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BEST PRACTICES AND SOURCES OF ERROR: WHAT PROJECT DOCUMENTATIONS REVEAL ABOUT THE SUCCESS OF INFRASTRUCTURE PROJECTS

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Abstract: *This study examines the practical outcomes derived from a systematic analysis of project documentation within the context of infrastructure projects. The aim was to identify recurring sources of error and best practices that influence the planning and execution of such projects. Qualitative content analysis was employed, involving the examination of various documents, including project plans, reports, and evaluation summaries. The key findings indicate that unclear communication structures, inadequate risk management, and the absence of systematic feedback mechanisms are common obstacles to project success. In contrast, projects that implemented standardized communication protocols and incorporated human factors into risk assessments demonstrated significant improvements. The analysis provides practical recommendations for optimizing project performance and underscores the importance of structured documentation processes. These findings contribute to new insights into how communication processes, risk management strategies, and feedback systems can be enhanced to ultimately increase the efficiency and effectiveness of infrastructure projects.*
Keywords: *Document Analysis, Infrastructure Projects, Communication Processes, Risk Management, Feedback Mechanisms*

INTRODUCTION

The key to assessing project quality lies in analysing its documentation. This process evaluates existing records (e.g., contracts, reports, plans, sketches, emails) to identify shortcomings or errors and develop strategies for optimization. In large, complex railway projects, such as those in German Railways, challenges like poorly documented processes, ineffective communication, and inefficient information sharing often hinder project quality. Mayring (Mayring 2015) emphasizes that thorough document review reveals problems, enabling solutions that enhance long-term project quality and uncover significant deviations affecting success.

Communication plays a central role in infrastructure projects. Alam and Gühl highlight the challenges posed by poorly defined communication structures and inadequate feedback mechanisms, which impact information flow and project outcomes (Alam, Gühl 2020). The human factor is equally critical, as Kerzner notes, stressing the influence of stress, miscommunication, and overload—factors often overlooked in favour of technical and financial risks (Kerzner 2022). These elements, however, are closely tied to decision-making and communication and must not be neglected.

The need to foster communication among project staff by building "communication bridges" (Müller-Rotenberg 2019) which enhance productive collaboration, is highlighted by Müller-Rotenberg. This approach can enhance technical performance and communication efficiency by integrating psychological and social aspects into project management. Such strategies contribute to better, long-term project outcomes and encourage the development of new management approaches.

RESEARCH METHODOLOGY

The central method of this research is qualitative analysis (Mayring 2015) of the contents of the documentation of a project. This method allows detailed examination of textual content and facilitates structural recognition of patterns and their interconnections. The basis of this method is the conceptual content analysis (Kukartz 2018). Where Mayring describes qualitative analysis of the contents of the

documentation as a single structured, clear, and strictly regulated method (Mayring 2015). Such a method gives clear and methodical results that give a detailed insight into the content of the entire documentation.

The method of Mayring is used in complex infrastructure projects to identify key elements and relationships within the documentation (Mayring 2015). These aspects are not immediately apparent. It is particularly valuable for gaining deeper insights into the meaning and context of texts, rather than just analysing data or facts superficially.

The main features of qualitative analysis of the content of the documentation stated by Mayring (Mayring 2015):

- Categorization,
- Analysis according to certain rules,
- Interpretation and parallel reflection,
- Clarity and directness (transparency).

By categorisation, it is understood that the text is broken down into smaller units (e.g. paragraphs, sentences, or individual terms) and, at the same time, categorizing those units (either inductive or deductive). Analysis according to certain rules also implies certain principles that must be followed. Furthermore, organising passages of text and understanding their meaning within the contextual and theoretical framework, clarifies the importance of the feature of interpretation. While the term reflection implies checking patterns and their interrelationships as well as their meaning, and at the same time what they specifically suggest for a research question or practical application. The whole process of analysis must be ensured through clarity and immediacy, i.e. transparency. This process must be present at every decision, from the very beginning of categorisation until the final interpretation and reflection.

The use of qualitative analysis of the content of documents in Research (Glaser, Strauss 1967):

This method was applied to the existing project documentation of infrastructure projects, including design plans, contracts, emails, reports, and construction records (Leimböck et al. 2017), to identify recurring errors, patterns, and typical textual structures. The analysis covered communication processes, risk management, and feedback mechanisms to systematically present both positive and negative aspects, all of which influence project development and outcomes.

The specific analysis was based on the principles of qualitative content analysis according to Mayring (Mayring 2015) and took into account the process execution in accordance with HOAI (Vygen, Joussen 2024) stages (tariff for architects and engineers). The first six main phases according to HOAI were directly analysed-from preliminary research, project development, through performance planning all the way to the completion of i.e., planning for project approval. Further categorisation was carried out according to Kuckartz, using coding techniques (Kuckartz 2018). In order to allow different projects to be compared and to analyse similarities and differences in planning and implementation processes, an approach based on Glaser and Strauss (Glaser, Strauss 1967) was used. This enabled the identification of systematic errors (El-Aboodi 2024) and success factors (Pfarr 1978).

This comprehensive combination of methods has identified, proven effective optimization strategies that can be successfully applied. It also revealed the sources of errors and clearly demonstrated their presence in the phases of the HOAI project processing process. In order to present the material of this research as clearly as possible, it is necessary to define the documents that were analysed:

1. **Project Plans:**
   Project plans provide a structured and detailed picture into the project, its phases, and its resources. They are essential for identifying disagreements during planning and implementation, as well as potential sources of error.
2. **Reports and Evaluations:**
   These documents provide feedback on the progress of the project within the phases in accordance with the HOAI and an assessment of the work performed. They serve as key challenges for the analysis and practical implementation of the project.
3. **Protocol of Project-Related Meetings:**
   Each regular recording of meetings provides feedback on the progress of a project and an assessment

of the work performed within the phases in accordance with the HOAI. They serve to analyse the challenges and practical implementation of the project as well as to solve possible problems.

4. **Contracts and Amendments:**
   The contracts regulate legal processes and as such provide insight into conflicts or adjustments during the project. Each change in a project, which must also be justified and documented, highlights the necessary changes that took place during a project as well as their influential further documentation.
5. **Commissioning Documents:**
   These documents contain all relevant information for commissioning i.e. carrying out work, including necessary tests and verification of requirements. As such, they serve as a clear orientation and guidance in planning and its implementation and what possible difficulties have been encountered.
6. **Construction Records:**
   Construction records contain detailed documentation of the construction site, such as building logs and daily reports. They are important for understanding the organisation of the construction process and possible unforeseen challenges.

RESULTS

In a detailed analysis of the above project documentation of infrastructure projects, there was a clear representation of several significant sources of errors that appear. Errors that contributed to challenges in the execution of project tasks and that affected the successful optimisation approach. The following results provide a detailed overview of the identified weaknesses and shortcomings as well as the effective strategies found in the tested projects.

Common Sources of Errors

Analysis of the project documentation revealed a number of recurring sources of errors that often-caused repeated delays and process inefficiencies in infrastructure projects. The above sources of errors are mainly related to three central aspects of project planning and execution, namely, ambiguous communication structures, insufficient risk management in management, and lack of feedback processes.

1. **Ambiguous Communication Structures**

The absence of clear protocols in project meetings often caused misunderstandings and delays, particularly around responsibility assignment. This hindered both day-to-day management and long-term coordination. According to Polzin (Polzin 2021), well-structured communication processes and proper documentation are crucial for enhancing efficiency and collaboration.

2. **Insufficient Risk Management**

In risk management, the human factor is often overlooked, including aspects like stress, misunderstanding, and overload, which are rarely addressed. Edmondson highlights the psychological safety, fear, and insecurity that can arise in such situations (Edmondson 2018). This leads to underestimating risks and higher error rates. Mayring also emphasises that applying methods mechanically, without considering social and human factors, can negatively impact project performance at all stages (Mayring 2015).

3. **Lack of Feedback Processes**

The lack of feedback culture in many projects leads to insufficient correction of errors, limiting performance and process improvements. Kessler and Winkelhofer emphasises that continuous feedback is crucial for complex infrastructure projects, helping to identify and address weaknesses early on (Kessler, Winkelhofer 2004).

Best Practices

This research also identified successful approaches and best practices that have been applied in several projects. This has also resulted in significant improvements in communication, risk management, and feedback culture.

1. **Standardised Communication Protocols**

Clear communication guidelines in successful projects reduced misunderstandings and boosted efficiency. Sutter (Sutter 2022) highlights how such systems improve collaboration and lower project risks.

This is especially important in complex projects like infrastructure work for the German railway.

2. Risk management with a focus on human factors

Projects that implemented training, stress management, and error reduction programs saw fewer errors and more efficient workflows. By focusing on the human factor, these programs became central to project processing. Schneck highlights that considering social and psychological factors significantly enhances the effectiveness of risk management (Schneck 2010).

The following diagram shows a summary of the error sources listed (See Fig. 1): The diagram illustrates the most common sources of errors (above) and their corresponding best practices (below). He points out how identified shortcomings in the processing of a project can be improved by targeted measures to increase the success of the project.

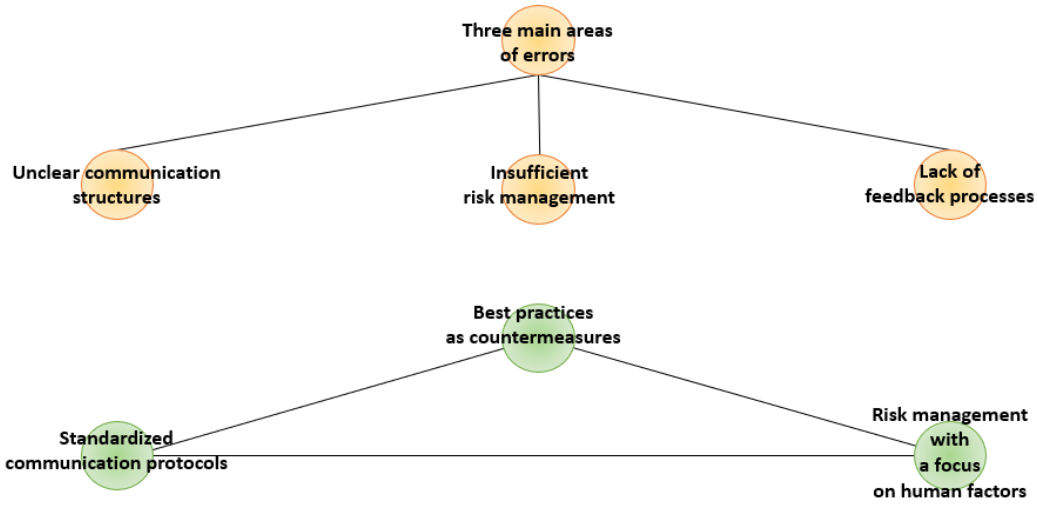

Fig. 1. Three main areas of errors and best practices

CONCLUSIONS

This research analysis highlights the critical importance of structured and well-designed processes in communication, risk management, and feedback mechanisms for the success of infrastructure projects. Many challenges, errors, and inefficiencies in project execution were linked to ambiguities or the absence of standardised processes. Implementing clearly defined, standardised procedures significantly enhances project quality and success.

Transparent communication is a key factor in project success. The lack of standardisation, clarity, and adequate protocols often led to misunderstandings, delays, and unclear responsibilities. Sutter emphasises that clear communication channels improve efficiency and reduce conflicts, particularly in complex infrastructure projects (Sutter 2022).

Risk management and human factors are also decisive for project success. Mechanical risk management methods often overlook psychological stressors like stress and misunderstandings, which contribute to errors and delays. Training and stress management programs have proven effective in mitigating these issues and optimising team performance.

Feedback mechanisms are vital across all phases of project management. This analysis showed that the absence of a structured feedback system consistently hindered improvements. Kessler and Winkelhofer argues that well-established feedback systems enable faster error correction, better schedule adherence, and higher efficiency (Kessler, Winkelhofer 2004). Continuous evaluation leads to improved project outcomes.

In conclusion, this research identified error sources in infrastructure projects and provided insights for optimising project management processes. It underscored the importance of standardised communication

protocols, human factor considerations in risk management, and structured feedback systems. These findings offer valuable guidance for future projects, helping project managers reduce errors and delays, and improve overall efficiency and success.

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НАЙ-ДОБРИ ПРАКТИКИ И ИЗТОЧНИЦИ НА ГРЕШКИ: КАКВО РАЗКРИВА ДОКУМЕНТАЦИЯТА НА ПРОЕКТИ ЗА УСПЕХА НА ИНФРАСТРУКТУРНИТЕ ПРОЕКТИ

Резюме: *В това проучване се разглеждат практическите резултати, получени от систематичен анализ на проектната документация в контекста на инфраструктурните проекти. Целта е да се идентифицират повтарящите се източници на грешки и най-добрите практики, които оказват влияние върху планирането и изпълнението на такива проекти. Използван е качествен анализ на съдържанието, включващ разглеждане на различни документи, включително проектни планове, доклади и резюмета за оценка. Основните изводи показват, че неясните комуникационни структури, неадекватното управление на риска и липсата на систематични механизми за обратна връзка са често срещани пречки пред успеха на проекта. За разлика от тях проектите, които прилагат стандартизирани протоколи за комуникация и включват човешкия фактор в оценките на риска, демонстрират значителни подобрения. Анализът предоставя практически препоръки за оптимизиране на резултатите от проектите и подчертава значението на структурираните процеси на документиране. Тези констатации допринасят за нов поглед върху това как могат да се подобрят комуникационните процеси, стратегиите за управление на риска и системите за обратна връзка, за да се повиши в крайна сметка ефективността и ефикасността на инфраструктурните проекти.*

Ключови думи: *анализ на документи, инфраструктурни проекти, комуникационни процеси, управление на риска, механизми за обратна връзка*

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