THE ROLE OF INTER-PROJECT COMMUNICATION AND CONTINUOUS RISK MANAGEMENT STRATEGY IN A MAINTENANCE FACILITY: A CASE STUDY

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Abstract

The increasing complexity of modern aircraft maintenance and strict safety regulations of the sector underscore an emerging trend of implementing project management practices in maintenance, repair, and operations facilities (Junqueira, 2020; Freitas, 2020). This case study examines a German aircraft maintenance facility employing hybrid project management methodologies. It reveals how the lack of communication between parallel-running projects, combined with inadequate sustained risk management, results in unoptimized resource allocation, unforeseen disruptions, and considerable delays, thereby hindering project success. This research employs a case study approach, utilizing qualitative data gathered through semi-structured interviews and a six-week observation period. Analyzed through thematic coding and compared against an established theoretical project management framework, the findings underscore the significant impact of insufficient inter-project communication and risk management. The study highlights the necessity for a project management office (PMO) to harmonize parallel project executions, enhance inter-project communication, and ensure continuous risk management. Providing unique insights into the operations of a German maintenance, repair, and overhaul (MRO) facility, this research offers practical guidance for similar environments, contributing to the otherwise limited literature on project management in aircraft maintenance facilities.

Keywords: Risk Management, Inter-Project Communication, Aircraft Maintenance, Project Management, Project Management Office, Case Study Research

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1. INTRODUCTION

The aircraft maintenance industry, crucial for ensuring the safety, reliability, and efficiency of air travel, has undergone significant evolution over the past decade. Characterized by a high-stakes environment, the aviation sector demands meticulous attention to detail and strict adherence to safety protocols. The advent of new technologies, changing regulatory landscapes, and the increasing complexity of modern aircraft have made the maintenance process increasingly intricate (Junqueira et al., 2020). Given these evolving challenges, there is a clear emerging trend for an approach that goes beyond traditional methodologies, highlighting the role of advanced project management practices in navigating these complexities. Project management in aircraft maintenance involves more than adhering to schedules and budgets. It balances safety, regulatory compliance, and operational efficiency (Freitas et al., 2020; Jayatilleke & Lai, 2018). Implementing structured project management methodologies can significantly enhance the efficiency and effectiveness of maintenance operations through systematic planning, resource allocation, risk management, and quality control (Project Management Institute, 2017). The incorporation of project management approaches into aircraft maintenance offers several key benefits. The nature of project management methods highly synergizes with the strictly defined repair tasks of aircraft maintenance, allowing for precise planning and resource allocation. Firstly, project management provides a structured framework to manage the extensive and often complex tasks involved in maintenance activities (Freitas et al., 2020; Samaranayake & Kiridena, 2012). Secondly, effective project management facilitates better resource utilization. By aligning maintenance activities with broader operational goals, organizations can ensure more efficient use of their resources, reducing downtime and optimizing cost efficiency (Monteiro et al., 2016). Lastly, project management plays a crucial role in risk management. Given the high-risk nature of the industry, the ability to identify, assess, and mitigate risks proactively is paramount. Project management methodologies provide the necessary tools and frameworks for rigorous risk assessment and mitigation (Kucuk Yilmaz, 2019).

The present case study focuses on a German aircraft maintenance facility that has recently implemented hybrid project management methodologies. This strategic move aimed to enhance the organization's efficiency while simultaneously streamlining the planning, execution, and closing phases of aircraft maintenance operations. Within this framework, each maintenance job is conceptualized as an individual project, complete with dedicated planning, a project manager, and project teams. This structure is replicated across three hangars and five aircraft standing positions, operating in parallel yet independently. Despite these advancements, the facility faces critical challenges that undermine the potential benefits of the hybrid project management approach. The study highlights the crucial absence of inter-project communication continued risk mitigation, and resource allocation between parallel running maintenance works (Callewaert et al., 2018; Gerdes et al., 2016; Stadnicka et al., 2017). Additionally, the lack of knowledge sharing has resulted in parallel projects repeating the same mistakes, further strengthening inefficiencies and elevating risks (Kucuk Yilmaz, 2019).

The primary aim of this research is to explore the role of inter-project communication and continuous risk management during the project execution phase within an aircraft maintenance context. The research goals also include evaluating the recommendations and observations of project managers at the maintenance, repair, and overhaul (MRO) facility, considering the potential benefits of implementing a project management office (PMO) to optimize inter-project communication and resource allocation (Project Management Institute, 2017). The main research question of the study is:

RQ1: How does the lack of inter-project communication impact resource optimization and project outcomes in a passenger aircraft maintenance organization using a hybrid project execution model, and could a project management office (PMO) serve as a potential solution?

The research employs a single organizational case study approach to provide an in-depth understanding of the specific challenges and potential solutions at the MRO facility (Yin, 2018). The methodology includes conducting semi-structured interviews with all four project managers at the facility, designed to gather qualitative data on their experiences, perceptions, and challenges encountered in managing aircraft maintenance projects (Mertens, 2024).

The challenges and solutions identified through the literature review and the case study serve as a benchmark for similar facilities grappling with issues in parallel project management, underlining the value of theoretical project management practices through the example of the MRO facility. The insights into effective communication strategies and risk management practices can be adapted and applied to other settings, potentially enhancing the overall quality and efficiency of operations in the wider industry (Kucuk Yilmaz, 2019). The study extends the limited academic discourse by linking theoretical concepts with practical applications in the field of MRO project management. The findings of this study hold considerable implications for other organizations within the aircraft maintenance industry and beyond.

The rest of this paper is organized as follows. Section 2 delves into the academic discourse on project management within the aircraft maintenance sector, emphasizing the crucial roles of effective communication and risk management strategies in enhancing operational efficiency and safety. Section 3 outlines the methodological framework employed in the research. Section 4 presents the empirical findings, highlighting the key challenges faced by the reviewed facility. Section 5 contextualizes the empirical findings within the broader literature on project management, drawing parallels and contrasts. The paper concludes with Section 6, which encapsulates the research's key insights, and limitations of the research, and suggests possible future research steps.

2. LITERATURE REVIEW

The aviation industry, a cornerstone of global connectivity and economic progress, has witnessed exponential growth and technological advancements over the past decades. This growth underscores the paramount importance of aircraft maintenance, which ensures the safety, reliability, and efficiency of air travel (Junqueira et al., 2020). The critical nature of aircraft maintenance is amplified by the industry's strict regulatory standards and the inherent risks associated with aviation operations (Adi et al., 2020). Maintenance tasks range from routine checks to comprehensive overhauls, each demanding significant attention to detail and unwavering adherence to safety protocols, carried out in dedicated MRO facilities worldwide. The evolution of project management within aircraft maintenance reflects the industry's response to increasing technological complexity and regulatory demands. Historically, maintenance practices were predominantly reactive, focusing on addressing problems as they occurred. However, the shift toward proactive maintenance strategies, characterized by planned and preventive measures, marked a significant evolution in the field (Monteiro et al., 2016). This shift was driven by the realization that proactive maintenance could significantly enhance aircraft safety and operational efficiency, including frequent and rapid A and B checks to more extensive C and D heavy maintenance visits, which occur only at intervals of every six to ten years.

The incorporation of formal project management methodologies into aircraft maintenance emerged as a pivotal development. This transition was fueled by the need for more structured and systematic approaches to handle complex maintenance tasks and coordinate multifaceted teams (Freitas et al., 2020; Samaranayake & Kiridena, 2012). Modern project management in aircraft maintenance encompasses a wide array of practices, including detailed planning, resource allocation, risk assessment, and quality assurance, all tailored to meet the unique demands of the aviation sector. Traditional project management techniques, such as the Waterfall model, are characterized by sequential, phase-based approaches (Kucuk Yilmaz, 2019). Meanwhile, agile project management methodologies have become important in scenarios where flexibility and adaptability are key (Bredillet et al., 2018). Hybrid methodologies, combining elements of both traditional and agile approaches, are increasingly recognized for their potential to balance the need for structure with the demand for flexibility (Callewaert et al., 2018). Hybrid project management methodologies represent a combination of traditional and agile approaches, tailored to leverage the strengths of both methodologies. These frameworks are characterized by their flexibility, adaptability, and structured planning (Bredillet et al., 2018). The traditional aspect is grounded in the theory of constraints and the critical path method, emphasizing systematic planning and execution, while the agile component is based on iterative development and lean principles, focusing on flexibility and continuous improvement (Project Management Institute, 2017). This allows teams to apply a structured approach where necessary, while remaining agile and responsive in other project aspects (Callewaert et al., 2018; Samaranayake & Kiridena, 2012).

Project management principles provide a framework for managing the complex and multifaceted tasks involved in aircraft maintenance, ensuring that all activities are executed on schedule, within budget, and to the highest safety standards. Case studies in the field have shown how project management methodologies can be effectively integrated and synergized with maintenance activities (Freitas et al., 2020). The predetermined A-D checks involve a series of detailed tasks that require careful planning and resource allocation. The application of project management principles ensures that these activities are conducted efficiently, with resources appropriately allocated, minimizing aircraft downtime while ensuring thorough inspections (Van den Bergh et al., 2013). Additionally, clear guidelines for aircraft maintenance, which are crucial for mechanics and technicians, align well with project management methodologies. These guidelines provide a structured framework similar to project plans, facilitating easy planning and resource allocation based on known requirements and past experiences (Chang & Kora, 2014; Gerdes et al., 2016; Samaranayake & Kiridena, 2012; Stadnicka et al., 2017).

Effective communication is a cornerstone of successful project management, serving as a critical link between the various stakeholders of a project. Theories of communication in project management emphasize the importance of clear, concise, and continuous information exchange among all parties (Wiewiora et al., 2014). In parallel multi-project environments, inter-project communication is particularly crucial. Effective communication across different projects enables better coordination, resource sharing, and alignment of goals. It ensures that lessons learned in one project are transferred to others, facilitating continuous improvement. The absence of inter-project communication can lead to resource conflicts, redundant efforts, and inconsistencies in project outcomes, all of which can be detrimental to the overall success of the organization (Silvius, 2021). Practices such as joint resource planning sessions and cross-project resource pools, supported by effective communication, are instrumental in achieving this optimization (Kulkarni et al., 2017). Best practices for inter-project communication include establishing clear communication channels, holding regular inter-project meetings, and maintaining a centralized information repository. Tools such as integrated project management software can support these practices by providing a platform for sharing project schedules, resource allocations, and progress updates. Additionally, models like the responsible, accountable, consulted, and informed (RACI) matrix can be instrumental in clarifying communication roles and responsibilities among project teams, ensuring that the right people are involved in the communication process at the right time (Pemsel & Wiewiora, 2013; Santos & Melicio, 2019).

Risk management in project management is a systematic process that identifies, analyzes, and responds to project risks. It involves recognizing potential problems before they occur and planning in advance how to address them, thereby

minimizing their impact on the project. The fundamental principles of risk management include risk identification, assessment, prioritization, response planning, and monitoring (Hill, 2004b). Continuous risk management refers to the ongoing practice of identifying and managing risks throughout the project lifecycle. This approach offers numerous benefits, such as the ability to respond to new risks as they emerge, improved decision-making based on current risk assessments, and enhanced project flexibility and adaptability (Gerdes et al., 2016; Kucuk Yilmaz, 2019). A pertinent example of the need for continuous risk management in aircraft maintenance is observed in the context of predetermined A-B-C-D checks in MRO facilities. Scheduled at regular intervals, these checks are critical for ensuring the airworthiness of aircraft. However, the discovery of unforeseen defects during maintenance poses a significant risk that requires immediate attention. Effective, continuous risk management in such scenarios involves promptly adapting project teams, resources, and schedules to address these unexpected issues. If a major defect is unearthed during a routine check, the project team must quickly reassess the situation, communicate with stakeholders, reallocate resources, and revise the maintenance schedule to address the defect without causing significant delays (Callewaert et al., 2018; Mütze et al., 2022). This adaptability is key to ensuring that aircraft maintenance is carried out efficiently, safely, and in compliance with regulatory standards, ultimately leading to improved project outcomes and operational efficiency. Effective inter-project communication plays a crucial role in identifying and sharing risks across different project teams. Proper communication ensures that resources are allocated efficiently and that risks are managed proactively, across the entire portfolio of the organization (Kucuk Yilmaz, 2019; Theis, 2012). Shared knowledge about resource availability and risk exposure through effective communication can lead to better-informed decisions and prepare parallel-running projects for potential disruptions (Samaranayake & Kiridena, 2012). Several models and frameworks have been developed to integrate inter-project communication and risk management within hybrid project management environments. One notable model is the integrated communication and risk management (ICRM) framework, which synergizes communication strategies with risk management processes, facilitating a coherent approach across multiple projects (Pemsel & Wiewiora, 2013). Moreover, this integration fosters a culture of collaboration and knowledge sharing, where risks are collectively managed and resources are optimized across projects, leading to overall improvements in efficiency and project quality (Callewaert et al., 2018).

In terms of inter-project risk management and communication, the Project Management Institute's body of knowledge underscores the significant roles of project management offices (PMO) and project portfolio management (PPM). PMOs and PPMs are instrumental in the overarching management of projects within organizations. The PMO serves as a centralized unit overseeing project management standards and practices, ensuring consistency and alignment with organizational goals. It acts as a hub for project governance, methodologies, documentation, and expertise, thus providing strategic guidance and support to project teams (Hill, 2004a). Project portfolio management involves the centralized management of one or more project portfolios to achieve strategic objectives. It focuses on analyzing and collectively managing a group of current or proposed projects based on numerous key characteristics. The primary goal of PPM is to optimize project outputs and benefits in line with the organization's strategic objectives and resource constraints. In environments where multiple projects run in parallel, such as in aircraft maintenance facilities, the roles of a PMO and a portfolio manager become increasingly significant. A PMO can provide a structured framework for overseeing these parallel-running projects, ensuring they align with the strategic objectives of the organization. The PMO facilitates resource allocation across projects, preventing over- or under-utilization of resources and ensuring optimal deployment based on project needs and priorities (Project Management Institute, 2017). With a comprehensive view of all ongoing projects, PPM identifies synergies, manages interdependencies, and ensures effective communication across projects, thereby enhancing overall efficiency and coherence. PMOs can significantly improve inter-project communication, ensuring that information is disseminated efficiently and effectively across project teams in a standardized manner (Bredillet et al., 2018). In essence, the literature advocates for the integration of robust project management practices, including the establishment of PMOs and effective project portfolio management, in complex and dynamic environments with parallel-running projects.

3. RESEARCH METHODOLOGY

This research employs a case study approach, focusing on a single MRO facility located in Germany (Eisenhardt, 1989; Yin, 2018). The selected MRO facility offers a unique opportunity to examine the challenges and potential solutions associated with managing parallel-running projects, with a specific focus on issues of inter-project communication and risk management. Alternative methodologies considered for this research include ethnographic studies, surveys, and experimental designs. Ethnographic studies could provide nuanced insights into the daily practices and interactions within the MRO facility (O'Reilly, 2011). Surveys could be used to gather broader statistical data about industry practices (Saunders et al., 2009). Further experimental designs could test specific hypotheses about project management interventions (Yeten et al., 2005). The case study methodology, complemented by qualitative interviews, was chosen to allow for a comprehensive and detailed examination of the practical application of project management techniques within a real-world environment. Qualitative interviews provide direct insights from project managers and staff, enriching the case study with firsthand experiences and perspectives (Saunders et al., 2009). This approach is advantageous for understanding the nuances of project management practices and the real-time challenges faced by professionals in the field. It also

facilitates an in-depth analysis of how theoretical project management strategies are applied and possibly adapted to meet the unique requirements of the MRO facility. The combination of a case study and qualitative interviews is ideal for capturing the complexity of inter-project dynamics and the strategic implementation of risk management practices (Yin, 2018).

3.1. Data collection

The data collection includes semi-structured interviews with all four project managers of the MRO facility, each lasting between 60 to 120 minutes. These interviews allowed for a conversational yet focused exploration of various aspects of project management within the facility. The semi-structured nature of the interviews provided the flexibility to delve deeper into topics as they emerged during the conversations while ensuring that all key determined research areas were covered (Rubin & Rubin, 2011). Semi-structured interviews contribute to the validity and reliability of case study research by allowing researchers to triangulate primary findings with observed data sources, enhancing the credibility of the conclusions. This approach ensures that the findings are not solely reliant on a single data source or perspective and enables the capture of complex, nuanced insights essential for a comprehensive understanding of the researched area (Yin, 2018). The interviews were conducted at the end of a six-week observation period, allowing for the official accumulation of previous learnings. The semi-structured interviews, involving open-ended questions, served as guided conversations where the following set of predetermined topics were discussed with all four project managers. All interviewed managers were asked to explain in detail the below mentioned, core topics, and to share historical examples where possible:

- the hierarchical structure of the MRO and its impact on project management;
- the project management practices implemented within the facility;
- the role and responsibilities of project managers in this setting;
- key performance indicators (KPIs) used to determine project success;
- challenges, problems, and difficulties encountered in project execution, including real-life examples and stories from specific projects;
- suggestions and recommendations for improvement from the perspective of the managers;
- each interview was transcribed verbatim to capture the detailed insights and nuances of the discussions (Braun & Clarke, 2006).

Alongside the interviews, a six-week observation period involved a close review of five parallel-executed aircraft maintenance projects. This observation included shadowing two of the four project managers, attending meetings, engaging in conversations, and interacting with mechanics. The researcher's presence during daily tasks, planning sessions, and documentation processes provided a comprehensive view of the workflow and project management practices in the organization. In addition to formal observations, unrecorded conversations with mechanics and other staff members were instrumental in gaining a ground-level understanding of the operations and the workplace culture. These conversations provided insights that might not be evident in formal interviews or meetings (Kawulich, 2005). The observational study aimed to note the structure of project planning, execution, and closing phases, providing a holistic understanding of how projects are managed in practice (Hammersley & Atkinson, 2019).

3.2. Data analysis

Due to regulatory limitations on recording conversations at the MRO facility, the interviews conducted with the four project managers were recorded in written format. This method involved taking comprehensive notes during the interviews to accurately capture the essence of the discussions. Transcribing interviews in written format, while challenging, ensured adherence to facility regulations and maintained the integrity and confidentiality of the information shared by the participants (Kuckartz, 2014). Post-interview, the notes were reviewed in collaboration with the respective project managers to validate and clarify the recorded information. This review process was crucial for ensuring the accuracy of the transcription and for gaining additional insights or clarifications from the interviewees. A thematic coding process was undertaken using the qualitative data analysis software, NVivo. This process involved categorizing the data into themes and patterns that emerged from the interviews. The coding was conducted in a systematic manner, allowing for the organization and interpretation of the data to identify key themes related to project management practices, challenges, and recommendations within the MRO facility (Braun & Clarke, 2006). To enhance the reproducibility and reliability of the findings, the coded results were revisited and cross-referenced with the original interview transcriptions (Saldaña, 2021).

The learnings obtained from the six-week observation period were synthesized with the results from the interview coding process. This integration of observational data with the interview findings provided a more comprehensive understanding of the project management practices at the MRO facility. After the initial analysis and coding of the interview data, the main emerging themes were revisited with the interviewees. The purpose of these follow-up conversations was to ensure that the conclusions drawn from the interviews accurately reflected the views and experiences of the interviewees (Harper & Cole, 2012). These combined efforts in the validation and feedback process were instrumental in ensuring that the interpretations of the interview data were accurate, reliable, and reflective of the participants' experiences and views.

Given the partially sensitive nature of the information discussed and observed during the research, requests from the side of the MRO facility had to be taken into account. The research ensures the anonymity of the interviewed project managers and mechanics and does not disclose the organization's name (Wiles et al., 2008).

4. RESULTS

The MRO facility discussed in this study is a critical node in the European aviation maintenance network. Over the years, it has expanded to include an area with three hangars, capable of servicing five aircraft simultaneously. This facility primarily focuses on the routine maintenance of medium-range passenger aircraft, such as the Boeing 737 MAX and Airbus A320. The facility employs approximately five hundred highly skilled aircraft technicians and services about 180 aircraft annually. The facility has contracts with several well-known airlines to conduct regular A-B-C-D checks throughout the year.

The facility adopts a project-based approach to aircraft maintenance, treating each maintenance task as a distinct project. This approach involves assigning a project leader and a bay manager to each project, who are responsible for overseeing the project's progression, managing the team, and communicating with clients. The facility operates under a linear organizational structure, with the head of production ultimately responsible for all project executions. The aim of the project management approach at the facility is to manage each project efficiently within the constraints of the traditional project management "iron triangle", scope, time, and cost. The facility operates with a structured hierarchy that focuses on planning and commercial activities to ensure long-term sustainability and operational efficiency. The planning team is crucial in preparing for incoming aircraft maintenance, based on the client's specific requirements. The team ensures that appropriate hangar space, resources, and workforce capacities are available and correctly allocated upon the arrival of each aircraft.

The structure of the interviews in all four cases adhered to pre-planned topics, including organizational hierarchy, project planning, key performance indicators (KPIs) of project success, discussion of organizational challenges, and proposed solutions. The results chapter presents the findings organized according to the same structure, enriched by data gathered during the observational period.

4.1. Project planning and measures of project success

Project planning at the MRO facility is strictly organized. Weeks before an aircraft's arrival, the planning team uses estimates and historical data to prepare a load plan that outlines the required man-hours for each maintenance project. This prediction extends to individual repair tasks. If the aircraft arrives with a known issue, technicians are provided with specific instructions that detail the time frame and procedures needed to rectify the problem. Every maintenance activity is pre-recorded and assigned on "job cards", which facilitate structured and efficient project execution. The prepared, long-term project plan includes a daily breakdown of predetermined tasks based on the requested repair check. This plan also specifies the allocated resources, equipment, and the maximum working hours available per day for the project to address the repair tasks. The assigned project leader is responsible for negotiations with customers to ensure that the project meets their expectations. Additionally, the project leader manages daily communication with the team, oversees controlling, and handles documentation tasks. The project leader's office is located within the hangar, close to the maintenance work, for simple oversight. The bay manager, typically a highly experienced maintenance expert, directly oversees the execution of the aircraft repair work and directs the allocated workforce at a macro level. The bay manager physically works on the maintenance of the aircraft and spends working hours with the team, on the aircraft.

Success in aircraft maintenance projects at the MRO facility is measured through a combination of predefined work hours, client expectations, and the expertise of the planning team. The planned work hours for inspections and other maintenance tasks are set in advance and offered to the client at a fixed rate. This approach facilitates clear financial agreements with clients and ensures that additional issues discovered during maintenance are addressed within the framework of the contract. These practices highlight the facility's commitment to efficient resource utilization and adherence to customer expectations. Each task in the executed project is predetermined in terms of estimated working hours for completion. Assigned mechanics must log their time on specific tasks. A project is considered successful if the predetermined tasks are completed within the planned working hours.

4.2. Primary challenges of the maintenance, repair, and overhaul

The following paragraphs review recurring themes identified through thematic coding, synthesizing insights from project managers. The performed interviews and observation have pinpointed primary issues centered on project management practices.

Project leaders unanimously highlighted the absence of effective communication between project teams as a significant difficulty. Each team operates in isolation, focusing solely on its own project's success. This siloed approach inhibits shared learning and collaboration. Furthermore, poor inter-project communication hampers the facility's ability to optimize resource usage, including workforce and equipment. Scenarios were observed where resources were either underutilized or overstretched, adversely affecting overall operational efficiency. Project leaders and bay managers typically adhere to the long-term planning provided by strategic planners weeks before project execution. Mechanics are allocated to aircraft based on these planned daily resources. Project leaders noted that the structure of tasks often shifts due to delays or unforeseen challenges in project execution, yet resource allocation remains unchanged from the original long-term plan. Managers tend to utilize one hundred percent of available daily resources, leading to the consumption of unnecessary project hours on days when teams face delays, compared to the pre-planned repair tasks. This results in the wasting of available resources which could be shared with other projects, where unexpected defects might require additional manpower. Mechanics also highlighted the same flaws in resource planning. If delays occur, or mechanics

must wait for other colleagues to complete tasks, they cannot proceed with their planned work. As a result, they remain idle at their stations, wasting resources allocated for project execution and negatively impacting both the success metrics and the profit margin of the maintenance work.

The project managers further noted a gap in continuous and comprehensive risk management across projects. The focus remains on individual project risks, which lacks a holistic approach to identifying and mitigating risks that could affect multiple projects or the entire facility. To illustrate the importance of this issue, one of the project leaders provided an example. The facility worked on two identical aircraft reparation projects, running in parallel. Team A discovered an unexpected defect in the first aircraft, requiring a special tool for the repair, transported in from a different facility. Due to insufficient inter-project communication, Team B only identified the same defect in the second aircraft two days later. By then, Team A had completed their repair and returned the special tool for calibration. Making it unavailable for days. Consequently, Team B could not proceed with their repair, resulting in a four-day delay. The project managers emphasized that the absence of knowledge sharing, high-level analysis of available information, and continuous risk management are recurring issues that lead to project delays and unforeseen difficulties, which could have been mitigated earlier. These challenges significantly affect both the operational efficiency and the outcomes of the projects undertaken by the facility.

Further conversations with the managers revealed that each has a distinct, personal approach to project leadership and documentation. They use different systems, terms, and styles of writing to create reminders and document difficulties encountered during project execution. These notes are entered into a common project management tool daily. However, managers only have access to their own projects' documentation, and the data entered is primarily shared with the customer to keep them informed about the status of the maintenance work. Managers highlighted that while the system is established, they do not have access to other teams' documentation and often do not understand the terms used by their colleagues. This lack of standardized communication becomes particularly problematic when managers take over ongoing projects from colleagues on vacation, as the varied terminology leads to misunderstandings and loss of knowledge.

The current project management approaches at the facility reveal significant challenges due to the lack of inter-project communication and common data sharing. This deficiency leads to missed opportunities for shared learning and collaboration. Both interviews and observations underscored a consistent absence of effective risk management practices during project execution phases. This oversight results in unoptimized resource allocation, unforeseen disruptions, and considerable delays. Although the facility's project-based approach and individualized attention to aircraft maintenance projects have their merits, the identified weaknesses in communication, resource utilization, and risk management are significant and need addressing.

4.3. Project managerial proposed solutions

The difficulties previously highlighted by all four project managers were noted and escalated to the production manager. Discussions and planning meetings with the involved stakeholders were conducted to address these challenges. During the interviews, project leaders commonly proposed the introduction of a PMO and a PPM role at the MRO facility. Throughout the time of the observation period, the potential implementations of these departments began to be considered and planned. This proposal aims to improve upon the identified operational challenges, particularly in risk management, documentation, communication, and resource allocation.

To bridge the communication gaps between different project teams, the PMO is envisioned as a central hub. The PMO and the designated portfolio manager facilitate communication and information sharing across parallel projects. Project information and documentation would be standardized and maintained collectively, aiding in the identification of potential project risks and improving resource allocation. The role of a project portfolio manager is suggested to oversee resource distribution across multiple projects, aiming to optimize the utilization of mechanics and ensure successful project completion within the planned framework, continually adapting resource allocation in response to changing project needs and addressing inefficiencies. Anticipated benefits include streamlined operations, reduced redundancies, and enhanced overall project outcomes. The PMO is crucial for improving risk management practices across projects, moving from a single-project-focused approach to a more integrated and comprehensive strategy.

With standardized documentation established by the Portfolio manager, communication barriers between different project teams are expected to decrease, fostering a collaborative work environment. Continuous documentation, up-to-date information availability, and iterated risk management across projects are anticipated to reduce unforeseen disruptions and delays, contributing to smoother project execution. Preliminary calculations also suggest that the implementation of a PMO would yield a return on investment in the long term, even with slight improvements in workforce utilization and risk mitigation compared to the current situation. The PMO is envisioned as a central unit responsible for overseeing and coordinating all ongoing projects within the facility. This office would ensure consistent project execution standards, facilitate effective communication across different project teams, and align projects with the facility's strategic goals. The role of the project portfolio manager within the PMO would include managing and synthesizing the entire portfolio of projects at the MRO facility. This role encompasses optimal resource allocation across projects, monitoring project progress, and aligning projects with both the facility's capacity and client requirements. The implementation of a PMO and a portfolio manager is expected to enhance project coordination, communication, decision-making, and risk mitigation, thereby improving overall project outcomes.

5. DISCUSSION

This section presents the findings from the MRO facility's case study within the broader landscape of existing literature on project management in MRO facilities and project management theory.

The challenges identified in the MRO facility, particularly regarding inter-project communication, resource utilization, and risk management, resonate with broader themes in the existing literature on project management within similar facilities. The observed lack of inter-project communication in the MRO facility resembles the findings of Samaranayake and Kiridena (2012), highlighting communication as a pivotal element in the successful execution of aircraft maintenance projects. Their study underscores the need for effective communication channels to coordinate multiple concurrent projects, a gap that is clearly evident in the current case study as well. The siloed nature of project management at the MRO facility leads to missed opportunities for shared learning and collaboration. The inefficient resource utilization observed aligns with the concerns raised by Kucuk Yilmaz (2019). Their research into strategic human factors and risk management in aircraft maintenance organizations points out that optimal resource allocation is crucial for operational efficiency. The case study's findings further reinforce this by showcasing how resource mismanagement leads to increased operational costs and project delays. Gerdes et al. (2016) further emphasize the importance of condition-based maintenance in reducing costs caused by unscheduled repair tasks. The MRO facility's approach to risk management, focused primarily on individual projects, reflects a lack of a comprehensive risk management strategy, as advocated by these authors. The case study also highlights the absence of continuous risk management, which often leads to the late realization of project disruptions and hinders the optimal allocation of resources, as project managers often adhere to the original long-term project plans without making necessary adjustments.

The siloed approach to project management at the MRO facility contrasts with the integrated approach suggested in the literature. Monteiro et al. (2016) note that a holistic approach to project management, often facilitated by a PMO, can significantly enhance efficiency and project success. The case study provides practical validation for several theoretical aspects discussed in the literature and is supported by the renowned Project Management Institute. Similar to the literature's suggestions, the interviewed project managers advocate for the introduction of a PMO and a project portfolio manager position, which hold significant potential for transforming the facility's project management landscape. The PMO is envisioned as a centralized unit that oversees all projects, ensuring consistency in management practices and standards. According to Hill (2004a), a PMO can enhance organizational efficiency by standardizing project-related governance processes and facilitating the sharing of resources, methodologies, tools, and techniques. Within the MRO facility, it ensures better coordination between projects, leading to more efficient use of resources and timely project delivery. A PMO also plays a critical role in improving communication within an organization. Hill (2004b) emphasizes that a PMO can serve as a communication hub, bridging gaps between different teams and departments. The role of the project portfolio manager is crucial in overseeing the allocation of resources across multiple projects. This position involves the more effective utilization of mechanics, equipment, and other resources, minimizing waste and redundancy. The integration of a portfolio manager can significantly improve risk management strategies by assessing and managing risks at the portfolio level. This holistic approach to risk management is expected to mitigate potential issues across projects, enhancing the overall success rate and reducing delays and cost overruns. The academic literature strongly supports the advantages of implementing a PMO and a project portfolio manager in complex, multi-project environments like MRO facilities. Overall, the theoretical background aligns with the recommendations of the project managers at the reviewed facility.

The primary objectives of this research were to understand the project management challenges faced by the reviewed MRO facility and to highlight the practical solutions proposed to address these difficulties. The case study provided detailed insights into the current project management practices at the MRO facility. It emphasized the academic perspective that effective communication is crucial for successful project execution in complex operational environments like MRO facilities. The identified challenges significantly impacted the facility's efficiency. Inefficiencies in resource utilization and the lack of a holistic risk management approach echoed concerns raised by Kucuk Yilmaz (2019) and Gerdes et al. (2016). The proposed solutions, including the implementation of a standardized PMO and a portfolio manager position, align well with academic recommendations. These changes are expected to address the observed challenges by enhancing communication, optimizing resource allocation, and improving risk management practices. During the observation phase of the research, plans to implement a PMO were already underway, and high-level calculations underscored the relevance of a globalized support department overseeing projects.

The insights from this case study highlight the need for improved communication channels and practices across the MRO industry to enhance operational efficiency and project success. The research aimed to provide valuable, practical insights into the difficulties of managing an MRO facility that executes aircraft maintenance through project management. The results illustrated the critical importance of inter-project communication, resource allocation, and continuous risk management. Additionally, the case study results showed that the facility's approach to overcoming these difficulties aligns with the theoretical background of the field. The study focused exclusively on a single MRO facility, providing in-depth insights into its unique operational context and hybrid project management methodology. This approach offered practical examples to compare project management methods with theoretical recommendations. The learnings from the study extend the limited literature on

project management in MRO facilities and further align with the diverse theoretical backgrounds also underscored by the Project Management Institute.

6. CONCLUSION

This research explored the project management practices at an MRO facility in Germany. The primary aim of this paper was to unravel the complexities and challenges inherent in managing multiple, parallel-running aircraft maintenance projects, with a specific focus on inter-project communication, resource allocation, and risk management. The research utilized a single organization case study approach, involving semi-structured interviews with the facility's four project managers and a six-week observational period. Drawing from a rich blend of empirical data and academic literature, the study identified critical challenges and provided practical solutions expected to enhance the facility's operational efficiency and project success. These insights were confirmed by the perspectives of the interviewed project managers and supported by the theoretical foundations found in existing project management literature. The study unveiled several key challenges within the observed MRO facility, building upon broader trends identified in the limited academic literature. The findings highlighted a lack of effective inter-project communication, leading to isolated operations and missed opportunities for collaboration and shared learning. This issue, as emphasized by both the case study and Samaranayake and Kiridena (2012), is critical for the success of complex project environments like MRO facilities. The facility also faced challenges in resource utilization, echoing Kucuk Yilmaz's (2019) findings on the importance of strategic resource management and continuous risk management. The study underscores the planned introduction of a PMO and a project portfolio manager position to tackle these challenges. The PMO is expected to centralize communication and standardize project management practices across the facility. Positioned hierarchically within the PMO, the portfolio manager aims to enhance resource allocation and risk management, reflecting the high-level strategic goals of the facility in alignment with the theoretical suggestions of the Project Management Institute.

While the research provides valuable insights, it is important to acknowledge its limitations. The study's findings are based on a single organization, which may limit the generalizability of the results to other facilities or the broader aircraft maintenance industry. The six-week observation period, while sufficient for initial analysis, may not fully capture the long-term implications and outcomes of the project management practices in place. Potential biases may be accounted with in the data collection process, particularly in the semi-structured interviews, where responses may be influenced by the interviewees' perspectives or experiences (Callewaert et al., 2018). Despite these limitations, the study provides crucial insights into the challenges and potential improvements in project management practices within the aircraft maintenance industry.

The implications of this research are significant, particularly for the broader MRO industry, which can leverage these findings to refine project management methodologies and enhance operational efficiency. By implementing the recommended PMO structure and project portfolio manager role, MRO facilities can expect improved coordination, enhanced risk management, and more effective resource utilization. These changes are likely to lead to reduced costs and increased project success rates, potentially fostering a more collaborative and integrated project management environment. The research expands upon the limited number of studies conducted in the field. It effectively bridges the gap between theoretical concepts and practical application, providing valuable insights for both academics and industry practitioners. The findings and recommendations serve as a blueprint for other MRO facilities facing similar challenges, guiding them in enhancing their project management practices. Future research steps may explore the longitudinal effects of these organizational changes within MRO facilities. It would be beneficial to study the long-term outcomes of adopting a PMO and a portfolio manager in various contexts to understand the scalability and adaptability of such changes across different sizes and types of MRO facilities. Additionally, comparative studies involving multiple MRO facilities that have implemented similar changes could provide deeper insights into the best practices and potential pitfalls. Further research could also extend into the development of specific metrics for assessing the effectiveness of communication and collaboration in project management within the MRO context in a quantitative manner. This continued investigation will enhance the understanding of the dynamic interactions within project management frameworks and contribute to the body of knowledge in MRO operational strategies.

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