

OPTIMIZATION OF INFORMATION PROCESSES IN INFRASTRUCTURE MANAGEMENT: PSYCHOLOGICAL AND INFORMATION SCIENCE PERSPECTIVES ON TEAM DYNAMICS AND ORGANIZATION IN LARGE-SCALE PROJECTS

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Abstract: *This paper focuses on the optimisation of information processes in infrastructure projects (Flyvbjerg 2023), combining the approaches of psychology (Edmondson 2018) and informational processes (Brecht-Hadraschek/Feldbrügge 2013). A key success factor is the effective exchange of information between interdisciplinary teams as infrastructure projects become increasingly complex. This study looked at psychological factors of man, such as trust, clear division of roles, psychological safety, and communication culture. Furthermore, the study also looked at aspects of information management, such as system designs and data organisation. A combined were, qualitative interviews and quantitative questionnaires. The results thus indicate that teams characterised by strong psychological safety, social competence (Lorch 2025), and clearly defined roles within the team (Davenport 2005) have better communication. On the other hand, unrelated information systems and insufficient communication present significant obstacles and can lead to further complications within projects. In addition, technical solutions, as a unit, are not sufficient to optimise a good flow of information. Thus, the information system must be developed taking into account psychological and organisational principles. The article offers practical guidelines for optimising team dynamics, communication, and data organisation.*

Keywords: *infrastructure; information processes; psychology; communication; project organisation*

INTRODUCTION

Complex infrastructure projects, like the rail digitalisation initiatives (Bandmann et al. 2024), are the most complex in the engineering and public sector. As such, they are complex and involve layered coordination between different participants. Turner (Turner 2014) includes engineers, project managers, political representatives, contractors and IT experts. They are organised and form part of distributed and multi-functional teams of a project. Such an environment is under dynamic management, and in such a system, the transmission and interpretation of information are described as keys to project efficiency, risk reduction, and timely implementation.

Despite modernised and updated digital platforms (Lorch 2024) for data sharing, planning and documenting project documentation, these projects often face a lack of information, insufficient communication and inconsistent workflows. Delays, increased project costs, and poor decision-making are not only part of the technical project but also result from team psychology, organisational structure, and

frequent information overload (Davenport 2005).

From an informatics perspective, problems in informatics systems include (Brecht-Hadraschek/Feldbrügge 2013):

- ▷redundancy and variability of information systems,
- ▷inefficient use of metadata,
- ▷lack of a common vocabulary for interdisciplinary communication,
- ▷insufficient adaptability of the system and its inadequate use. Especially in infrastructure projects where various types of systems are often mixed, the source of which derives from a completely different scientific urban than the infrastructure (Flyvbjerg 2023).

Despite the system's technical advancements and widespread use, people frequently overlook the human factor. A factor that actually determines how system tools should be used and programmed. In this way, communication in the team is also endangered, and the success of the project is put in doubt.

This research looks at the insufficient and mismatched connection between information systems and psychological processes at the team level. Here it is assumed that for successful and optimal communication in infrastructure projects, a socio-technical symbiosis is needed.

The research focuses on the following research question:

How can the principles of psychology and information processes be used to optimize communication processes and improve the efficiency of organizational teams, especially in large infrastructure projects?

To answer this question, this article presents a study of mixed methods.

RESEARCH METHODOLOGY

A mixed methods approach was used for a comprehensive study of the relationship between psychological factors and information processes in infrastructure projects. It combines qualitative data obtained from interviews (Mayring 2022) with quantitative data obtained from surveys (Steiner/Benesch 2018).

This methodological approach represents a focused part of the author's ongoing doctoral research, where interviews, questionnaires, and document analysis are applied.

The chosen approach significantly contributed to exploring complex socio-technical systems. Furthermore, the goal is to obtain a practical, evidence-based recommendation for optimising communication and information management for large projects.

This is a mixed research method:

Qualitative component: semi-structured interviews

The qualitative phase of the research was conducted through semi-structured interviews with a targeted sample of 15 experts actively involved in infrastructure projects, including external employees who carry out work in the field. These participants were selected based on their work experience in managing or coordinat-

ing multi-functional teams from various organisational structures. In doing so, their direct work in communication and information processes, as well as psychological security and social competence, was taken into account. The duration of the interview was between 60 and 75 minutes, and the interviews were conducted in person, indoors and anonymously with the consent of each respondent.

Quantitative Component: Online Survey

To make the qualitative information as complete as possible, a quantitative survey was used, intended for a wider sample of over 100 experts in the infrastructure field, with a response rate of 80% of fully completed questionnaires. The examination was exclusively anonymous and voluntary and was carried out using existing verified tools and specially constructed elements.

Statistical analysis covered descriptive indicators and Pearson correlations so that all patterns could be thoroughly examined, verified, and evaluated. Additionally, strong connections were discovered between having high psychological certainty and how effective people felt communication was, as well as between clear roles and less delay in using information tools. Quantitative findings confirmed the qualitative results obtained from the interview.

RESULTS

The above-mentioned and -used analysis of qualitative and quantitative data has provided important insights into how psychological factors and the organisation of information systems affect the efficiency and quality of information processes in large infrastructure projects such as those on German Railways.

Psychological safety and trust (Edmondson 2018): a strong correlation was found between psychological safety and the effectiveness of team communication. The results of the survey showed that teams with higher psychological certainty had significantly fewer problems with passing information. According to Robbins and Judge (Robbins/Judge 2023), having trust has positive influences on the course and exchange of information in a team. And this is exactly what's evident from the survey when it comes to observing the project at its various stages.

Adequate role organisation, planning and communication flow (Schein 2016): teams with well-defined and distributed roles had fewer communication problems and delays. Statistical analyses confirmed a significant relationship between distributed roles and a reduction in delays. In addition, communication is disrupted and reduced, which adversely affects the achievement of the project objective. In contrast, clearly distributed responsibilities and knowledge of information tools have improved accountability and consolidated decision-making (Duhigg 2025).

Participants expressed dissatisfaction with segmented or inadequate information systems and tools (Bellmann/Krcmar 2002), particularly with multi-volume digital tools. A large number of participants agreed that segmented or inadequate systems hinder and burden timely decision-making. It is recommended to introduce a unique communication platform that is also adapted to the type of project, organisation and institution that uses it (Varner/Beamer 2011). It is also proposed

to better integrate and organise the system to improve the workflow and thus reduce the increasing administrative burden on projects.

Organisational influences (Probst et al. 2013): the study showed that in some cases there is a mismatch between organisational structures and the information systems to be used. The teams involved in the training process had sufficient knowledge and more easily adapted.

Table 1. Key factors for successful information processes in infrastructure projects.

Factor Group	Specific Factor	Impact	Outcome
Psychological Factors	Psychological safety, trust	+ Improved team communication – Fewer information gaps	More efficient information flow
Organisational Factors	Clear role definition, planning	+ Better decision-making – Fewer communication issues & delays	Higher project quality
Technical-Digital Factors	Segmented tools vs integrated systems	+ Better workflow (integrated systems) – Lower efficiency (segmented tools)	Reduced administrative burden
Organisational influences	Training, structure-tool compatibility	+ Better adaptability + Increased psychological safety	More stable project implementation

All the above results emphasise the importance of information systems and their tools, but also organisational adjustments in order to achieve successful adoption of digital information processes in the management of projects and organisations (see Table 1.)

DISCUSSION

It is precisely all the above results that emphasise the need to take into account both the technical and psychological aspects of information management and organisations in management. While systems such as centralised databases form its central meaning, factors such as psychological security, trust, and clear role allocation within a team are equally important for the effectiveness of information sharing and decision-making. This confirms the theory of information processing (Brecht-Handraschek/Feldbrügge 2013) and is consistent with the importance of psychological safety in teamwork (Sandahl/von Knorring 2023).

CONCLUSION

This study examined the interaction between psychological factors and information management in complex infrastructure projects and related management. The results clearly showed that technical solutions alone are not sufficient for the success of the project and its processes. Furthermore, organisational aspects of teams, such as trust, role clarity, and psychological security, are crucial to ensuring sound decision-making, communication, risk, and challenge management.

Future studies:

Further research in the field of information systems technology and related tools and experimental approaches can greatly help if psychological knowledge of humans is applied in programming. In addition, more detailed comparisons between organisations, both internally and externally, can reveal how an organization's culture influences its successes. An interdisciplinary approach that combines psychology, information technology, organisational science, and sociological knowledge is key to solving complex challenges associated with managing infrastructure projects.

Concluding with the above, the article emphasises that sustainable success in complex infrastructure projects is based on a balance between technology and human factors. Thus, investing in people, the culture of the organisation and optimising the process should not be a choice but a necessity for the future effectiveness of project management.

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ОПТИМИЗИРАНЕ НА ИНФОРМАЦИОННИТЕ ПРОЦЕСИ В УПРАВЛЕНИЕТО НА ИНФРАСТРУКТУРАТА: ПСИХОЛОГИЧЕСКИ И ИНФОРМАЦИОННИ НАУЧНИ ПЕРСПЕКТИВИ ЗА ЕКИПНАТА ДИНАМИКА И ОРГАНИЗАЦИЯТА В МАЩАБНИ ПРОЕКТИ

Резюме: Тази статия се фокусира върху оптимизирането на информационните процеси в инфраструктурните проекти (Flyvbjerg 2023), съчетавайки подходите на психологията (Edmondson 2018) и информационните процеси (Brecht-Hadraschek/Feldbrügge 2013). Ключов фактор за успеха е ефективният обмен на информация между интердисциплинарните екипи, тъй като инфраструктурните проекти стават все по-сложни. Това проучване разглежда психологическите фактори на човека, като доверие, ясно разделение на ролите, психологическа безопасност и култура на комуникация. Освен това проучването разглежда и аспекти на управлението на информацията, като проектиране на системи и организиране на данни, комбинирани, качествени интервюта и количествени въпросници, събрани от над 200 лица. По този начин резултатите показват, че екипите, характеризиращи се със силна психологическа безопасност, социална компетентност (Lorch 2025) и ясно определени роли в екипа (Davenport 2005), имат по-добра комуникация. От друга страна, несвързаните информационни системи и недостатъчната комуникация представляват значителни пречки и могат да доведат до допълнителни усложнения в рамките на проектите. Освен това техническите решения като цяло не са достатъчни за оптимизиране на добрия поток от информация. По този начин информационната система трябва да бъде разработена, като се вземат предвид психологическите и организационните принципи. Статията предлага практически насоки за оптимизиране на екипната динамика, комуникацията и организацията на данните.

Ключови думи: инфраструктура; информационни процеси; психология; комуникация; проектна организация

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