Improving the resource management process in industrialization projects

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Abstract. In today's rapidly evolving business landscape, effective project management is vital for achieving business goals and maintaining competitiveness. Organizations are increasingly adopting project management methodologies and investing in the necessary skills and tools. This study aims to enhance resource management in industrialization projects by optimizing resource allocation and utilization while minimizing costs. Strategies developed in this study seek to ensure project objectives are met more efficiently, thereby enhancing overall project profitability. A significant issue identified was the lack of a comprehensive tool to provide an overview of product-related activities. To address this, two proposals were implemented: an activity calendar and a dashboard highlighting key information. These tools brought substantial benefits to the company under study, including reduced task time and complexity, resulting in annual savings of over €12,600. By addressing these gaps, the project achieved significant improvements in cost management, resource allocation, and task visibility, positioning the company for long-term success in a competitive market.

Keywords: Project Management, Resource Management, Cost Management, Business Analytics.

1 Introduction

In recent years, businesses have experienced significant transformations due to economic cycles, technological advancements, and new business models. To thrive in this dynamic environment, companies recognize the importance of project planning, adaptability, and effective project management (PM) strategies [1]. The dissemination of knowledge within the PM field has also become increasingly important [2].

PM involves applying knowledge, skills, tools, and techniques to efficiently and effectively plan, manage, and control projects. It aims to ensure projects are consistently completed within the planned time and budget, coordinating teams to achieve project objectives [3]. This requires identifying requirements and objectives,

studying stakeholder needs and concerns, maintaining active communication, and managing project constraints such as scope, quality, time, cost, resources, and risks [4].

Two prominent PM approaches are predictive and agile. Predictive PM uses data analysis techniques to predict project progress and performance, dividing the project into sequential stages with specific deliverables managed according to an established plan [5]. This approach enables informed decision-making, preventive measures, and accurate tracking of project progress [6].

Agile PM methods focus on delivering value quickly, promoting teamwork, and flexibility for changes. Projects are divided into small stages called "sprints", with teams collaborating to deliver increments of value at each sprint [7]. Agile methodologies prioritize people and interactions, software over documentation, customer negotiation, and responsiveness to changes. Examples include SCRUM, Lean, and Kanban, all aiming to deliver value to the customer efficiently [8].

While predictive PM suits projects with well-defined requirements and few changes, agile methods excel in projects with uncertain requirements and a need for adaptation. Combining methodologies can be beneficial, using predictive PM for progress prediction and problem identification, and agile methods for quick value delivery and flexibility [1].

To implement effective PM practices, companies must use appropriate methodologies and tools. Cost leadership, focusing on achieving lower costs, is a strategy for companies to succeed in competitive markets [9]. Incorporating cost reduction into the company's culture and operations requires time, organization, and sometimes investments. Challenges may arise due to conflicts and resistance, delaying progress [10]. Involving top management can facilitate the process by gaining their agreement and conviction regarding the benefits of proposed changes. The success of cost reduction practices depends on the company's cost management culture, top-level management commitment, and collaboration of all employees.

So, this study, carried out as part of a master's thesis, is concerned with improving the cost and resource management process in industrialization projects which is a topic that focuses on finding better ways to manage the costs and resources required to complete industrial projects. This includes developing strategies and methods to optimize the use of resources and reduce costs, while ensuring that project objectives are met. The aim is to increase the efficiency of the industrialization process and ultimately improve the profitability of the project.

The article is structured into five main sections, namely introduction, literature review, case study, analysis and discussion, and conclusions.

2 Literature Review

2.1 Action Research Methodology

The research methodology that will be used for the development of this project will be Action Research, which is a strategy more focused on solving organizational problems, such as changes within an organization that involve not only the researcher but also the workers of the organization in question. Action Research is a social research

approach that involves empirical evidence and is closely linked to resolving collective problems or taking action. This methodology requires the participation of both researchers and representative participants of the situation or problem in a cooperative or participatory manner [11].

2.2 Project Management

The area of project management takes a key role in the development of this study. It is an area that has been growing exponentially in the last thirty years, due to the large number of projects and their complexity. In this sense, project management, in simple terms, is the study of the best way to manage projects with specific activities, in order to obtain certain previously defined results, within a certain timeframe and with a certain cost and quality.

To understand what project management is, it is relevant to highlight PMBOK that holds significance in this area by setting standards, establishing a shared language, offering extensive guidance, gaining industry respect, encapsulating best practices, and fostering professional growth. So, taking into account the PMBOK Guide 6th edition, project management is the application of knowledge, skills, tools and techniques to project activities to meet project requirements. Before the starting of the project, there is the conception phase that is the beginning of the project and consists of the preliminary evaluation of an idea, defining the expected outcome of the project, managing ideas for action and possible alternatives, and defining the way forward to bring the project to fruition. In that way, for a better application of PM practices, a division of the project life cycle by phases was created. This cycle is a series of phases that a project goes through from its beginning to its conclusion [12]. The general phases of a project's life cycle are the following [13]:

- Starting the project: develop project charter and identify stakeholders.
- Organizing and preparing: improve the details and develop the project management plan, defining deadlines, costs and quality.
- Carrying out the work: project execution and control, with comparison of what was previously planned and the status.
- Ending the project: lessons learned and finalize the project.

2.3 Cost Management

Cost management is a crucial aspect of project management that involves planning and monitoring expenses to ensure projects stay within budget constraints. Integrating cost management into project management practices offers several advantages, such as accurate cost estimation, efficient resource allocation, and proactive risk management. It also enhances project transparency, accountability, and decision-making [14].

During project planning, executives approve project costs and collaborate with stakeholders to develop a comprehensive budget. Throughout execution, cost management techniques are used to monitor and control expenses, comparing actual costs with planned costs and addressing budget deviations. Effective cost management fosters project transparency, trust, and communication, providing stakeholders with

clear financial visibility. It also plays a crucial role in risk management by identifying and addressing potential cost risks, minimizing uncertainties, and maintaining project profitability through analysis and contingency planning.

2.4 Business Intelligence

Business Intelligence (BI) systems originated in 1958 with definition of BI as capturing relationships between facts to guide strategies [15]. Evolving from Decision Support Systems (DSS), BI systems leverage advancements in computing to enhance decision-making [16]. BI encompasses processes, technologies, and tools transforming data into knowledge for business activities [17], enabling real-time decision-making by reducing data processing time.

The Microsoft Power Platform is a suite of low-code tools facilitating rapid development of customized business applications, data visualizations, and process automation solutions. Its user-friendly interface and pre-built connectors allow for robust solutions without extensive coding. Comprising Power BI, Power Apps, and Power Automate, it offers versatility and collaboration for end-to-end solutions. With its integration capabilities and popularity, organizations are increasingly adopting Power Platform to streamline processes, boost productivity, and drive innovation.

3 Case Study

In this case study, the resource management process at a first-tier supplier of the automotive industry was analyzed. To better understand the whole process, this section describes how the procedures that characterize this process have been performed.

For reasons of confidentiality, commercial advantage and industrial property rights, all information relating to cost and resource management that will be presented has been changed or altered. However, the conclusions reached represent the integrity of the facts and have therefore not been modified.

3.1 Resource Management: needs and opportunities

Regarding the management of the company's resources, there was no tool to visualize all the activities. This gap had an impact not only on the company's human resources management, but also on the capacities of the production lines. Moreover, there are numerous activities that exist from the product level, considering that there are more than 15 different customers. In addition, all communication processes for the respective activities are archaic, with email being used for most notices. Some of the activities mentioned are, for example, related to:

1. **Samples** that have to be produced already with the requirements requested by customers in terms of hardware and software;
2. **Manufacturing process** used to evaluate a production line's capacity to meet desired targets at maximum capacity, identifying bottlenecks and ensuring quality standards. Required by customers for production line approval, the

process involves the project manager (PMg) informing the customer about the new production line and scheduling the "run at rate". After agreeing on a date, the PMg communicates the activity details, including dates, quantities, and duration, to the entire project team;

3. **Visits** for quality assurance, technical consultation, technology updates, relationship building, and issue resolution. Visits are arranged by the PMg and communicated via email.

The product studied identified over 100 activities for more than 15 customers, managed through outdated communication processes, primarily email. Activity statuses are tracked manually by the PMg. For instance, the PMg must send an email to confirm the production of the samples. The study concludes that there is a need to optimize these mechanisms and develop a new tool to provide an overview of all activities per client and production line, enhancing planning and preventing project team and production line bottlenecks.

The problems identified during the study of the resource management process are summarized in Table 1.

Table 1. Problems Identified in Resource Management.

Problem	Description	Possible Solution
There is no overview of all activities	Lack of an overview of the dates of each activity to allow better planning of future activities	Creating a tool/calendar
Archaic activity communication processes	Project teams know about activities by email or at a meeting	Creation of a standardized process to better record all project-related activities
No overview of all activities already done	It is not possible to have a quantitative analysis of all the activities that have already taken place	Creating a dashboard in Power BI

As can be seen in Table 1, with regard to resource management, the problem related to the lack of an overview of the activities is particularly noteworthy. Although other problems have been addressed, the creation of a calendar tool was the main milestone in this field, making it possible to streamline all the PM tasks on a daily basis.

3.2 Shared Calendar

After analyzing the company's situation at the beginning of the project, a significant gap was identified in the overview of project activities. To address this, the team brainstormed and decided to create a software tool to enhance the performance of the PM team and the entire project team. Using Microsoft Power Apps, a calendar tool was developed providing a monthly overview of all activities. The application was programmed with Microsoft Power Fx, a user-friendly coding language similar to Excel formulas, designed for simplicity and ease of use in creating business applications

within the Power Platform. The decision to create an application from scratch rather than use an existing one was mainly due to the fact that it would be possible to customize and prepare the application according to the company's day-to-day activities. The existing applications on the market, despite providing some customization, are still very limited and are not, and cannot be for security reasons, integrated with the company's internal databases, such as OneDrive and so on.

So, the calendar has two possible views, the "Calendar View" and the "List View". Fig. 1 shows the interface of the "Calendar View", which is, to some extent, the main view and the purpose for which this tool was made.

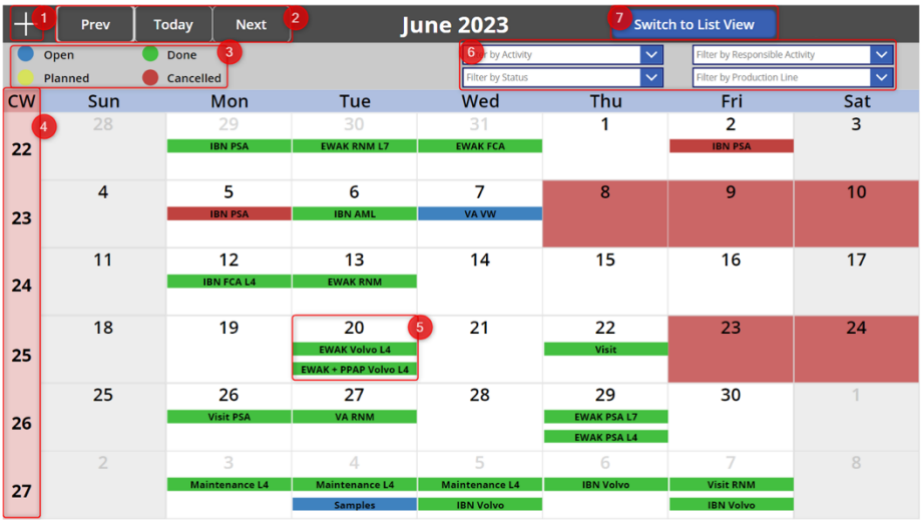


Fig. 1. Calendar view interface.

The parts numbered in Fig. 1 are explained below.

1. The purpose of this button is to open a form, which will later be created and analyzed to allow adding all the information about an activity that will be included in the calendar.
2. The three buttons shown are designed to navigate through the different months in the calendar, with the "Prev" and "Next" buttons decreasing and increasing by one monthly unit respectively. The "Today" button allows to go to the current month.
3. The guide shown serves as a reference for the statuses of the activities. Thus, an activity is automatically colored according to its status.
4. The "CW" column indicates the number of each week, a very important reference in the field of PM.
5. Depending on the day each activity begins and ends, they are arranged in small rectangles on the respective days, with the title corresponding to the combination of Activity + Customer + Production Line.

6. The filter area is used to make visible only those activities that fulfil the requirements of the filters applied. Thus, in this section it is possible to filter by the type of activity, the status of the activities, the person responsible for the activity and/or the production line on which the activity takes place.
7. The functionality of this button is to switch to the other available view of the application, the "List View", which will be explained and analyzed later.

It is also important to emphasize other features that have been programmed in advance. It is important to note that all public holidays are automatically filled in red. In addition, the current day is always colored yellow to serve as a reference. Finally, when entering an activity, the start and end date of the activity is required. If this time interval includes public holidays or weekends, the activity will not be visible. In short, activities are only visible on days when the company is actually open.

Fig. 2 shows the form for entering an activity in the calendar.

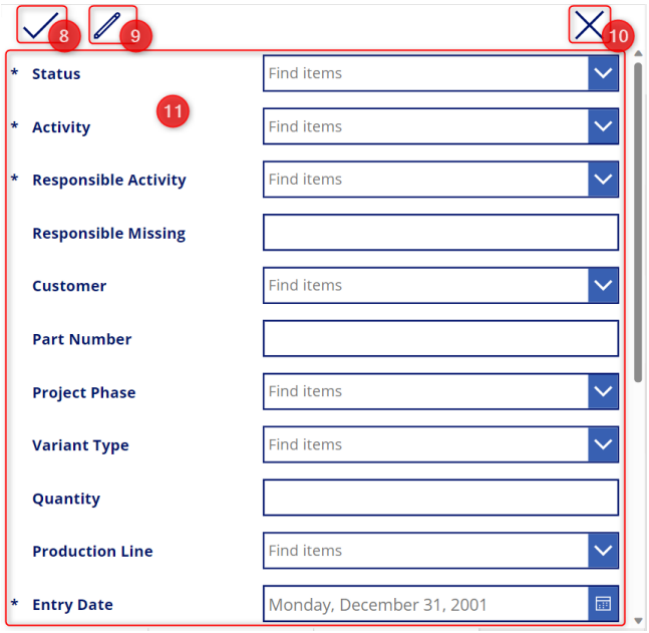


Fig. 2. Activity form 1.

The parts numbered in Fig. 2 are explained below.

8. This button is for final submission of the completed form.
9. This function allows to edit the form.
10. The purpose of this button is to cancel the form submission.
11. This section contains the information needed to fill in the form.

Having analyzed the "Calendar View", it is now important to analyze the "List View". This format displays the information in list form and does not provide an overview of all the activities. However, has the advantage of making it easier to manage activities that are contained in different months, since there is no need to navigate between months to find the activity. Fig. 3 shows the design of this type of view.

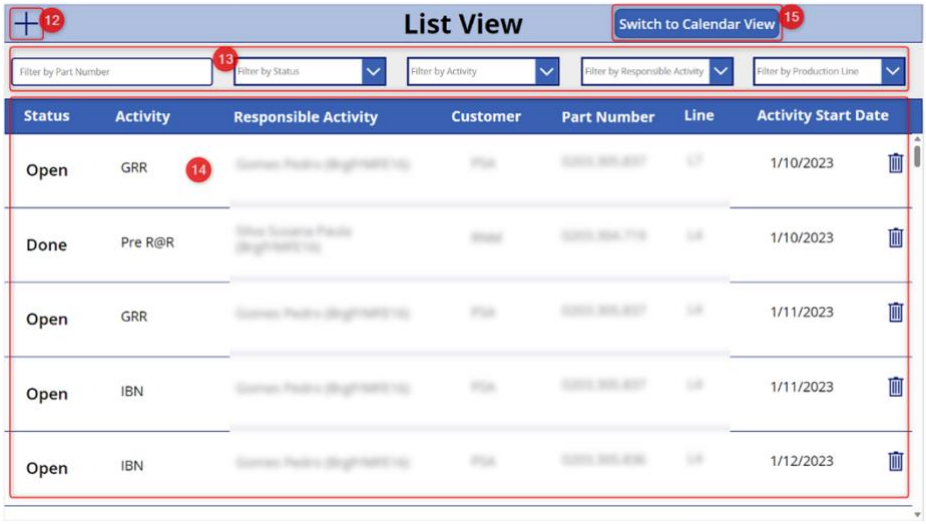


Fig. 3. List view.

The parts numbered in Fig. 3 are explained below.

12. This button has the same functionality as the one explained in point 1.
13. The filter area is similar to the “Calendar View”. However, it also allows to search for information by the Part Number (PN) it is associated with.
14. The structure is presented in list format, with a few key pieces of information being emphasized. However, in this section there is a button to delete an activity that was previously added. After clicking the button, a confirmation is required.
15. The functionality of this button is to switch to the other available view of the application, the "Calendar View".

The application developed in this action research project and presented here has been adopted by the company and is currently used as the official tool for managing project resources. It is an application that is characterized by being very easy to use, practical and, above all, it has filled an important gap that was found when the company's previous situation was analyzed. The application was quickly shared and used by around 120 employees. However, only the PMg has the ability to edit the content. In addition, it is important to note that the entire team meets weekly and, at the beginning of this meeting, this application is presented and an overview of the following weeks is given to understand what activities have been done and what remains to be done.

3.3 Dashboard

Once the calendar had been applied, it was thought that it would be useful to develop a dashboard in Power BI that would make it possible to quickly and effectively analyze all the information provided - see Fig. 4, 5, 6 and 7. The figures are followed by an explanation of the main components and information provided by the dashboard.

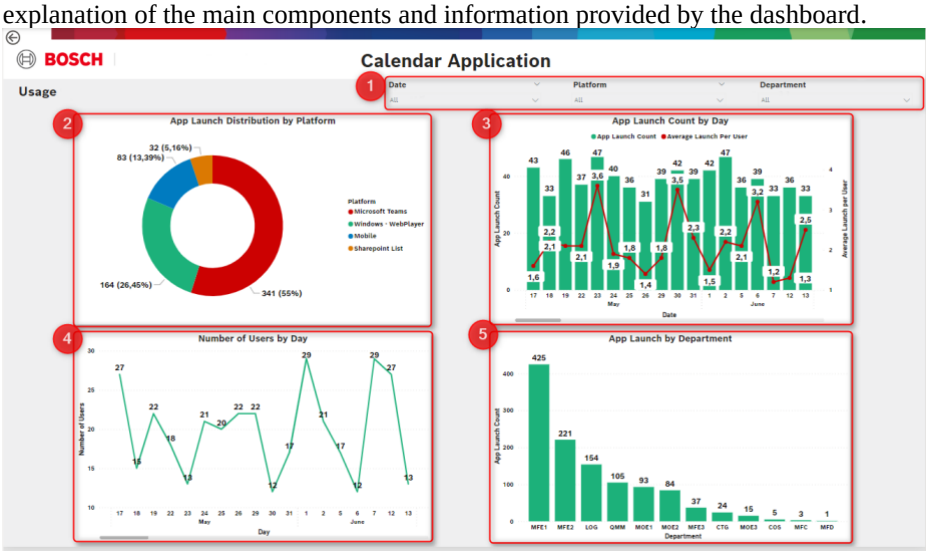


Fig. 4. Dashboard – Usage View.

Usage:

1. Filter Area: the purpose of the filter section is to enable different types of analyses, such as understanding the time spent on each activity, the contribution each client makes to the company's activities, among others.
2. App Launch Distribution by Platform: its purpose is to count the number of uses of the application per available platform.
3. App Launch Count by Day: the vertical bars show the number of times the application has been opened per day, while the red line shows the number of times each user has opened the application on a given day.
4. Number of Users by Day: counts the number of different users who have used the application per day.
5. App Launch by Department: total number of calendar uses per department.

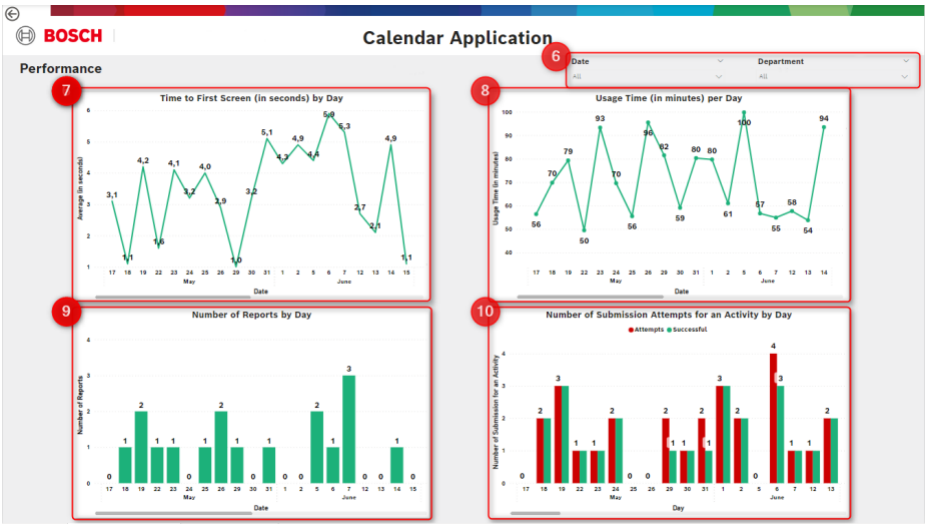


Fig. 5. Dashboard – Performance View.

Performance:

6. Filter Area: the purpose of the filter section is to enable different types of analyses.
7. Time to First Screen (in seconds) by Day: time it takes to open the application, on average, per day.
8. Usage Time (in minutes) per Day: total time the application has been in use per day.
9. Number of Reports by Day: number of complaints reported in total per day.
10. Number of Submission Attempts for an Activity by Day: the vertical bars refer to the number of activity form submissions per day; the red columns refer to the number of attempts, while the green columns show how many of those attempts were successful.

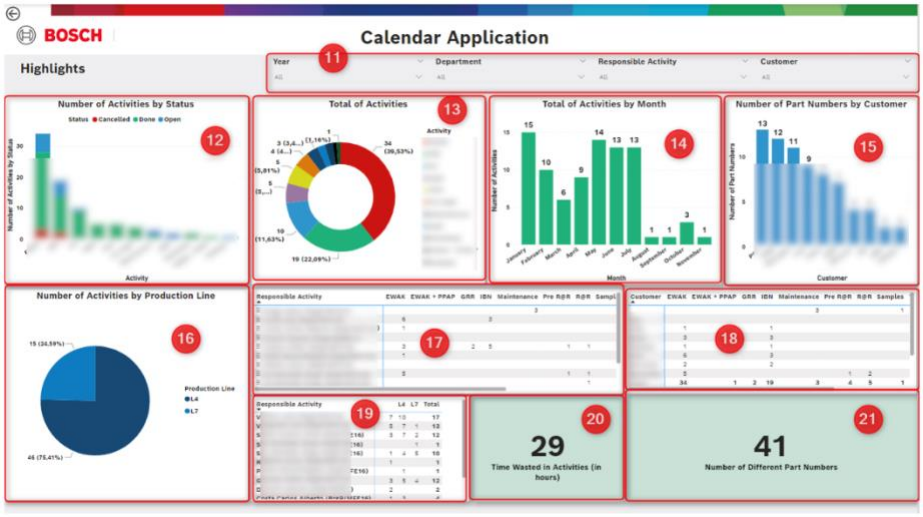


Fig. 6. Dashboard – Highlights View.

Highlights:

11. Filter Area: the purpose of the filter section is to enable different types of analyses.
12. Number of Activities by Status: allows to see the number of activities by status.
13. Total of Activities: total number of activities.
14. Total of Activities by Month: allows to see the total distribution of activities per month.
15. Number of PNs by Customer: Allows to see how many different PNs are involved in activities per client.
16. Number of Activities by Production Line: it allows you to see the number of activities distributed across the corresponding production line.
17. Number of Activities per Person: distribution of the number of occurrences of each activity by person responsible.
18. Number of Activities per Client: distribution of the number of occurrences of each activity by client.
19. Number of Activities per Person and per Production Line: distribution of the number of activities per production line per person responsible.
20. Time Wasted: total number of hours spent on activities.
21. Number of PNs: total number of different PNs involved in activities.

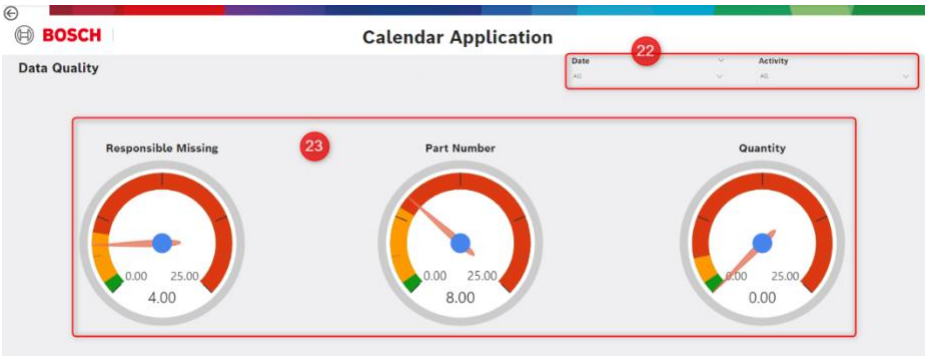


Fig. 7. Dashboard – Data Quality View

Data Quality:

22. Filter Area: enables different analyses.
23. Dial Gauges: the purpose of this section is to guarantee the quality of the data. To this end, each graph shows the absolute number of fields that were not filled in correctly on an activity's submission form. However, only three sections of the form are counted because they are the free text parts and require specific formatting.

4 Analysis and Discussion

The comprehensive literature review conducted in this study has provided an in-depth understanding of key concepts related to PM. Initially, the examination focused on aspects concerning PMg, who play a central role in coordinating and monitoring projects. A clear comprehension of the responsibilities and tasks carried out by these professionals is essential in identifying opportunities for improvement in the processes of cost and resource management.

Drawing upon the concepts discussed in the literature review and the presented tools, proposals enhance the processes of resource management regarding industrialization projects. One proposal entailed enhancing the resource management template, making it more user-friendly and automating analysis using Power BI. This action will provide PMg with clear and up-to-date information on costs, facilitating data-driven decision-making.

The other proposal involved the creation of a software tool using Microsoft Power Apps. This tool offers an encompassing overview of all activities related to industrialization projects, enabling progress tracking, task assignment, and real-time updates. By employing Power Apps, managers will be equipped with a comprehensive view of ongoing activities, allowing them to identify bottlenecks and take proactive corrective measures. The development of this application is greatly facilitated by prior knowledge and training in Microsoft Power Apps, in this case, following Low-Code

Development Platform (LCDP) principles. This knowledge minimized the need for extensive coding expertise and allowed to leverage the visual development methods offered by the platform. It also enabled us to seamlessly integrate data from various sources, including OneDrive, Dynamics 365, and other compatible databases, making the application more versatile and data-accessible for effective project management. The main advantage of this application is that it can be integrated with the company's database systems, which is not the case with applications for reasons of data security and confidentiality.

The implementation of the proposals presented in the previous sections is expected to yield substantial benefits for the company. Leveraging Power BI, the company will be able to conduct more accurate and detailed analyses of costs and resources in its industrialization projects. This will provide a better understanding of cost drivers, identify areas of inefficiency or waste, and make informed decisions to optimize resource allocation.

Additionally, the utilization of Power Apps will streamline activity management processes by providing a centralized platform for tracking progress, assigning tasks, and ensuring timely updates. The use of this tool enhances transparency, facilitates effective communication among team members, and enables proactive intervention in case of any project delays or issues.

By implementing these proposed enhancements, the company can expect improved project outcomes, reduced costs, enhanced resource utilization, and increased overall project success rates. The integration of Microsoft Power Platform tools, such as Power BI, Power Apps, and Power Automate, will provide the necessary infrastructure for efficient data analysis, streamlined workflows, and informed decision-making.

In addition, it is important to mention the gains that these proposals bring to the company. Although the main focus of the application created is not to save time on a daily basis, but rather to provide an overview of everything that is happening in the project, time saving is still a very important KPI to be analyzed. Therefore, each PMg was asked to estimate, on average, how much time they gained after implementing the tool, as it will make it possible to replace many manual and complex processes, as well as collate all the information in one place. The estimated time, using an arithmetic mean of the responses from each PMg, was 16.7 minutes per day, which, taking into account the company's cost rate for indirect staff, gives a monetary gain of 12,600.00 €/year. In addition, each PMg filled in a questionnaire to measure satisfaction and usefulness of the application from 1 to 5 in relation to the dashboard created, with 1 being the worst possible and 5 the best. Regarding satisfaction, the dashboard was rated with 4,44, and in terms of usefulness, 4,33.

5 Conclusions

The primary aim of this research project was to assess company's cost and resource management, with a specific focus on enhancing the performance of the PM team. Through extensive theoretical research, the critical role of effective cost management for PMg was underscored. Cost management ensures financial control, optimized

resource allocation, informed decision-making, and transparent project activities, all contributing to project success and efficiency. Recognizing the multifaceted responsibilities of PMg, it was evident that the efficiency and efficacy of tools and resources available to them are paramount. These tools simplify processes, automate tasks and ensure accurate data management, thereby increasing productivity and enabling quick decisions to be made.

An exhaustive study of the company's processes revealed a general complaint within the PM team regarding the lack of a tool providing an overview of all product-related activities. Consequently, two proposals were implemented: a calendar of activities and a dashboard highlighting key insights. These enhancements have led to significant benefits, including reduced task time and complexity and savings of €12,600 per year.

In summary, this research underscores the pivotal role of work studies in enhancing companies' performance in competitive markets. By analyzing and optimizing internal processes, identifying efficiency opportunities, and promoting innovation, companies can strategically position themselves for success. In an environment where adaptation is constant, investing in continuous improvement is essential, as it empowers companies to navigate challenges and thrive in an ever-changing world.

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References

1. Pons, D. (2015). Project management for the development of new products. In Handbook on Project Management and Scheduling Vol. 2. https://doi.org/10.1007/978-3-319-05915-0_15.
2. Blichfeldt, B. S., & Eskerod, P. (2008). Project portfolio management - There's more to it than what management enacts. International Journal of Project Management, 26(4), 357 – 365. https://doi.org/10.1016/j.ijproman.2007.06.004.
3. Abbasi, G. Y., & Al-Mharmah, H. (2000). Project management practice by the public sector in a developing country. International Journal of Project Management, 18(2), 105 – 109. https://doi.org/10.1016/S0263-7863(98)00074-X.
4. Cooke-Davies, T. (2002). The "real" success factors on projects. International Journal of Project Management, 20(3), 185 – 190. https://doi.org/10.1016/S0263-7863(01)00067-9.
5. Saynisch, M. (2010). Beyond frontiers of traditional project management: An approach to evolutionary, self-organizational principles and the complexity theory - Results of the research program. Project Management Journal, 41(2), 21 – 37. https://doi.org/10.1002/pmj.20159.
6. Rodrigues, A., & Bowers, J. (1996). System dynamics in project management: A comparative analysis with traditional methods. System Dynamics Review, 12(2), 121 – 139. https://doi.org/10.1002/(sici)1099-1727(199622)12:2<121::aid-sdr99>3.3.co;2-o.
7. Hu, Z.-G., Yuan, Q., & Zhang, X. (2009). Research on agile project management with scrum method. Proceedings - 2009 IITA International Conference on Services Science,

Management and Engineering, SSME 2009, 26 – 29. https://doi.org/10.1109/SSME.2009.136.

8. Molhanec, M. (2007). The agile methods - An innovative approach in the project management. ISSE 2007 - 30th International Spring Seminar on Electronics Technology 2007; Conference Proceedings: Emerging Technologies for Electronics Packaging, 304 – 307. https://doi.org/10.1109/ISSE.2007.4432868
9. Tanwar, R. (2013). Porter's Generic Competitive Strategies. IOSR Journal of Business and Management, 15, 11–17.
10. Himme, A. (2012). Critical success factors of strategic cost reduction. Journal of Management Control, 23(3), 183–210. https://doi.org/10.1007/s00187-012-0157-8.
11. Altrichter, H., Kemmis, S., Mctaggart, R., & Zuber-Skerritt, O. (2002). The concept of action research. *The Learning Organization*, *9*(3), 125 – 131. https://doi.org/10.1108/09696470210428840
12. Project Management Institute. (2021). The standard for project management and a guide to the project management body of knowledge (PMBOK guide). (Seventh edition.). Project Management Institute, Inc.
13. Project Management Institute. (2017). The standard for project management and a guide to the project management body of knowledge (PMBOK guide). (Sixth edition.). Project Management Institute, Inc.
14. Machado, D., Tereso, A., & Afonso, P. (2023). Ratio Project Planning: cost optimization projects in the production phase. Procedia Computer Science, 219, 2003–2010. https://doi.org/10.1016/J.PROCS.2023.01.501
15. Trieu, V. H. (2017). Getting value from Business Intelligence systems: A review and research agenda. Decision Support Systems, 93, 111-124
16. Chaudhuri, S., Dayal, U., & Narasayya, V. (2011). An overview of business intelligence technology. Communications of the ACM, 54(8), 88–98. https://doi.org/10.1145/1978542.1978562
17. Loshin, D. (2012). Business intelligence: the Savvy Manager's Guide. (M. Kaufmann, Ed.) (2nd Edition). Elsevier.