Improvement of project management processes and practices aided by lean tools in a metalworking company

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Abstract.

The research presented in this paper was developed in a Portuguese metallurgical company. The company has many projects ranging from the industrialization of products through the production of initial tool samples (called initial samples) to projects such as the development of prototypes. Prior to this research, the company had already made efforts to improve project management practices. The main objective of the research project was to improve the practices of project management, with the implementation of risk management tools, evaluation of software for project management and the use of Lean tools. In the end, there was an increase in the number of company projects delivered on time (from 22% to 70%), mainly due to the implementation of the Kanban board, which also increased the company integration and the awareness of projects current situation. The new software presented was negative evaluated as it had a high impact on the increase of project managers' tasks. Risk Management was shown as the point that demands more evolution within the aspects addressed by this research project.

Keywords: Project Management, Project Management Software, Risk Management, Lean, *Kanban.*

Introduction

According to the PMBOK 6th edition (PMI´s project management standard guide), a project is something unique, temporary (has a definite beginning and end), with limited resources and a defined scope. So, project management consists of how to better use the knowledge, skills, tools, and techniques to achieve the objectives defined

(PMI, 2017). Project management has relevance in many industry sectors and contexts (Svejvig and Andersen, 2015; Padalkar and Gopinath, 2016).

Risk management is an important part of project management so it should be well discussed. A risk is an event that may occur and impacts the project in a positive or in a negative way, and there is some knowledge about it. According to PMI, risk management can be done in two distinct ways, qualitative and quantitative (PMI, 2017).

Project management practices can also be improved using a Lean-based practice known as *Kanban*. Lean Production System has the main objective to remove all the unnecessary activities in production. Unnecessary activities are the ones that do not aggregate value to its final product and are called wastes (Womack, Jones and Roos, 1990). That philosophy of reducing cost and improving productivity, by eliminating wastes is the main guide of Lean Thinking. Authors presented this philosophy as "doing more with less" (Womack, Jones and Roos, 1990).

Wastes can be identified in all processes and practices done in companies. An example is waste in project management processes. Therefore, a company to thrive in a competitive environment, like the current one, must find ways to improve the management of new projects. The Project Department at this company is new, as it was created less than 5 years ago. Consequently, it presents some issues due to the lack of maturity in this area, such as poor risk management and low control over projects. This means that there were opportunities to improve project management and risk management practices. Therefore, the objective of this research was to improve project management processes and practices in a metalworking company, aided by lean tools.

This paper is structured in seven sections. The first section is a brief introduction regarding the background and objective. The second section is a literature review embracing all relevant topics used in the context of the research reported in this paper. The third section presents the research methodology. The fourth section describes the situation of the project management practices used at the company, followed by a critical analysis of that situation. The fifth section is related to the action planning and implementation proposals presented to the company to solve the problems identified. In the sixth section the results and discussion of the proposals implemented are presented. The seventh section presents the conclusions.

Literature Review

This literature review is focused on three mains topics: Project Management, Risk Management, and Lean Production because they fit the central theme of this research.

Project management

Project Management has come a long way, since the beginning of time. Some examples of project outcomes over the years in human history include the Pyramids of Giza, Taj Mahal, Panama Canal, human beings landing on the moon, among other examples. However, over the last 30 years, project management has been widely recognized as an efficient tool to handle novel or complex activities (PMI, 2017).

As the years went by, the number of project-based organizations increased, as a way for companies to respond to highly competitiveness on the global market, to deal with new challenges brought by globalization projects, and to treat and resolve problems and tasks from any kind and dimension (Alhawari *et al.*, 2012).

The International Project Management Association (IPMA) defined project as a unique, temporary, multi-disciplinary and organized endeavor to realize agreed deliverables within predefined requirements and constrains (IPMA, 2015).

The success of Project Management (PM) is associated with the outcome of the project. But that assumption may not be as precise as it seems. It is been proven over the years that even projects that were poorly managed were successful such as the Fulmar North Sea oil project, which turned out to be relatively successful. Although a successful project tends to have good PM (Munns and Bjeirmi, 1996).

PMBOK has a focus on processes, although it is perceptible the increase on the importance of competences regarding PM. According to IPMA, projects, programs and portfolios begin and end with people, therefore the impact that people has in a project should have a greater importance and be better analyzed to improve the success of project, program or portfolio management (IPMA, 2015).

PMBOK defines that a project has 10 relevant project management knowledge areas: integration, scope, schedule, cost, quality, resource, communications, risk, procurement, stakeholder (PMI, 2017).

Risk management

Risk management includes the activities to ensure the identification, classification, response and monitoring the project's risks (PMI, 2017).

Companies are susceptible to face internal or external factors that make it uncertain whether and when they will achieve their objectives. The effect this uncertainty has on an organization's objective is what is called "risk" (ISO, 2018).

Since its first edition on 1996 the PMBOK focus on Risk Management, and on its last edition PMI presents a definition that meets the definition presented on the ISO 31000. As important as identify risks is to manage them and to do that PMI has a general guide to help identify the steps needed to execute a complete and successful RM. A company must have a risk management plan, a risk identification process, a risk analysis, a response planning and implementation and it should always monitor the risks on a project. The main goal of these steps is to increase the odds of positive risks, also called opportunities, and reduce the odds of negative risks to happen (IPMA, 2015; PMI, 2017).

It's possible to say that a project has risks in its roots and because of that project risk management must be something that accompanies the project from its definition through all the project phases, initiating, planning, executing, monitoring and closing (PMI, 2017).

Lean production

An innovative idea arises due to necessity, that is, it emerges because of a set of specific conditions where the traditional ideas were not enough. And that context exemplifies how Lean Production ascended in one country, Japan (Alves *et al.*, 2014).

In the middle of the 20th century Eiji Toyoda, a Young Japanese Engineer, went to America to understand how Ford River Rouge was able to produce more cars per day than Toyota produced in thirteen years of effort. After going back to Japan, Eiji had the idea reduce waste during production instead of producing more in less time, a different approach from the one at Ford. For that, a multidisciplinary team were created, and the goal was to solve problems as fast as possible in the best conceivable way. And for that some tools were developed to facilitate the implementation of this new way of thinking.

Lean Production continued to evolve and became more than a way of producing. It has a much broader definition, which is to apply Lean in every possible situation and is called Lean Thinking. Womack and Jones crystalized value as the first principle of Lean Thinking so, from that point on, Lean Thinking was much more than just waste and cost reduction (Bicheno and Holweg, 2016). According to Womack there are five key Lean Thinking principles those being: identify value; map the value stream; create flow; establish pull production; and seek perfection (Womack and Jones, 1996).

One relevant Lean Tool for this paper is the *Kanban.* Traditional manufacturing company's strategy are driven by "push system", having inventories of products according to clients forecast. *Kanban* is the tool to implement the pull production (fourth Lean thinking principle). Kanban means visual to provide information to regulate the flow of inventory and materials. It has three rules: visualize the workflow; limit the number of Work In Progress parts at each workflow state and, the last one, measure the lead time (Lin, Chen and Chen, 2013).

Research Methodology

Action research methodology was used in this research project. This methodology was developed by Kurt Lewin. It´s important to enlighten what this methodology is about, and it means "learn by doing". In other words, it means you will be learning by implementing proposals (Saunders, Lewis and Thornhill, 2009). In the last two decades, there has been a growing use of action research. When the main objective is to explore a theory regarding practice, action research is the most obvious choice because it emphasizes knowledge produced in the context of the application (Eden and Ackermann, 2018).

This methodology can be divided into five steps: Diagnosis, action planning, action taking, evaluating, and specify the learning (Tüzün *et al.*, 2018).

Current Situation and Diagnosis of the Project Management Practices of the Company

The company under study, founded in 1940, was first focused on the repair of hunting weapons and defense. Later on, its founder changed the company core business. ETMA started to focus on gutter and curtain accessories. Over time ETMA reinvented itself once again by entering the metalworking market, more specifically turning, stamping, tools production and galvanic treatments. One of the most important decisions for ETMA's present success was to produce special screws, being the only company in Portugal at that time to do so. The company evolution never stopped and today the company has a total of 10 integrated processes to better serve its customers in the widest possible way. Its customers are mostly from the automotive, electrical, home appliance, fixation, and plastic injection industries. This means many new projects that require standardized project management processes and practices to be efficient. However, this is missing.

The focus of the research was to show that the company needed to improve its PM processes and propose the improvements. Examples of poor performance in PM were low delivery rates and poor risk management.

The low delivery rates have been a problem. In September 2018, project management at ETMA was done by two project managers, with weekly meetings between them, to keep track on how the projects were, regarding its development. Key stakeholders were left out of those meetings, which impacted delivery rates, since it reduced the company’s integration between sectors.

Between August 2016 and August 2017, a study by a third-party consultant company was conducted at ETMA. It concluded that the company had low rates of compliance. Only 22% of the projects were delivered on the date settled at the baseline, and an even lower percentage was reported, when compared to the project charter (around 20%). However, the same study also concluded that the company has the capacity to absorb 2.44 new projects per week, and it was receiving 2.5 new projects per week. That is, the company is theoretically capable of fulfilling the delivery rates presented at the project charter.

At ETMA, risk can be seen in two different ways. The first, called technical risk, concerns process risks, in other words, how the process can affect the project outcome. The second is about risks that can affect the project management process and are called organizational risks. The first type of risk and its management were well stablished; however, the second type is where the company had the biggest gap and needed to improve.

Beyond the issues presented above, a total of five main problems were identified, those being: the number of projects delivered past its due date; the lack of commitment to the previous schedule; the excessive number of tasks that a project manager has, regarding the project management software; the difference between the actual tool cost and the selling price; and the lack of treatment of organizational risks causing projects do deviate from their initial due date or scope.

Those identified problems were directly related with the three main goals: 1) implementation of a new software; 2) development of a risk management plan; 3) implementation of a *Kanban* board.

Action Planning and Implementation

New project management software evaluation

The first step was to develop an implementation plan, and for that the whole project life cycle was studied to find a better solution for the templates, i.e. to achieve a more practical template for both projects types, prototypes and initial sample.

One of the works done was the evaluation of the applicability and efficiency of a new project management software that would fit the way of working of the company and could help in the use of project management techniques. The software selected to be tested was the UEBE.Q. The main reason for this option was that this software was already installed in other sector of the company and it would facilitate the integration among sectors.

The expected improvements for the project management module were:

1. Keep track of changes on the tasks such as due date, responsible and documentation;
2. Reduce the amount of time a project manager dedicates to managing tasks on a project management software;
3. Increase company integration;
4. Be user friendly.

So, based on these factors, the templates developed were as close as possible from the way ETMA uses to manage its projects. The template was divided in two categories. The prototypes template, with less phases, and the initial sample template, with more phases. This difference is due to the need to create and validate a production tool, in initial sample projects, since prototypes do not require a production tool, just a simpler one to do the folding manually.

The total number of tasks for a prototype project goes around 57 tasks. On the other hand, for an initial sample project, the total number of tasks is around 70.

Risk management

The first step related to risk management was to identify the risks. For that, a risk register was developed so it could be filled during the project life. The aim was to gather as many risks as possible at the beginning of the project, more precisely at the kickoff meeting. Doing that would be a gain in time to develop contingencies for the risks, and at the end of the project that information would be stored for future similar projects.

Alongside this risk register, another proposal was presented to analyze the risk using a bow-tie diagram, even though its use was first developed to deal with the risk of an accident (Markowski, Mannan and Bigoszewska, 2009).

The last proposal was to elaborate the company's Risk Breakdown Structure (RBS). At first, the proposal was to elaborate the RBS with groups similar to those proposed in PMBOK, so the risks would be distributed among four different groups: technical; management; commercial; and external. However, this type of classification did not represent the way risks are distributed at, so to develop a better and more useful RBS, ETMA's project risks were first categorized as internal or external. An internal risk was latter classified according the project phase it was associated to. External risks were separated in two different categories: Monitoring, that was also a phase on the project life cycle at ETMA, however the project was already delivered but not approved by the client yet, so it was classified as an external risk, and Industry, that were the risks regarding the industry sector, such as market oscillation, competitors and others risks related to the metalworking sector. However, the company was not ready yet to implement a complex tool to treat its organizational risks, so it demands to take a step back for the moment. A simpler way to manage the risks for the present would be enough. So, it was decided to move on to a second cycle of the action-research. A simpler template was the final proposal. Risk analysis would be done by a checklist of risks, with the most common ones of past projects, replacing the risk register. This action planning table would also replace the bow-tie diagram, however those changes were not yet implemented.

Kanban board

The goals of the Kanban board were:

1. Identify project bottlenecks;
2. Help visualize the project phase;
3. Help visualize material flow in a manufacturing project;
4. Increase the number of projects delivered on time.

After defining the goals, it was necessary to develop the board structure. It was agreed from the beginning that the board should have the same number of phases of a project, so it will be easier to identify and relate the Kanban board with the project at SharePoint. The six phases of a project were represented on the board, those being: initial sample study; initial sample preparation; development of means; initial sample execution; validation and reports; and the last column is monitoring.

Kanban cards were also developed, and they must have synergy with the board, so the link between the cards and the columns were defined as the most important task for each phase. So, the criteria established to move a card to the next column is if all activities of the current phase have been done. However, this definition was only possible after a couple of iterations on the *kanban* board. There were four iteration cycles until the final card model has been defined.

Results Evaluation and Discussion

Project management software

It was proposed the implementation of UEBE.Q software to track changes in the tasks, such as due date, responsible and documentation. The benefit of the UEBE.Q software regarding this subject is undeniable, since every single change on a task is followed with an explanation about the reason for that change, and it is also kept a record of the number of changes on that task.

Additionally, the software was intended to reduce the amount of time a project manager dedicates to managing tasks on a project management software. The results regarding this subject were not near the objective, impacting the final evaluation of the software, since the number of activities for one single initial sample project would be never shorter than 70. And at the current project management software this number is not higher than 20.

Since the company is using the software in different sectors, company integration, would be a positive point. However, the project module did not move forward.

The software does not have a friendly interface, what would increase the amount of time spent for users to learn on how to work with the new software, and it would not bring as much benefits to the company as expected.

Risk Management

ETMA did not have a database regarding its organizational risks, and that made the implementation of a more complex risk management approach difficult. The first cycle of the action research did not present satisfactory results, leading to the development of a new risk management approach, and start a new development cycle.
This caused the risk management proposals not to reach the desired results. Nevertheless, by obtaining greater knowledge about the risks of each project the company could be prepared to unexpected organizational situations that may affect the project.

Project management Kanban board

The implementation of a Kanban board tool allowed the identification of project bottlenecks, helping the increase the project's compliance. A visual management, given by the Kanban, to identify where, during the project life cycle, the projects tended to accumulate, was proposed. And as soon as the first trial was done, it was clear enough where actions where necessary. The results for the bottleneck identification were clearly identified, as can be seen in Fig.1.

Fig. 1. *Kanban* board bottleneck identification (In Portuguese)

Since the Kanban board and the card were designed according to how a project is executed at ETMA, the checklist status on the cards, together with the Obeya meeting, improved knowledge regarding the project status and how much of the project has yet to be completed to guarantee the delivery of the project.
The way the board was developed did not improve material flow analysis, since all material flow happens in a single column (initial sample execution). So, regarding this objective, the board gave no insight or improvement.
Also, the Kanban tool helped to increase the number of projects delivered on time. Fig. 2 presents the evolution of projects compliance, going from 23% on the last quarter of 2018 to 70% on the second quarter of 2019.

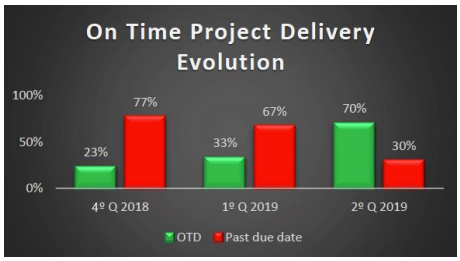

Fig. 2. – On time project delivery evolution

Conclusions

This paper presents the results of a project undertaken in a metal company, for improving project management processes and practices aided by Lean tools. The Kanban was the solution that represented most gains for the company. It can be said that both implemented boards, the Project Management Kanban Board increased company integration, since each week the boards were updated, and each team member would be able to present project problems or solutions. Also, the project management Kanban allowed the company to identify company projects bottlenecks as shown in Fig.1.

Another gain was the increase in projects delivered on time from the end of 2018 until the middle of 2019, showing a bright future for the boards and its functionality.

The project management sector is a new sector inside the company, so it can be said that despite having an already well-established structure, the sector can improve a lot, and the company is aware of that. Therefore, the actions proposed during this research had a positive impact at the company project management sector. Nevertheless, for future improvements, define standards for key activities, and implement the daily *kaizen* at the project management sector, integrated with the *Kanban* board, will allow the sector to be in constant evolution.

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