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Implementation of project management and lean production practices in a SME Portuguese innovation company

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Abstract

Competitiveness in a world characterized by volatility, uncertainty, complexity and ambiguity, known by the acronym VUCA, is accelerating companies towards innovation. To ensure business continuity and control risk, companies must manage operations and projects with skilled teams and applying project management methodologies.
The research described in this paper was undertaken in a SME Portuguese company, specialized in offering research and development solutions for industry. The main goal of the research is to implement project management good practices and lean production methodologies to improve the global performance of the company. A structured and adaptive toolkit to prioritize, select, assign resources, plan, execute and monitor projects is also in development to help the company reaching its strategic goals.
The action-research methodology was used, with the researcher becoming part of the work environment, actively participating in the necessary tasks with other internal stakeholders, in a context of learning by doing. To implement the project management customized tools linked with the company strategic plan, the researcher used Business Process Management (BPM) and Lean principles. Some expected findings are the BPM customized solution implemented in the company as well as better organization and more efficient processes at the company, supported by Project Management methodologies.

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1. Introduction

Competitiveness is a key factor for an organization's success. Today, ensuring competitiveness is a highly demanding task as organizations are facing a brand new context commanded by globalization of economy, crisis phenomena, increased competition, service and process innovation and increased emphasis on time to market [1]. Companies are being forced to change their attitude and innovativeness is seen as the key factor that allows them to compete under these circumstances [2]. In the VUCA world, where change is the only constant, the efficient and effective resources management is becoming a major challenge. In order to effectively and efficiently manage its resources, companies need to manage and deliver projects on time, on budget, inside the scope and in accordance with the quality requirements agreed with the customer. For this, companies must have at least one strategy that can be classified in one of these three groups: differentiation, cost leadership and focus [3].

The main goal of this research work was to define an approach for the implementation of a tailored BPM based on Project Management (PM) practices and tools and Lean thinking principles on an innovation Portuguese Small and Medium Enterprise (SME). This technological company uses different engineering branches to generate solutions that support other companies' competitiveness and profitability, improving their methods and organizational processes. Nevertheless, their job-shop to build the prototypes and work organizational processes is lacking organization and has many wastes. The increased number of new projects demands a project management approach and the implementation of Lean production tools to improve production processes and performance, reduce process bottlenecks and reduce projects lead time.

This paper is structured in five sections: the first section introduces the objectives. The second section presents a brief literature review. The research methodology is presented in the third section. The fourth section contains a description of the company and the diagnosis and preliminary results of the implemented actions. Finally, the last section presents some conclusions and further work.

2. Literature Review

In order to organize this section, the author split the content in four subsections, each one related with one of the research areas: 1) PM Methodologies and Bodies of Knowledge; 2) BPM and KPIs; 3) Lean Production; 4) Change Management.

2.1. Project Management Methodologies and Bodies of Knowledge

Many industrial companies need to improve their project management practices. These companies have several types of projects: innovation projects, new product development projects (which include industrialization projects), expansion projects, etc. According to Perrotta et al. [4] industrialization projects are related to the design of a manufacturing line to produce a certain product, aiming at reducing production costs and increasing manufacturing efficiency/efficacy. The authors referred important benefits of PM in industry: linking project objectives to strategic goals, increasing the communication across the organization, using common resources in order to level usage.

Another important issue when we talk about PM is related to team roles. The Belbin Team-Role Self-Perception Inventory (BTRSPI) was used in order to assess the team effectiveness. This is a behavioral test, devised by Meredith Belbin, to assess how an individual behaves in a team environment [5].

In an innovative factory of equipment, the construction is done at the production area, also named Gemba, i.e., the actual place where the real added-value work is done [6], and building of new equipment is a challenge, because it is

necessary to do what has never been done before, in terms of time, budget, quality requirements, and scope. This is the definition of a project.

Despite the importance given to PM, there has been a greater difficulty in defining and measuring the true value of investment in PM [4]. The value will depend on its correct implementation [4]. The adaptation of PM practices and the maturity of PM processes will have a significant impact on performance in terms of time and cost [7]. PM methods can be regarded as guidelines that have been designed to assist project managers. According to Rai [8] the design science paradigm is mainly concerned with the question: how to design viable and useful guidelines? There is broad consensus that both construction and evaluation techniques are required for this purpose, namely: design thinking, predictive models and agile models.

Most projects fail because conventional PM concepts were not adapted to a dynamic business environment. According to Shenhar [9] the "Diamond Framework" should be used to understand the nature of the projects and diagnose the gaps between the current capabilities and what is needed to make the project a success. The same author defends that the "Diamond Framework" (also called the NTCP model [9]) uses four bases to analyze projects, so that every stakeholder can have a better understanding of what needs to be done: 1) Novelty (How intensely new are crucial aspects of the project?); 2) Technology (Where does the project exist on the scale from low-tech to super high-tech?); 3) Complexity (How complex is the product, the process and the project?); 4) Pace (How urgent is the work? Is timing normal, fast, time-critical or blitz?).

2.2. Business Process Management (BPM) and Key Performance Indicators (KPI's)

PM are constituted by processes, and a business process is, according to the Association of Business Process Management Professionals (ABPMP) [10], a set of activities that transform inputs into outputs (products or services) with value to the customer. Business processes, just like projects, are cross-functional and horizontal, because they cross the organization's functional barriers.

BPM involves any combination of modeling, automation, execution, control, measurement and optimization of business activity flows, in support of enterprise goals, spanning systems, employees, customers and partners within and beyond the enterprise boundaries [10]. The principles of BPM [11] indicate that a result is more efficient when the activities and resources are managed as a process, that is, when an organization relates its activities, allocates resources, determines the necessary inputs, and monitors processes, based on the intended results.

BPM continues to be a top business priority and building business process capability is still a major challenge for senior executives [12]. In fact, according to Sharp [4] "business process thinking is becoming mainstream thinking". Thus, according to ABPMP [10] there are four main targets in business processes: 1) a company exists to create value for customers in terms of products; 2) all organizational goals must be created to deliver value to the customer; 3) business processes are the vehicles by which products are created and delivered to the customer; 4) BPM establishes the means by which business processes are managed.

Performance measurements and KPIs provide decision makers with a snapshot of their business operations, showing how well the business is achieving its goals. The design of the dashboards with the aggregation of all KPIs [4] is expected to be approved by stakeholders, as advocated by Hester [13].

According to Siau et al. [12], modeling can be used by systems' developers to provide "as-built" schemes of the system. Alternatively, modeling can be more formally used to describe the systems in much more explicit and granular detail. The "As-Is" mapping allows an integrated and visually representation (workflows, swim lane diagrams, RACI matrix [14], Kanban [15], A3 Report [16], SIPOC [10], VSM [17], Fishbone Diagrams [18], ...) of PM industrialization processes inside the organization. A well performed "As-Is" mapping, not only makes the PM processes better known but also makes inconsistencies more evident, and that is the starting point to build one robust "To-Be" model.

2.3. Lean Production

In parallel with the establishment of business processes and project management practices the company also needs to develop production processes to transform the production factors (objects, media, work and information) into products. Lean Production has been one methodology that effectively manages these factors, based in the Toyota Production System (TPS) [19][20]. The sequence of implementation of Lean Production should follow the five lean

thinking principles: 1) Value; 2) Value Chain; 3) Flow; 4) Pull; 5) Perfection [20]. The cyclical realization of these principles enables continuous improvement and systematic waste reduction, i.e., of all activities that do not add value from the customer's point of view.

2.4. Change Management

The resistance to change is a constant in humans. According to Goleman [21], managers often fail to appreciate how profoundly the organizational climate can influence financial results. It can account for about a third of financial performance. Organizational climate, in turn, is influenced by leadership style—by the way that managers motivate direct reports, gather and use information, make decisions, manage change initiatives, and handle crisis [12].

Taking into consideration that not all PM problems can be solved through the use of a software, prescriptive research guidelines should mainly focus on procedural approaches (i.e. methods) and architectural blueprints (i.e. models and frameworks) of problem solutions [22].

A well-designed plan is required to develop a new organization's mindset. It is necessary to prepare the context (inside the organization) to process and project-based management in all its axes, including its cultural readiness to accommodate the change. Training, Workplace Innovation (WI) practices [23] and practical strategies must be employed to: develop the process, adoption of PM thinking, increase competitiveness, improve employees' job-satisfaction and well-being. A process and project-aware organizational culture can evolve through active leadership and continuous development plans, paving the way for successful and sustained process and PM.

3. Methodology

The selected research methodology was Action-Research (AR). According to Saunders [24], AR is a research methodology that involves the researcher in action research cycles embedded in the work environment in a learning by doing context – this was the main reason to apply AR methodology in the present research. This methodology is characterized by allying action and reflection, having technical and theoretical components.

A definition for AR, according to Susman et al. [25], presented in Rapoport's (1970: 499), is: "action-research aims to contribute both to people's practical concerns, in a given problematic situation, as well as the objectives of the social sciences through joint collaboration within a mutually acceptable ethical framework". The author points out that AR is geared towards creating a desired future, obtained by dealing with people's practical problems.

It is also mentioned that AR is collaborative due to the interdependence between the researcher and the system, since the research process management will be partly a function of the needs and competences of both [26].

According to Saunders [24] the action research spiral commences within a specific context and with a clear purpose. This is likely to be expressed as an objective [12]. Diagnosis, sometimes referred to as fact finding and analysis, is undertaken to enable action planning and a decision about the actions to be taken [24]. These are then taken and the actions evaluated (cycle 1). Subsequent cycles involve further diagnosis, taking into account previous evaluations, planning further actions, taking these actions and evaluating. The final theme suggests that action research should have implications beyond the immediate project; in other words, it must be clear that the results could inform other contexts. The researcher, in the present case, followed the phases of process mapping (AR: diagnosing), process re-engineering (AR: planning and taking action), testing and results evaluation (AR: evaluating).

4. Description, diagnosis and preliminary results of the implemented actions

This section contains the company and framework presentation, and the research steps already completed, namely the training of the project team, the description of the "As-Is" model and the design of the "To-Be" model.

4.1. Company and work framework presentation

The company ESI - *Engenharia, Soluções e Inovação*, is a ten-year spinoff of Minho University. The mission is to build customized and innovative solutions for their clients and growth year by year. They count with 2 patents, 35

employees and a 1.8M€ turnover in the last 3 years. The team is young (average age of 35 years old) and highly qualified (70.6% of the team has a master degree, the 29.4% concluded the secondary school).
After defining the context and purpose, the diagnosing phase of the AR was carried out. So, different types of manufacturing activities were identified as well as the existence of many manufacturing functions for different products. This allowed the identification of process improvement projects. Then, it was necessary a methodology to prioritize and select improvement projects and assign resources to the selected projects became necessary.

In this sense, based on the diagnosis phase and with stakeholders' collaboration, the following steps were defined and implemented: 1) Training the project team – the team that will be responsible for the implementation of the improvements; 2) Build the "As-Is" model: how process happens before the intervention. The "As-Is" model will lead to the description of the actual process map; 3) Build the "To-Be" model: how process map should look like in the future in order to accommodate the project management methodology to manage the projects and how the project management methodology will be customized to the organization; 4) Test the model in the pilot project: the new methodologies as well as the new process map will be tested in one pilot project and the results will be measured and compared with the KPI's established at the "To-Be" modulation stage; 5) Closing the gap: how to mitigate or even eliminate the problems that may arise with the changes in the organization.

4.2. Training the Project Team

The researcher, in order to leverage the competences of PM of the project team, designed a training course to introduce PM methodologies and to show practical examples of the application of the various tools in PM area. Potentializing team work was another objective of the training, having in consideration that, according to IPMA [27], team work is about bringing people together to achieve a common objective. The team and stakeholder's knowledge about PM was considered a key point for the success of the organizational change project.

The team was submitted to Belbin Team-Role Self-Perception Inventory (BTRSPI) [5] in order to access the team role self-perception. Based on these results and on the observation of the team role players, done during the activities elaborated at the training sessions, the researcher assigned the responsibilities to project team members.

4.3. Description of the "As-Is" model

During the second stage of the present research, the researcher continued using methods to gather relevant information about the company and the way they are performing work, namely: 1) semi-structured interviews with managers and employees; 2) participant observation for data collection and analysis; 3) structured observation for data collection and analysis; 4) document analysis. The data collection, done until today, lead to some preliminary conclusions: poor performance, inexistence of defined processes, inexistence of middle management lack of leadership at the team managers; the need of a directional management due to the lack of a creativity mindset; misused organigram; lack of an internal and external communication plan with the stakeholders; lack of reporting procedures; inexistence of formal documents to: initialize the project, to register and share lessons learned, to register the change requests, reception of deliverables by the client, tools to register the raw material reception. The historical data, like timesheets and materials spend in one project were not accurate and cannot serve as grounded base to study the main issues and the improvements that need to be implemented.

4.4. Designing the "To-Be" model

In order to design the "To-Be" model, a process for improvement projects in manufacturing environments, according to Aqland et al. [28], one needs to consider the operators' skills and the type of problem solving methodologies to be used. The same author argues that the working-place areas should be standardized before implementing the process improvement initiatives [28]. At the present research, these two factors have been considered. Thus, before starting the design of the "To-Be" model, the standardization of the working places and some crucial templates were elaborated and the operators' skills will be reinforced through brainstorming sessions.

One of the first results was the sense of urgency to design a new organizational chart, in order to accommodate the new staff/functions and to release resources from functional to project tasks. The Organization Chart was already changed and implemented during the intervention.

Based in the work that is done so far, this paper focuses on the first three phases: training the project team, collect the data to build the "As-Is" model and present some proposals of the tools to build the "To-Be" model.

Other result of the research was the need to make a first cleaning before starting a real 5S methodology [29] at Gemba. As showed in the Fig. 1 the first step is under execution.

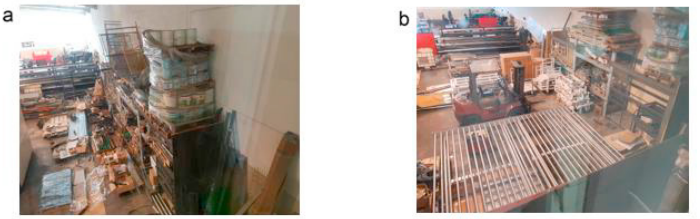

Fig. 1. (a) Gemba before the immersion stage; (b) Gemba after the first waste cleaning to prepare the 5S implementation

In order to create a framework to evaluate and select the innovation projects the company will design and implement, the authors decided to use, in the first two years, the "Diamond Framework" (also called the NTCP model). After that span time, the portfolio will need to be prioritized by other techniques and using other tools.

The identification of stakeholders is a key step for project success, thus we will use the tools and techniques recommended by the PMBOK Guide [30]. Templates already created are shown in Table 1.

Table 1. Templates Created

Reference	Project Phases	Document Name	Responsible	Consulted	Accountable	Informed
T_PM_#001_I	Initiation	Project Chart	Project Manager	Stakeholders	Sponsor	Stakeholders
T_PM_#002_I	Initiation	Project Team Chart	Project Manager	Managers/ Sponsor	Project Manager	Managers
T_PM_#003_I	Initiation	RACI Matrix	Project Team	Stakeholders, Managers, Sponsor	Project Manager	Managers, Sponsor
T_PM_#004_I	Initiation	Stakeholders Identification	Project Team	Stakeholders, Managers, Sponsor	Project Manager	Managers, Sponsor

It will be crucial, during the execution of the "To-Be" model, to consider the study of Keegan [31] that reveals that the project control systems serves to stifle innovation. The process improvement to move from "As-Is" to "To-Be" will follow the proposed sequence defined in the Tables 2 to 6:

Table 2. Step 1: Defining and exploring the process

#	Phases	Purpose/Goal	Tools to be used
1	Select the process(es)	Clarify the goal and the scope of the process	Process Sheet
2	Characterize the process	Define when it begins and ends; Identify inputs and outputs	Process Sheet
3	Quantify the big numbers	Knowing the capacity, the effectiveness (client perspective), and efficiency (resources perspective)	
4	Define goals to the improvement project	What is the problem and what do we want to guarantee with the improvement?	A3 Report
5	Explore the operation field	Explore the operations environment: get to know the actors environment	Gemba walk

Table 3. Step 2: Representing the current process "As Is"

#	Phases	Purpose/Goal	Tools to be used
6	Characterize the situation	List the main activities and actors involved; identify the big phases	Process analysis template
7	Resource Investigator (RI)	Who does what?	RACI Matrix
8	Specialist (SP)	What are the baselines? What is the technological support?	RACI Matrix
9	Quantify and confirm the current situation in the field	What is the processing time?	Gemba walk and Process analysis template

Table 4. Step 3: Identify Improvement Opportunities

#	Phases	Purpose/Goal	Tools to be used
10	Model flow	Represent information flows; Calculate current performance in terms of response time and value	VSM or swim lane
11	Identify opportunities	Identify problems; detect wastes; bottlenecks; interfaces	Brainstorming, fishbone diagram, 5W
12	Quantify improvement potential	How could we work?	VSM

Table 5. Step 4: Modeling the Future Model "To-be"

#	Phases	Purpose/Goal	Tools to be used
13	Improvement prioritization	Cost-benefit analysis of the improvement ideas	Impact/Difficulty matrix
14	Future process mapping	Identify problems; Detecting wastes, bottlenecks, interfaces	VSM; 5W, 4M, 7W
15	Action planning	What? How? Who? When? How Much? Where? Why?	Organization Chart, OPPM; Gantt, 5S, SMED, Standard Work, Kaizen, Visual Management

Table 6. Step 5: Implementing and Controlling

#	Phases	Purpose/Goal	Tools to be used
16	Plan execution and verification	From "As-Is" to "To-Be" model	Training; OPPM; A3 Report; Dashboard of KPI's

At the current stage of the research, the Step 1, 2 and 3 are almost finished and some of the tools of the Step 3 "To Be" model is already in place, like the new Organization Chart, the A3 Report, Project Team Chart, and the RACI Matrix.

5. Conclusions

The company under study, a SME Portuguese innovation company, faced several problems, namely: undetected process bottlenecks, production bottlenecks lack of adequate control, undocumented procedures, flawed or nonexistent monitoring, inefficient processes and total absence of a PM framework. Processes are a company's guidebook for getting the job done, while projects are one-off tasks that allow for innovation. Both are critical to the organizational competitiveness and sustainability.

This paper presented ongoing research work to establish BPM principles at the company in order to improve the production and PM practices applying PM concepts and lean thinking principles and tools.

Some actions done under the research were: the observation/analysis of the internal documents as well as the followed procedures, the training of the team, the diagnosis to characterize the reference situation, the preliminary characterization of the project team, the design of templates presented at Table 1, the design and implementation of the new organization chart, the selection of the pilot project and the collection of production indicator's in order to build the complete "As-Is" model.

In the next months more work will be done in order to complete all the steps defined, namely the implementation of the customized PM framework and the design and implementation, in one pilot project, of the tools developed for the company (presented from Table 2 to Table 6) as well as the "To-Be" model of the company BPM processes.

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