject (industrialisation project) is needed. Such an approach aims to improve communication and collaboration between the many departments involved (Ferreira et al., 2017). Considering the specific context of this research, industrialisation projects, where limited time and resources, inherent uncertainties, and high complexity is associated with the necessity of managing multifunctional and limited resources, makes PM a natural contributor to improving the success of the projects, especially by providing a powerful set of tools that will work in synergy with the SG system (Perrotta, et al., 2017a), discussed in the next section.

2.2 Useful project management practices in industrialisation projects

In the past thirty years, PM has developed substantially as a discipline and significantly increased in visibility and importance (Kwak and Anbari, 2009; Mir and Pinnington, 2014; Zhai et al., 2009). Thus, several methods and techniques have been developed, covering all aspects of managing projects from their genesis to their completion (White and Fortune, 2002). PM tools and techniques are the mechanisms by which PM processes within the organisation are delivered and supported. PM practices include, besides PM techniques (e.g., work breakdown structure or earned value management), the various guidelines in which the processes of the organisation are defined, including the use of procedure documents, checklists, job aids, and templates, as well as the use of software packages and various databases (Fernandes et al., 2013; Tereso et al., 2019).

Specific empirical studies have been conducted which identified the most used PM practices, for example, the work from White and Fortune (2002) and Besner and Hobbs

(2006). White and Fortune (2002) listed 44 methods, methodologies, tools, and techniques and asked the respondents to indicate which had been used in the project being considered to participate in the survey. The options chosen to be included in the list were those found in a selection of standard textbooks of PM (e.g., Kerzner (2017). From an analysis of 236 participants, White and Fortune (2002) found that the most commonly used tools identified were: 'off the shelf' software (77% of the respondents); Gantt charts (64%); and cost-benefit analysis (37%).

The study developed by Besner and Hobbs (2006) surveyed views of 70 tools and techniques, with 753 respondents. The authors' findings are consistent with the results from White and Fortune (2002). Although Besner and Hobbs selected a larger number of tools and techniques, the three most used tools identified by White and Fortune (2002) are also in the top list of Besner and Hobbs (2006). A more recent study undertaken by Perrotta et al. (2017b), which assesses the usefulness of PM practices performed in an automotive company, where the industrialisation projects follow a phase-gate process is highlighted. A questionnaire was developed to identify the degree of PM practices' usefulness. From a total population of 18 industrialisation PjMs, 17 responded, resulting in a 94% response rate. Analysing the results, it can be noticed that great importance is given, firstly, to time management, being the 'time-schedule' ranked as number 1 and the 'milestone list' as number 4. According to Perrotta et al. (2017b), this result can be attributed firstly to the importance that clients' deadlines have on the industrialisation process itself, providing a guide to developing the industrialisation time-schedule and milestone list. Secondly, knowledge management is critical for industrialisation projects, the knowledge acquired along the development of manufacturing lines for NPD is essential for future projects, either concerning new projects using similar technology or projects with the same specific needs (Haass and Azizi, 2020). Thirdly, to change management, since industrialisation PjMs identified the practice engineering change request (ECR) as very important. Due to their fast-paced environment and innovative new manufacturing lines development, it is common to have changes related to the process and as such, ECRs must be filled to formalise, approve, and register those changes.

Comparing the study of Perrotta et al. (2017b) and the study of Besner and Hobbs (2006) some conclusions could be taken. In fact, major differences could be perceived regarding what the identified 20 most useful PM practices are in the industrialisation context when compared to Besner and Hobbs (2006)'s top 20 PM practices. Only half of the top 20 PM practices identified in the study of Perrotta et al. (2017b) as the most useful were also part of the top 20 of Besner and Hobbs (2006), highlighting the differences inherent to the industrialisation projects context. While the top 20 from Besner and Hobbs (2006) are more related to the knowledge areas of scope, integration (through monitoring), quality and risk management, the study of Perrotta et al. (2017b) showed that a greater relevance in industrialisation projects is given to time, change and risk management, with more than one practice of each populating the top 20.

2.3 Communication and social approach to project management

The scenario described so far gives the PjM an essential role in conducting the project, as well as major importance in the interface with the different project stakeholders. According to the literature, setting up information and communication channels is actually crucial for the success of the PjM function (Zulch, 2014).

Project teams are facing greater pressure to increase their performance and to solve problems on time to respond to market pressures. Besides that, projects are becoming more complex and dynamic (Kerzner, 2017), to which we can add the challenges of the pandemic situation we are going through (Silva and Hewagamage, 2021). In this scenario, investing in communication in the work context is increasingly seen as a competitive advantage, and PM specialists have been exploring the use of social network technologies as a way to optimise efforts in a project team, as revealed by the literature review by Daemi et al. (2020).

The concept of Social PM (SPM) emerged in the literature in 2008, and since then captured the attention of PjMs but also of communication experts. The vision of organisational communication theory was one of the perspectives on which our research was based. Its literature explores the role of human communication in the development of the organisational mission. In fact, human action is always supported by communication and its process is permanently framed by the social and cultural conditions where it occurs. Organisations are 'small societies', whose functioning is largely dependent on communication, and project teams are part of those 'societies'.

In this context, the emerging concept revealed great opportunities to enable teams to collaborate and share information, thereby enhancing project cooperation and coordination, to achieve success (Harrin, 2021; Silvius, 2016b). SPM proposes the use of social networks to help teams to work together and to assist PjMs in driving the delivery of projects. It brings new empowerment to project teams because it creates an atmosphere where everyone can participate in developing or sharing their expertise, and contributing to the evolution of projects, even if they are not directly assigned to them. It is also a way of managing more successfully organisational knowledge (Nisar et al., 2019).

Having emerged at the beginning of the 21st century, this approach to communication in PM has been slowly asserting itself. In 2016, Sponselee (2016) identified 17 possible usages of social media in PM (see Table 1) within which we can find some classic areas of PM such as stakeholders' management. However, Sponselee (2016) has gone further by also considering aspects such as reputation and relationship issues, which are actually items related to communication.

Table 1 Social media functionalities and PM usages

Social media functionalities		*Usage area*
To build identity	1	Profile pages on social media
	2	Recruiting project resources
	3	Research on (potential) stakeholders and suppliers
To promote conversations	4	Short (video) chats
	5	Content related discussions
	6	Online solicitations
To stimulate sharing	7	Project content and status updates at one central location
	8	Product and document reviews
	9	Knowledge of the crowd
To increase presence	10	Retrieving and utilising the availability and location of others
	11	Working remotely, independent of time, location and device

Source: Sponselee (2016, p.29)

Table 1 Social media functionalities and PM usages (continued)

Social media functionalities		*Usage area*
To create relationship	12	Insight into relationships
	13	Engaging stakeholders
To build reputation	14	Project pages
	15	Project ambassadors
To generate groups	16	Targeted communication
	17	Cooperation between project team members

Source: Sponselee (2016, p.29)

After this initial work, it then became evident the need for increasing communication skills at all levels of the project organisation from what we advocate that social media can be very helpful channels. In fact, social media tools can have a great influence on several aspects of teamwork, such as communication, coordination, mutual support, balance of member contributions, effort, cohesion and knowledge management (Daemi et al., 2020; Hysa and Spalek, 2019; Ma et al., 2021; Molendijk, 2018; Nisar et al., 2019; Silva and Hewagamage, 2021).

Indeed, PjMs have been using email as the preferential tool for communicating and exchanging information, through which they share reminders, assignments, meeting minutes, reports, etc. (Pedrosa et al., 2018). But this traditional model of PM communication faces a challenge, because of the increasing volume of shared emails and the overwhelming variety and speed of daily information received, trends that can compromise projects' outcomes (Bond-Barnard et al., 2017; Nach, 2016; van Dokkum and Ravesteijn, 2016). Thus, the need for increasing communication skills and finding alternative channels is evident at all levels of the project organisation, when ensuring that the information reaches everyone from the bottom (project team) to the top (upper management).

Following that line of thought, studies such as those of van Dokkum and Ravesteijn (2016), Wijngaard et al. (2016), Zhang et al. (2018), and Al-Shehan and Assbeihat (2021) identified some applied advantages of the use of social media in PM as, precisely, the reduction of email usage, but also the decline in phone calls and meetings, understood as time-consuming communication channels. As already noticed, today project information tends to be dispersed and abundant and, just like in every social network, SPM can be a strategy for congregating people and information to facilitate access and storage of project data (Al-Shehan and Assbeihat, 2021).

However, the adoption of the SPM concept may also experience certain barriers (Al-Shehan and Assbeihat, 2021; Hysa and Spalek, 2019). Some of them can be related to individual concerns of team members - such as the loss of privacy or the blurring of lines between professional and personal lives, whereas other barriers may be caused by the organisation's engaged in the project – as the 'concerns about data security or compliancy with the organisation's policies' [Silvius, (2016a), p.294].

Despite these concerns, recent literature advocates that improvements in communication can be achieved through the adoption of the SPM approach. But, bringing these ideas to the industrialisation projects' environment demands the development of a new vision on the PM communication framework, since it requires the adoption of the

typical features of social networks to facilitate interaction between individuals, between teams, and between projects.

3 Methodological approach

Exploratory research was carried out, aiming to learn from the experience of industrialisation project stakeholders, with a project that involved seven researchers in an in-depth case study over three years. The case study is a qualitative methodology that supports research on studying complex phenomena within their contexts (Baxter and Jack, 2008). The case study strategy was selected as contextual conditions are relevant to the phenomenon under study. Since PM is dependent on context (Besner and Hobbs, 2013), it is difficult to separate the phenomenon and the context (Baxter and Jack, 2008). Therefore, this section presents the case study background, giving an overall idea of how industrialisation projects are managed in an automotive company and what are the main challenges of managing industrialisation projects, as well as the research methods applied.

3.1 Case study background

The company under study is a first-tier automotive company, founded in the late 1800s, with 395,000 employees worldwide. The sales volume in 2020 was almost 71.5 billion euros, 10% of which was invested in research and development. The presented case study is installed in one of the plants of this company, whose focus is to develop and produce integrated solutions for navigation, telematics, and entertainment for automotive vehicles, meeting the needs of the clients. More precisely, the scope of this case study is industrialisation projects, which comprise the stages from industrialisation of the product to series production.

A new project starts with a client's request, which can be related to the development of a new product or to make changes to an already existent one; this project is named global project. The global project then begins with the collection of client requirements, to further develop the product concept. Once the concept is approved by the client, the plant where the industrialisation process will be carried out is involved and, thus, the industrialisation project begins. The main objective of an industrialisation project is to define a manufacturing line for the new product that can satisfy all client's requirements for quality and quantity.

Then, the industrialisation project starts with an iterative process that includes prototyping and line design. The prototyping process serves as the basis for the definition of manufacturing and assembly processes and then the design of the production line. With the prototyping process, it is in-tended to

1 prove the concept
2 validate functionalities
3 provide a more stable basis for the establishment of processes, workstations, and test stations.

The industrialisation project ends with the handover for the start of series production.

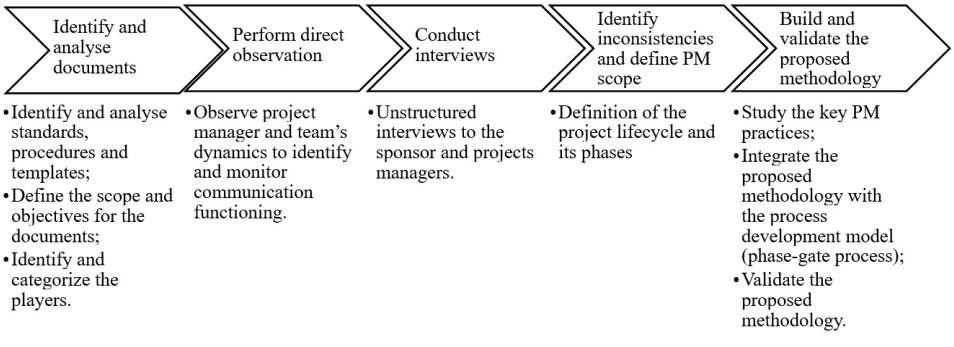
This process involves many areas in the company, requiring strong PM skills to be applied to accomplish project objectives. NPD projects, and specifically industrialisation projects, follow a phase-gate process, which is very similar to Cooper's SG system and is known in the company as product engineering process (PEP). This process uses quality gates to assess the quality of the samples produced, and uses PM practices, following the organisation project lifecycle model (OPLM) to achieve better project performance, aiming to promote synergy between the project team, a good work pace and meeting deadlines. Finally, the industrialisation project is considered closed when the handover to the department responsible for the mass production is made.

3.2 Research methods

Before considering the implementation of new PM processes in an organisation, regardless of the sector of activity, it is important to understand the existing situation, how the processes are carried out, and which players are involved, especially in the so-called core team. The core team is the group of stakeholders with different roles in the industrialisation project that performs PM activities, namely, the PjM officer, the PjM, the launch manager, the parts purchase manager, the sample build coordinator, and the project quality manager.

The research steps followed, to map the existing PM processes and to develop the communication audit, in the case study are summarised in Figure 1.

Figure 1 Required steps to map the existing pm processes and to develop the proposed methodology



The first step was the identification and analysis of internal documents, whether related to the set of specific rules of the organisation for the PM, such as OPLM, or templates to be used throughout the project's life cycle and to communication between project teams and its stakeholders. In detail, the existing standards and procedures in the organisation that may be relevant to the application of PM practices were compiled and analysed. Also, all existing templates related with industrialisation projects, both PM specific and organisation templates were compiled, since they may serve as in-puts/outputs for PM processes. With all these documents compiled, the scope and objectives were defined, and the players related to those documents were identified. The players were categorised as responsible, supportive and/or accountable. With this effort it was possible to stablish the initial state and understand how the work is carried out by the project managers.

In the second step, the objective was to directly observe PM 'happening' in the organisation, what activities are performed by the PjMs and how. To identify and monitor communication functioning, project managers were observed, paying special attention to communication flows and barriers. Also, project teams' dynamics were analysed, identifying the different departments involved and possible communication barriers. In this way the evaluation of the organisation's communication system, through a complete analysis of its messages, channels, and flows, internally and externally, was performed. The communication audit (Quinn and Hargie, 2004), using the selected research tools to map general PM processes, allowed the development of a communicative perspective of the organisation. In the next step, unstructured interviews to industrialisation projects' sponsor / proxy sponsor were conducted to assess the organisation's awareness of PM, capturing the industrialisation project sponsor's point of view, which improvements should be included, as well as identifying how much support to PM practices the sponsor provides. With the sponsor's support, project managers have more empowerment to implement PM practices within the organisation. As well, unstructured interviews were carried out with ten stakeholders with different roles in the project industrialisation core team. The PjMs were interviewed to help to identify improvements for the proposed methodology. The proposed solution buy-in by the main stakeholders is crucial to a successful implementation. In this sense, the project manager's expectations were taken into account during the solution development.

The fourth step is related to the definition of the project lifecycle and its phases so that the identified PM processes can be mapped accordingly. A well-performed mapping, developing workflows, in addition to making PM processes better known, also makes inconsistencies more evident, such as activities without inputs/outputs, was the starting point to be able to develop the new methodology. Once the process activities for each PM phase have been defined and mapped, each has been described in terms of process activity ID, purpose, inputs, outputs, and organisational assets needed to fulfil the purpose of the process activities. The PM scope was defined, differentiating it from the SG system. To implement the proposed methodology, the communication system was designed. The communication scope focused on creating and implementing a communication plan for the proposed methodology acceptance, using change management strategies to support the global adoption of the methodology in the environment and with the stakeholders.

The last step to build the proposed methodology involved research about PM best practices, how they would be applied and how the current practices can be improved, based on PMBOK (PMI, 2017), which is the guide recommended by the organisation, and other references (Andersson and Chapman, 2017; Müller et al., 2012; Rajablu et al., 2017). At this point, it was important to have certified PM professionals involved to assess the best practices that could be applied as improvements to the existing process. Finally, the last step in developing the proposed methodology was to assure the integration of the PM methodology or general PM practices with the phase-gate process in place used for the process development, contributing to a better definition of the work and a better understanding of the phases to be carried out to ensure compliance with deadlines.

Once the proposed methodology was built, it was validated through the realisation of focus groups with the stakeholders who are directly affected by it, namely the PjMs, and those who will be of great relevance to assist in the implementation, the project sponsors.

As in other qualitative studies in Project Management, the validation would require the implementation of the proposed methodology during a considerable time, to be able to apply it in a new set or a portfolio of industrialisation projects. As such, the validation adopted was the detailed appreciation of the proposed methodology by the PM core team that would apply the methodology in the future, through two focus groups. During the focus groups, in addition to the researcher conducting the group, two observers, one from the researcher's team and another from the company, also took notes. At the end, the notes were shared, and a common agreement reached.

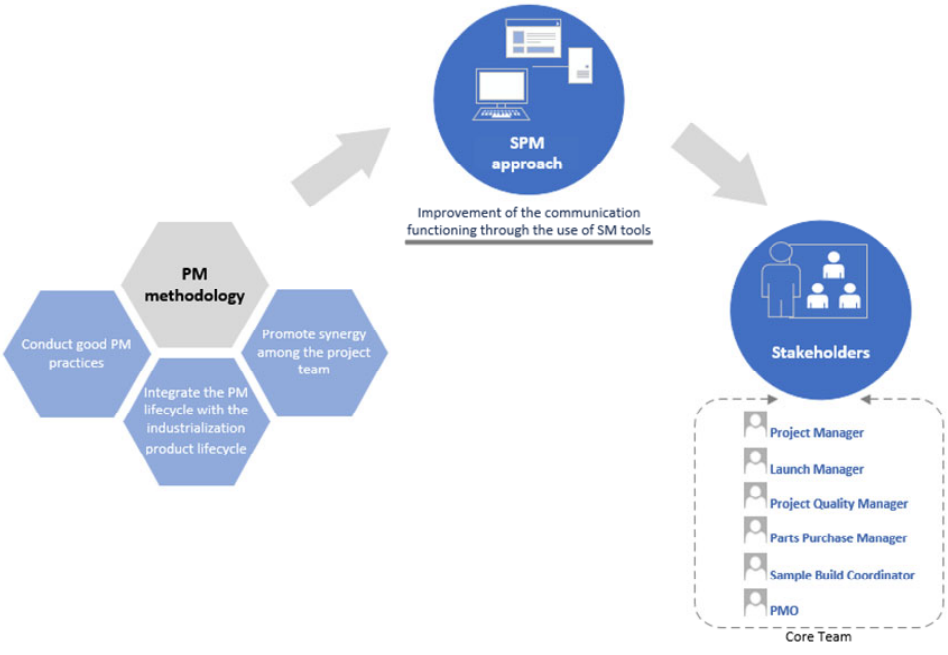
4 Proposed solution

This section aims to respond to the research question (How to manage industrialisation projects in the automotive industry?) by proposing solutions to develop and integrate a PM methodology in the automotive industry company. The proposed solution is presented in Subsection 4.1, showing the integration of the industrialisation product lifecycle with the PM lifecycle. Its main objective is to promote synergy among the industrialisation project team. Industrialisation projects are characterised by complex interrelated activities, the integration of an efficient PM methodology in the product industrialisation lifecycle may facilitate and increase the company's response to changes and avoid repetition of former mistakes, by facilitating collaboration among the numerous stakeholders and supporting up-front decision-making process, thus increasing client satisfaction.

The proposed methodology aims to bring changes inside the field of industrialisation projects as the conduction of good PM practices that will allow PjMs to define, monitor and control more efficiently the project lifecycle. Thus, as a proposed solution, in Subsection 4.2, the key PM practices that will best serve PjMs are identified.

Subsection 4.3 presents the last proposed solution to facilitate the integration of the PM methodology in the industrialisation complex environment, as outlined in Figure 2. This integration is possible through the adoption of the SPM approach in industrialisation projects, which can enhance efficiency and flexibility in PM work – using social networks platforms. In this case study, a PM community was designed to be part of the company's internal social network, integrating more informal communication flows. The use of more informal forms of interaction (such as wikis, chats, and forums), together with other more classical online and offline channels, is fundamental for a more integrated approach, and the engagement of the community is the key to building trust and knowledge, expertise and the development of a common identity. With this new premise, it was possible to identify the information flows and, subsequently, the structuring of the folders for the projects, which contributed to the standardisation of the processes and definition of the roles of each team member.

Figure 2 Embedding a pm methodology through the SPM approach (see online version for colours)



4.1 Integration of the industrialisation product lifecycle with PM lifecycle

To accomplish the first research objective (Obj.1), the proposed methodology envisages the integration between the industrialisation product lifecycle with the PM lifecycle. This was achieved through an exhaustive study. This study was based on what processes industrialisation projects go through, both related to the NPD and the PM itself. To attain an integrated view of PM in industrialisation projects and to characterise all PM processes and issues involved in each project's lifecycle phase, the main research methods applied were documental analysis, direct observation, and unstructured interviews.

In this sense, the following plan for the documental analysis was performed.

1 Identify all documents from PEP and OPLM that could be used as inputs or outputs in the management of industrialisation projects.

2 List all PM activities foreseen in the OPLM.

3 Link the activities of 2) with the inputs and outputs identified in 1).

4 Identify inconsistencies in the OPLM such as: activities without inputs and/or outputs; activities whose descriptions do not clarify their objectives; activities that are not executed by choice or by lack of evidence of their execution; activities, inputs, or outputs that have no impact on the purposes of the project and therefore should not be considered within the scope of PM; activities whose responsibility is unclear or does not involve the appropriate actors for its successful completion.

Besides the documental analysis described above, some information was collected and validated using some primary data collecting tools, such as direct observation and unstructured interviews. The direct observations focused on PjMs acting in their open space context and project meetings. The unstructured interviews were conducted with some elements of the core team, covering different areas, to have an overall perspective of the existing situation.

The core team is the group of stakeholders that performs PM activities. The interviews were made to the following elements with the following functions: one Project Management Officer; two PjMs; one launch manager (LM); two project quality managers (PQMs); two parts purchase managers (PPMs); and two sample build coordinators (SBCs). The project management office (PMO) is the department responsible for standardising the project-related processes and operates as an internal service provider to support the PjM in executing projects appropriately. The PjM is the person nominated to lead the core team and ensure that project objectives are achieved. The LM is the coordinator for the product manual and final assembly, and responsible for product layout, production line standardisation, and investment quotations. The PQMs represent the clients' vision in the industrialisation process, build the bond between the client and the plant. The PPMs are responsible for purchasing all new parts for sample building and ensure they are available when needed. The SBCs are responsible for planning sample construction and coordinating all related tasks, including the survey of process deviations in each sample stage, the follow-up, and the report of the results.

After data collection and analysis, the existing procedure for the management of industrialisation projects was established. To be able to improve the PM process, it is of great relevance to differentiate between the processes involved in the management of the industrialisation project and those in PEP. In the company practice, there was no clear distinction between PM activities and PEP activities. In fact, PM activities played a minor supporting role to PEP, where the latter worked as the backbone of all industrialisation projects in the organisation, which means a focus on the effective-ness of the result, devaluing its efficiency.

The work of industrialisation projects performed in the company under study is divided into two parallel flows of activities:

1 New product development, for which the phase-gate process identified as PEP is followed.

2 Project management, for which the OPLM is followed, as illustrated in Figure 3.

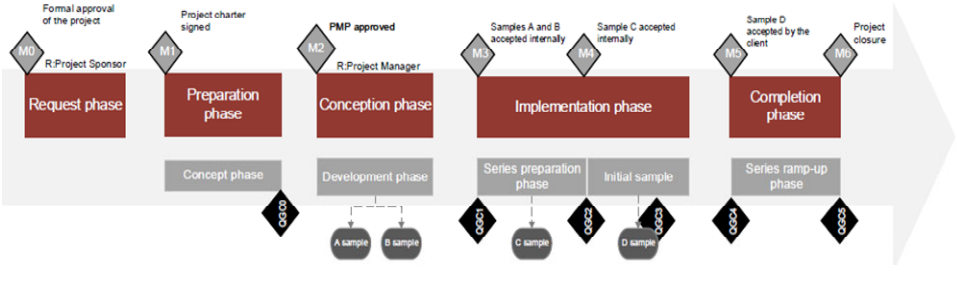
Regarding PEP, it describes the processes related to the execution of industrialisation projects and is divided into five phases: concept, development, series preparation, initial sample, and series ramp-up. The PEP is defined as a phase-gate process, using quality gates to assess the samples produced to increase the maturity of the product itself before conceptualising the manufacturing line.

In the concept phase, the product concept is defined, evaluated, and validated, and the A-sample building is planned. The industrialisation time schedule is created. Potential barriers and risks to product development and manufacturing are identified within a preliminary risk analysis. After that, a quality prognosis is made (milestone QGC0), which documents the product quality indicators. In the Development phase, the first prototypes (A-sample and B-sample) are constructed and internally validated. After that, the planning of the C-sample starts. At the end of this phase, the requirements for

B-sample are verified (milestone QGC1), and the suppliers are defined to produce the C-sample. In the Series preparation phase, the first samples to be validated by the client are constructed (C-sample) and tools and equipment for the industrialisation process are adjusted and approved. The production planning is released (milestone QGC2), the requirements for C-sample are verified, the planning of the manufacturing processes is finished, the initial samples can be produced, and the purchased components are released. In the Initial sample phase, the production is simulated with the elaboration of samples (D-Samples), to optimise the productive resources, identify and eliminate potential problems, and approve the manufacturing process. At the end of the D-sample, the internal production is released, the manufacturing process is validated, and the initial samples can be sent to the client for release (milestone QGC3). The approval of this sample by the client indicates that the product exhibits high maturity and confirms that it can move to production (milestone QGC4). In the Series ramp-up phase, small series are produced to identify and eliminate remaining problems and optimise cycle time and process efficiency. The production process is robust, the lessons learned are captured and retained and the industrialisation project team can be released (milestone QGC5).

Related to the PM, the OPLM describes the management process of the industrialisation project and includes five phases: request, preparation, conception, implementation, and completion. The PjM is responsible for the approvals of the OPLM. In the Request phase, once the new project is accepted, the PjM is nominated, and the kick-off meeting is performed. The Preparation phase starts with the approval of the project charter and is dedicated to the definition, preparation, and coordination of all plans, which will be further integrated into a comprehensive PM plan. In the conception phase, the final goal is the achievement of the final product concept and the creation of the manufacturing line. There are a set of PM activities executed on each of those sample phases. The implementation phase is dedicated to executing the PM plan considering its possible changes. During the Implementation phase, the internal approval of project results is foreseen. Finally, in the completion phase, the project should be closed with the acceptance of the project and all documents archived, lessons learned retained and project team released.

Figure 3 Processes to manage industrialisation projects (see online version for colours)



Each phase of OPLM is delimited by milestones, which are events that mark the advent of a certain outcome and project delivery. The Request phase is the only PM phase that has no corresponding phase in PEP. Also, there is no quality gate related to the milestones M0 and M1. The Request phase starts with the formal approval of the project (milestone M0) and, during this phase, front-loading processes are applied to prove that the potential project complies with the project acceptance criteria (milestone M1). Then,

the Preparation phase occurs during the PEP concept phase. During this phase, a PjM is nominated, who identifies preliminary resource needs (budget, equipment, and tools, experience and competencies, knowledge, among others) and roughly outlines the project (milestone M2).

After approval of M2, the project team that will work on the conception phase is created, corresponding to the monitoring of the development phase of the product life cycle (construction of samples A and B), and which the final stage consists in the release to the series preparation phase (milestone M3). The implementation phase comprises the C and D samples and processes acceptance internally (milestone M4) and by the client (milestone M5). The completion phase closes the project and releases the PjM and their team (milestone M6).

Management of industrialisation projects is a core activity in the organisation, but the NPD process phase-gate (PEP) and the PM process (OPLM), later implemented in the company, were not completely aligned. This situation lacks clear justification beyond the envisaged diversity and complexity of most projects. Several deliverables were identified in both processes PEP and OPLM, and there was also no clear distinction between activities and deliverables. Another pointed obstacle to integrate the PM lifecycle with the product's industrialisation lifecycle was due to the fact of PM activities play a minor supporting role to PEP, where the latter works as the spinal cord of all industrialisation projects in the company. For example, although there exists a formal time schedule and proper milestones from PM that all the project team must comply with, they usually follow the deadlines dictated by the milestones of PEP (QGCs).

4.2 Management of industrialisation projects – key PM practices

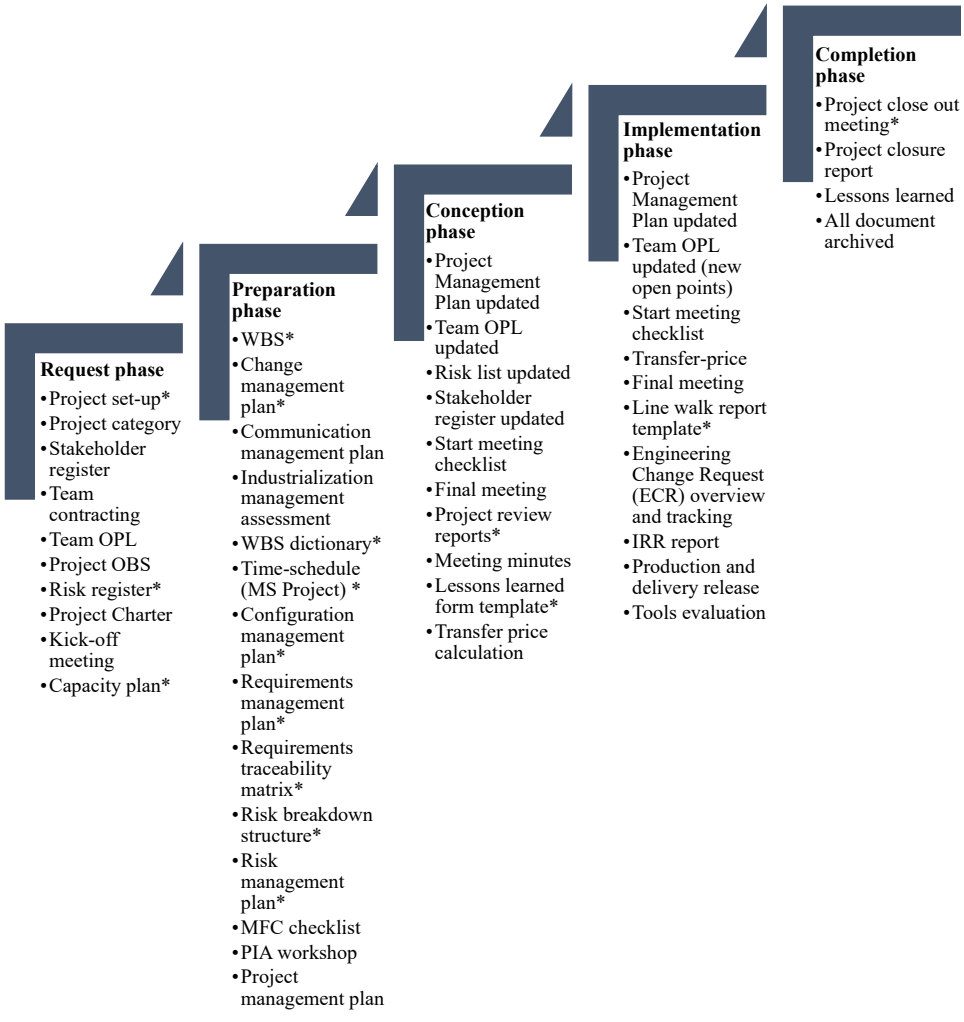
PM is recognised as a core competence to improve the development and execution of projects at the organisation. The new PM methodology is presented as a solution that proposes many improvements to the existing PM practices in industrialisation projects, both in the workflows, changing the way work is done, and in specific activities, new documents, new communication channels/flows, etc. In this sense, and to achieve the second objective, the key PM practices included in the proposed methodology are presented in this section.

During the process mapping of the PM activities, as they were carried out in industrialisation projects, it was already possible to identify, not only some inconsistencies that require attention, but also barriers to some activities, which led to the suggestion of several improvements to the PM processes. The main research methods applied were the focus groups, documental analysis, direct observation, unstructured interviews, and survey. Regarding the focus group, the discussion was freer-flowing, to assess the validity of those suggested improvements, and if they actually bring value to an efficient and effective PM practice, and to discuss the proposed PM methodology. Two focus group sessions were conducted with five PjMs. Their opinion and suggestions were also of great importance to the validation of the proposed improvements.

The proposed methodology will come as an alternative to conducting the good practices of PM inside the field of industrialisation projects. Figure 4 shows the key practices defined for each phase of the proposed methodology and the new practices introduced through the proposed methodology are detailed (highlighted with * in Figure 4).

Among the changes the new methodology brings, the implementation of new PM practices is crucial for allowing the PjMs to approach (define, monitor and control) tasks in their own way, planning deliverables and managing uncertainties/risks over the industrialisation project lifecycle. For the context of this study, the definition of Perrotta et al. (2017a, p.27) for practice was adopted, 'A practice can be defined as a management activity that helps in the execution of a process through the use of techniques and tools'. In this context, a tool can be a template, or software used to produce a result whereas a technique is a procedure applied by a person to execute a certain activity and may employ the use of tools.

Figure 4 Key PM practices defined for each phase of the proposed methodology (see online version for colours)



In the request phase, the first improvement with the proposed methodology was the creation of a first activity called 'project set-up' that would accommodate the definition of project category, creation of the project folder and project ID, and definition of quality targets.

Particular attention should be given to change management and capacity management, due to their high impact on the PjMs contribution to the industrialisation projects performance indicators.

In its turn, the change management plan was proposed to monitor and control changes to the project, and those changes must be managed well by the PjM, being their impact evaluated accordingly.

In order to have PM processes revised, particular focus was given to the following processes: requirements management, configuration management, create scope baseline and create schedule baseline. So far, these processes are diluted through the entire project lifecycle, and therefore, there is no specific moment where they take place. For example, the project requirements are needed to develop the plant project charter, however, their management is not yet standardised at the organisation. In this sense, it was imperative to revise the way these management processes were done. This allowed proposing templates such as the requirements management plan and requirements traceability matrix as improvements, to assure the accomplishment of the requirements during the whole project and to associate requirements to the project deliverables that satisfy them and their respective work packages.

Departing from the WBS and the identified resource requirements (time and costs), all activities within the project are identified, as well as their sequence, dependencies, and durations, to produce the flow chart and the time schedule of the project. Another improvement of the proposed methodology is related to revisiting the time-schedule to promote the early search for internal and external dependencies that would influence the schedule, such as lead times for equipment availability, and to develop guidelines for the approval of the time schedule. Another suggestion of the proposed methodology is that the time-schedule should have a milestone list. This would facilitate communication with the upper management, turning it more efficient and objective.

In the conception phase, a project review report template was proposed to guide the team throughout the project, helping gathering data of work performed, giving feedback, communicating efficiently, solving issues, and looking for sources of change.

Although the company under study had already a template to manage the communication in the industrialisation projects, with the embedding of the proposed methodology it was considered essential to review the already existing communication plan to dilute possible barriers. A SPM approach was then introduced in the communication plan template, to develop a new communication frame-work that required the adoption of typical social networks features.

In the Implementation phase, in which the final samples are produced and evaluated by the client, it was of extreme importance the standardisation of the line walk report. The line walk was a practice performed by the PQM with the client, to verify the line and engage the stakeholders. Although this template was already used in the company because it was the responsibility of the PQM, it was optional for the PjM to use it for

monitoring and controlling the project work. However, with the embedding of the proposed methodology, this template has become mandatory to be used to formalise the execution of the line walk with stakeholders.

Lastly, in the completion phase, the close-out meeting was introduced. In this sense, the PjM should perform an official meeting to close the project, engaging the team in compiling lessons learned, with highlights of the most relevant product and manufacturing process experience.

4.3 A social project management approach to industrialisation projects

Looking at the issues that arise from the communication audit, the development of an integrated communication approach was suggested, comprising the inclusion of communication improvements across all the PM processes, in a coherent and synergetic mode. It became clear that the proposed methodology could incorporate relevant advances by integrating communication and SPM strategies in the different processes, phases, and activities of industrialisation PM. Regarding the internal computing platform, it was decided that it should include SPM solutions, allowing continuous access to information and communication tools, by which a virtual workspace could be created, enriching the decision-making processes and continuous knowledge sharing. This application platform should, then, integrate social media internal tools, designed to develop a collaborative environment that can increase the compromise of teams and the involvement of stakeholders.

Considering the complexity of communication management in an industrialisation project, Social PM can be seen as a way of incorporating, in a more fluid way, the project into the global social ecosystem of the organisation, putting everyone in a continuous conversation. Social media may be a unique way to induce a more social approach to PM, either by being incorporated in a work methodology or by being considered in a software solution, as it induces the use of new channels and ways to communicate to project stakeholders. It should be noted, though, that the SPM approach that we support does not imply the replacement of traditional communication means, but it proposes the use of social media to communicate more rapidly with pressured, geographically distant, or culturally diverse teams.

The philosophy of the SPM is that social media have the potential to increase the flexibility and celerity of PM work, by using more informal ways of interaction (as chats or forums), to which we add the need to use a more integrated approach with other more classical online and offline channels. Considering all these ideas, an integrated communication approach was developed for SPM in order to create new action guidelines valid to industrialisation projects (see Table 2) and in accordance with the communication tasks that should be performed by PjMs. The next chart summarises the roles accomplished by SPM channels and crosses them with other more global communication responsibilities that should be developed by the PjM leaders, proposing a holistic view of communication in PM.

Table 2 Guidelines to an integrated communication approach to SPM in industrialisation projects

Communication objectives		*Social media use in PM (SPM roles)*	*Integrated communication use in PM (Communication roles)*
1	To develop a common identity	Reinforce organisational culture	Develop a global symbolic system
		Create a sense of community	Sponsor teamwork
		Build awareness to the project	Share information and recognition
		Align teams	Line up sense-making and teamwork
		Engage stakeholders	Create partnerships
2	To promote information/interaction	Ease information flows	Develop multi-level communication flows
		Gather information	Define communication headmasters
		Enable real-time project information	Support time aligned information
		Convey rich content	Develop high involvement contents
3	To facilitate work processes	Simplify remote working	Create virtual teams
		Research potential stakeholders and distribute resources	Manage stakeholder participation
		Allow online solicitations	Manage virtual work
		Ease knowledge exchange and lessons learned	Promote knowledge sharing across the organisation
		Enable document reviews	Reduce documents' spread
		Facilitate status updates at one central location	Manage information flow and communication responsibilities
		Create project pages	Develop project autonomy

In the audit, it was also possible to verify that PjMs were able to recognise their lack of skills in the field and the consequences of poor communication within their teams. And confirming this diagnosis, a program of strategic workshops was created, with the purpose of improving the communication skills of PjMs, to facilitate the relationship with the team members and stakeholder management. The contents of these workshops can be summarised as follows: to explain the basic principles of human communication in organisational contexts; to introduce de SPM approach; to discuss communication barriers detected in the company; and to debate possible solutions to be implemented. PjMs saw the workshops as an enhancing activity of their abilities, giving them the opportunity to discuss and find solutions to problems/barriers they encountered in their day-to-day work.

In fact, the implementation of this kind of communication thinking can face some difficulties, such as the human resistance to change or the break of old work systems. Having an SPM tool does not mean that implicitly project members understand its importance, utility, and applicability. For instance, considering the survey results, it is noticeable that informal communication is not well understood, and this should be considered when implementing such an approach. In our case study, it was clear that to adopt a social communication system, the company needs to be aligned with a less hierarchical communication model, crucial for the acceptance of this SPM concept.

Consolidating the survey and observation data analysis, it became evident that: working teams are often large, irregular, physically distant, and competitive; that email and skype are the most used interaction tools; meetings are seen as dispensable; there are multiple communication channels, frequently performing the same functions; and project members are not engaging in an SPM approach, despite having a social media platform available in the organisation. Therefore, we advocate that integrated management regarding communication is needed, considering the strategic use of online and offline channels and practices through all PM process, and that improvements can be achieved through the adoption of the SPM approach.

5 Conclusions and future work

Across all industrial sectors, PM has become an essential element in the successful delivery of projects. This paper presents an innovative approach to manage industrialisation projects through an integrated, global, and social system, operationalised by the implementation of a new PM methodology and SPM solutions.

The first objective of this research – integrate the PM lifecycle with the product's industrialisation lifecycle – was achieved through the analysis of the processes involved in industrialisation projects, which allowed the correct mapping of macro activities in each of the OPLM phases and in the PEP phases. The state of the art of industrialisation work allowed the identification of new activities and suggestions of improvement to be applied, to facilitate the integration of the PM processes with the PEPs. Those improvements were validated during the conduction of focus groups with the core team being largely accepted and their value-added recognised.

In relation to the achievement of the second objective – to identify the key PM practices in industrialisation projects – the proposed methodology was based on the detailed definition of the existing state of PM practices applied at a large automotive organisation and further development of the future scenario, considering the inconsistencies identified and improvement of key PM practices. Thus, the new methodology is intended to function as a guideline, understanding what exactly the PM role is in industrialisation projects, with the objective of supporting PjMs and their teams in achieving projects' success.

Lastly, for accomplishing the integrated and global management of industrialisation projects envisaged and to respond to the third objective – improve industrialisation projects communication functioning using social PM – the communication environment between the teams, the different channels and flows were audited, seeking to assess their efficiency, effectiveness, and quality. Only after this analysis, a communication plan was defined (including the design of new processes, tools, and actions). After these evaluations, several actions were taken – such as communication workshops, or the

creation of a communication guide and an online community for industrialisation PM – that improved the PM communication framework. These theoretical and practical contributions helped to build knowledge in SPM, under an organisational communication perspective and gave guidelines for PM practitioners on how to develop SPM in industrialisation projects. But, bringing these ideas to the industrialisation projects' environment demands the development of a new vision on the PM communication framework, since it requires the adoption of typical features of social media networks in highly hierarchical and regulated teams – and this is a working progress process. Table 3 presents a summary of the research results.

Table 3 Research results

Integrated project management methodology under a social perspective in industrialisation projects		
Obj. 1	Integrate the PM lifecycle with the product's industrialisation lifecycle	The proposed methodology integrates the activities of two parallel flows: 1) New product development, for which the phase-gate process identified as PEP is followed; and 2) Project Management, for which the organisation project lifecycle model (OPLM) is followed (see Figure3).
Obj. 2	Identify the key PM practices in industrialisation projects	The proposed methodology will come as an alternative to conducting good PM practices inside the field of industrialisation projects. The key practices defined for each phase of the proposed methodology and the new practices introduced through the proposed methodology were detailed in Figure 4.
Obj. 3	Improve industrialisation projects communication functioning through the use of Social PM	The proposed methodology encompasses the fundamental guidelines to an integrated communication approach to SPM in industrialisation projects (see Table 2).

The limitations of this research are mainly derived from the research methods and approach adopted – a major case study, since its context-driven characteristic is paramount. However, and since the researchers were fully aware of the limitations involved in qualitative research methods, namely interviews, observation and focus groups, they carefully planned the application of each method, trying to minimise possible bias, and having always several researchers present during each data gathering method. Additionally, like any methodology, it portrays a simplification of reality and should be used cautiously when industry organisations adopt it to successfully manage their industrialisation projects. Exploring more case studies would result in expanding the outcome of this research.

Concerning the validation of the proposed methodology, the study included an internal validation, performed by the PM core team, through focus groups. Therefore, for future research, it would be useful to test this PM approach in managing industrialisation projects with other case studies. The application of the approach to other environments would allow discussing mainly the mechanisms that can be used to mitigate resistance in the implementation of new PM practices, as well as indicating improvements to the proposed approach developed from a single case study. The future case studies could be also used to develop policies and procedures to govern social media adoption and use, since its maturity is low (Kanagarajoo et al., 2020).

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