

https://dspace.org/

An evaluation of the quantitative risk assessment simulation undertaken during the planning stage of mega-projects

Zwane, Sibongile; Schutte, David; Maila, Sue; Jones, Razaak

Laryea, Samuel; Li, Baizhan; Essah, Emmanuel Adu; Mensah, Sarfo; Liu, Hong ...

2024-07

University of the Witwatersrand, Johannesburg

https://hdl.handle.net/10539/41385

Zwane, et al. (2024). An evaluation of the quantitative risk assessment simulation undertaken during the planning stage of mega-projects In: Laryea, S. et al. (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 967-977

Downloaded from a DSpace repository. https://dspace.org/

PROCEEDINGS OF THE WABER SuDBE CONFERENCE 2024

30 – 31 July 2024
University of the Witwatersrand
Johannesburg, South Africa

EDITORS

Prof. Samuel Laryea, University of the Witwatersrand, South Africa
Prof. Baizhan Li, Chongqing University, China
A/Prof. Emmanuel Adu Essah, University of Reading, United Kingdom
A/Prof. Sarfo Mensah, Kumasi Technical University, Ghana
Prof. Hong Liu, Chongqing University, China
Prof. Runming Yao, University of Reading, UK/Chongqing University, China

ISBN: 978-0-7961-6032-4



In collaboration with:

Proceedings of the WABER SuDBE 2024 Conference

30th – 31st July 2024

University of the Witwatersrand, Johannesburg, South Africa

© Copyright
The copyright for papers in this publication belongs to the authors of the papers.

ISBN: 978-0-7961-6032-4 (e-book)

The ISBN for this publication was provided by the National Library of South Africa. Legal deposits of the publication have been supplied to the National Library of South Africa, Library of Parliament, and other places of Legal Deposit.

First published in July 2024

Published by:
WABER SuDBE Conference 2024
C/o Professor Samuel Laryea, Conference chair
School of Construction Economics and Management
University of the Witwatersrand, Johannesburg, South Africa
Email: info@wabersudbeconference.com / samuel.laryea@wits.ac.za
Website: www.wabersudbeconference.com

Editors

Prof Samuel Laryea, University of the Witwatersrand, South Africa
Prof Baizhan Li, Chongqing University, China
A/Prof Emmanuel Adu Essah, University of Reading, United Kingdom
A/Prof Sarfo Mensah, Kumasi Technical University, Ghana
Prof Hong Liu, Chongqing University, China
Prof Runming Yao, University of Reading, UK / Chongqing University, China

Declaration

All papers in this publication have been through a review process involving a review of abstracts, peer review of full papers by at least two referees, reporting of comments to authors, revision of papers by authors and re-evaluation of the revised papers to ensure quality of content.

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

AN EVALUATION OF THE QUANTITATIVE RISK ASSESSMENT SIMULATION UNDERTAKEN DURING THE PLANNING STAGE OF MEGA-PROJECTS

Sibongile Zwane[1], David Schutte[2], Sue Maila[3] and Razaak Jones[4]
[1,2,3,4]*School of Construction Economics and Management, University of the Witwatersrand, South Africa*

This research examines how the absence of robust risk identification processes during the planning stage can significantly impact the quantitative risk assessment (QRA) outcomes and increase the likelihood of cost overruns in mega-projects in South Africa. By analysing specific mega-projects and their risk identification procedures, this study highlights the importance of a high-quality assessment of the QRA input stage in the context of these mega-projects. Through surveys and interviews with project managers and stakeholders, the study has provided deeper insights into the consequences of inadequate planning, such as project cost overruns and decreased project profitability. The research indicated that a robust risk identification process during the planning stage is pivotal in mitigating cost overruns in mega-projects in South Africa. Projects that prioritise structured methodologies involving all the relevant stakeholders and conduct comprehensive risk identification practices are better equipped to control project costs. The unanimous agreement on the significance of risk identification in cost overrun prevention emphasises its paramount importance. The findings will contribute to the risk management body of knowledge, offering valuable recommendations for improved risk identification and mitigation strategies to enhance project outcomes and positively impact project owners. Lastly, the paper sheds light on the nuanced landscape of risk identification, its impact on cost overruns, and the strategies for its improvement.

Keywords: construction risk, mega-projects, planning stage , quantitative risk assessment QRA, risk identification

INTRODUCTION

Inadequate risk identification during megaproject planning leads to cost overruns (Naumets et al., 2022; Sanchez-Cazorla et al., 2016). Effective risk management involves systematic identification of potential risks and proper scheduling of construction activities to prevent delays and increased costs (Wang et al., 2015; Brookes and Locatelli, 2015). Insufficient planning increases the risk of delays, rework, and additional expenses, impacting stakeholder confidence and project profitability (Simushi and Wium, 2020; Sanchez-Cazorla et al., 2016). Addressing these challenges is crucial for mitigating overruns and ensuring project success.

Inadequate risk identification in megaprojects leads to various consequences including job insecurity, delayed completion, poor workmanship, reputation damage, legal issues, reduced

[1] Sibongile.zwane@wits.ac.za
[2] djschutte7@gmail.com
[3] mailaskea@gmail.com
[4] jonesrazaak@gmail.com

profitability, budget overruns, and safety risks (Aljohani et al., 2017; Caldas and Gupta, 2016). Megaprojects, characterized by their complexity and long durations, require robust risk identification to mitigate cost overruns, which can cause delays, legal disputes, reduced profitability, and reputational damage (Sanchez-Cazorla et al., 2016; Simushi and Wium, 2020). Early risk identification in the planning stages is crucial to prevent cost overruns (Babaei et al., 2021). Ensuring quality risk identification processes throughout the project lifecycle is essential for managing cost overruns effectively (Durdyev, 2021). Flyvbjerg (2014) advocates for improved planning, stakeholder engagement, and risk assessment to address cost overruns in megaprojects.

Inadequate planning in identifying risk activities is linked to cost overruns in megaprojects (Babaei et al., 2021; Haslindas, 2018). This study emphasizes the need to investigate this failure and its impact on cost overruns, stressing effective strategies to mitigate risks and improve risk identification. Insufficient risk identification can severely impact job security, work quality, stakeholder confidence, profitability, and safety (Aljohani et al., 2017). Stakeholders may lose faith in the project team's ability to manage the project successfully. Learning from empirical data and previous projects should guide the planning stages of megaprojects (Brookes and Locatelli, 2015). Addressing this issue is crucial to mitigate risks and ensure successful project outcomes.

The objective of the study is to provide a comprehensive overview of the risks during the planning phase and their harmful effects on costs, budgets, and schedules, particularly on South African mega-projects. The study aims to investigate the nature of these risks to offer a detailed understanding of the conflict between the cost and benefit of mitigating a specific risk against a potential cost excess. Additionally, the research seeks to provide guidance on how to best approach risk identification proactively in the planning stage of mega-projects.

LITERATURE REVIEW

Cost overruns in construction projects are frequent due to their inherent complexity (Afzal et al., 2019). Mega-projects, with their significant financial investments, are especially susceptible to unforeseen events often neglected during planning (Ashkanani & Franzoi, 2022). Inadequate risk identification at this stage can lead to delays, legal disputes, reduced profitability, and reputational harm (Simushi & Wium, 2020).

The literature emphasizes the importance of risk identification and stakeholder integration during planning to mitigate risks. Stakeholders should designate an action owner to implement the risk action plan (Brady, 2012). Commitment to risk management is essential for project success.

Mega projects

Mega-projects like infrastructure for water, transportation, energy, and communication support public needs and economic growth (Li et al., 2021). They are characterized by complexity, uncertainty, political influence, and long life cycles exceeding 10 years (Sanchez-Cazorla et al., 2016). Defined as projects with capital expenditures over 1 billion USD, they attract attention due to environmental, budgetary, and community impacts (Caldas & Gupta, 2016). Valued at six to nine trillion USD annually, about eight percent of global GDP, mega-projects face risks in decision-making, cost overruns, and environmental impacts (Li et al., 2018; Aiyetan & Das, 2022), essential for social and economic development, particularly in developing countries. Mega-projects are further defined in Figure 1.

Sources	Complex Projects	Uncertainty	Ambiguous	Influence by internal factors	Influence by external factors	Influence by political factors	Life cycle > 10 years	Various interfaces	> 1 Billion USD	Impact on Environment	Impact on Local communities	Multiple stakeholders
1. Sanchez-Cazorla, Alfalla-Luque and Irimia-Dieguez (2016)	X	X	X	X	X	X	X	X	X	X		X
2. Caldas and Gupta (2016)	X	X	X	X	X	X	X	X	X	X	X	X
3. Federal Highway Administration, n.d					X	X			X	X	X	
4. Aiyetan & Das (2022)	X	X							X		X	X
5. Li, Lu, Taylor and Han (2018)	X	X		X	X	X			X	X	X	X
6. Li, Xiang, You, Guo, Liu and Ren (2021)						X	X	X	X	X	X	
7. Zhai, Shan and Le (2020)	X					X				X	X	X
8. Zheng, Chen, Han, Ren and Shi (2021)	X			X	X	X				X	X	X

Figure 1: Mega Projects defined *Source: Compiled by authors*

The complexity of mega-projects

Understanding "complexity" in mega-projects involves high investments and the involvement of multiple stakeholders and sponsors, which significantly complicates these projects due to diverse interests and expectations. Aiyetan and Das (2022) surveyed 189 out of 225 randomly selected participants in Gauteng, KZN and the Western Cape. Key stakeholders identified in South African mega-projects include Civil Contractors (22.75%), Construction Contractors (17.46%), Project Managers (12.70%), Site Agents/Supervisors/Administrators (12.70%), Civil Engineers (12.17%), Quantity Surveyors (7.41%), Plant and Equipment Operators (4.76%), Other professionals (4.23%), Planning Engineers (3.17%), and Safety Officers (2.65%).

Zheng et al. (2021) identified multiple stakeholders through semi-structured interviews. Among the 22 respondents, 50% worked for owners, 18.18% were General Contractors, 13.64% were Subcontractors, and the rest were Supervisors (9.09%) and Designers (9.09%). Positions held included Department Managers (36.36%), Project Managers (31.82%), Vice Presidents (18.18%), Project Directors (9.09%), and Presidents (4.55%). These stakeholders can be categorized into two groups: Contractors (22.48%) and Owners/Professionals (77.52%). Further categorization into Top Management (managers, directors, company heads, professionals) and Production (construction personnel, supervisors, engineers, safety personnel) shows 62.17% attributed to Top Management and 37.83% to Production. Government involvement in mega-projects, while not prominently listed in the data above, plays a crucial role in economic growth and social prosperity objectives (Zhai, Shan, & Le, 2020). In their study, involving 1,000 professionals from 1,000 mega-projects across major Chinese cities, they found that government stakeholders accounted for 2.90% of the sample, with clients at 34.70%, consultants at 26.4%, contractors at 24.3%, designers at 8.4%, and research institutions at 3.30%. Despite the small percentage, the government's role is vital, providing legitimacy, resilience, efficiency, and accountability throughout the project lifecycle.

The literature confirms that multiple stakeholders from various institutions contribute to the complexity of mega-projects, each following specific policies, procedures, and experiences from past projects (Zhai et al., 2020).

Risk identification activities

Risk Management is a systematic process involving risk identification, qualitative and quantitative analysis, response planning, and monitoring (Dey, 2012; PMI, 2021). A clear risk management plan is essential before starting risk identification (Brady, 2013). The plan outlines roles, methods, and reporting formats (Brady, 2013; Stephenson, 2015). Scope and context involve defining boundaries and methods (Hollmann, 2022; Stephenson, 2015). Techniques like brainstorming, PHA, and interviews help identify risks (Brady, 2012). Historical data and lessons from past projects are invaluable (Hollmann, 2022).

Risk identification is crucial for managing uncertainties impacting project objectives (Li et al., 2021; Rzempala et al., 2022). According to Knight, measurable uncertainties are termed risks, distinct from true uncertainty (Stephenson, 2015). PMBOK defines risk as uncertain events affecting objectives positively or negatively (Project Management Institute, 2021). Effective risk identification mitigates adverse outcomes and enhances project viability (Project Management Institute, 2021; Rzempala et al., 2021).

After identifying risks, qualitative and quantitative analyses evaluate them (Evrin, 2021). Quantitative analysis needs substantial data and resources (Evrin, 2021). Nabawy et al. (2021) highlight gaps in risk identification across mega-projects, advocating better management. Qualitative risk analysis categorizes risks by likelihood and impact using a risk matrix (Hollmann, 2022). The risk register guides subsequent quantitative analyses if needed (Evrin, 2021). Risk treatment involves action planning and integration with project control (Brady, 2012). Effective treatment includes selecting response strategies, developing action plans, and updating schedules and budgets (Brady, 2012; Stephenson, 2015).

The need to improve risk identification

Effective risk management is crucial for project success, preventing problems throughout the project (Project Management Institute, 2021). Early risk identification is essential for effective management (Sanchez-Cazorla et al., 2016). Early planning methods and tools help establish objectives and address uncertainties (Ashkanani & Franzoi, 2022). Thorough risk identification ensures no risk factors affecting mega-projects are ignored (Sanchez-Cazorla et al., 2016). Inadequate risk management practices, often relying on Excel spreadsheets, highlight the need for improved methods (Nabawy et al., 2020; Faizollahi & Akukwe, 2021).

Training and education

Training and experience significantly influence management performance in mega-projects (Ashkanani & Franzoi, 2022). Risk management education and training is essential for learning and communicating risks, with all stakeholders needing training in the risk management process (Hopkin, 2017). A well-structured methodology, particularly regarding experience and knowledge, is crucial for an effective risk management strategy (Adeleke et al., 2018). Continuous training enhances learning and improves risk practices (Hopkin, 2017).

Risk standards and frameworks

Tools and techniques such as brainstorming, checklists, decision tree analyses, and Monte Carlo simulations manage risks in construction projects (Goh et al., 2013). Risk management standards and frameworks, like those from the Project Management Institute and the SANS 31000 guideline, provide systematic approaches. However, rigid adherence to standards can negatively impact risk management, as they may become outdated and unsuitable for specific contexts (Nyvik et al., 2021). Effective use of standards requires considering situational context (Nabawy et al., 2020).

Cost overruns

Cost overruns are common in construction, with final costs often exceeding original budgets (Seddeeq et al., 2019). This global issue affects construction project success (Aljohani et al., 2017). Improper risk management is a significant factor contributing to cost overruns (Haslinda et al., 2018; Simushi & Wium, 2020).

Factors affecting poor planning

Construction projects involve critical stages: initiation, planning, execution, monitoring, control, and closing (Sanchez-Cazorla et al., 2016). Risks are particularly prevalent in the

planning stage, where incomplete choice definition and poor budget estimates based on partial project information are common (Faizollahi & Akukwe, 2021).

Mega-projects face numerous risk factors that can lead to delays or failures, requiring proactive risk management to mitigate potential issues (Flyvbjerg et al., 2003). Irimia-Diéguez and Oliver-Alfonso (2010) identified nine main risks in infrastructure and mega-projects; design risks, political and legal risks, contractual risks, construction risks, operation and maintenance risks, labour risks, client/user/society risks, economic and financial risks and lastly, force majeure risks.

Consequences of poor planning

Poor planning in risk management can lead to various issues, including a lack of stakeholder support and unclear project objectives (Dumont, Gibson, & Fish, 1997). Reliance on team members' experience and intuition (Doloi, 2012) and subpar quality specifications (Hanna & Skiffington, 2010) significantly impact project outcomes. Ineffective construction methods (Doloi, 2012) and challenges in identifying and pricing substitute materials (Hanna & Skiffington, 2010) further complicate matters.

Impact on cost overruns

Poor risk identification during planning impacts cost overruns. Key factors include changes in work scope, incomplete design at tender, contractual claims, lack of cost planning, and delays in costing variations. Early identification mitigates issues like stakeholder involvement, price fluctuations, high machinery costs, procurement procedures, poor site management, cost control, delays between design and procurement, improper cost estimation, additional work, and unsupportive government policies (Ramabodu & Verster, 2013).

METHODOLOGY

A mixed-methods approach investigated how inadequate risk identification during the planning stage impacts cost overruns in mega-projects. The study used a questionnaire and semi-structured interviews to gather insights from professionals involved in risk identification. The population consisted of professionals who have been involved in the risk identification process within these projects. The unit of analysis is a mega-project. Purposive sampling targeted Programme Managers, Quantity Surveyors, Risk Advisors, Project Managers, and Engineering Managers from Engineering, Procurement, and Construction Management (EPCM) firms and consulting companies. The purposive sampling method allows the study to focus on individuals who can provide the most insightful and relevant data for the research questions being investigated.

ANALYSIS AND RESULTS

Quantitative data analysis

The numerical data underwent descriptive analysis. Quantitative data, collected during the qualitative interviews, was recorded by researchers and used to count category frequencies. Findings will be presented in tables.

Risk identification

Many respondents agreed that risk identification followed systematic procedures, engaged relevant stakeholders, used structured methodologies, considered internal and external factors, and categorized and prioritized risks. The primary tool used was risk registers. The time allocated for risk identification varied from less than one week to over four weeks.

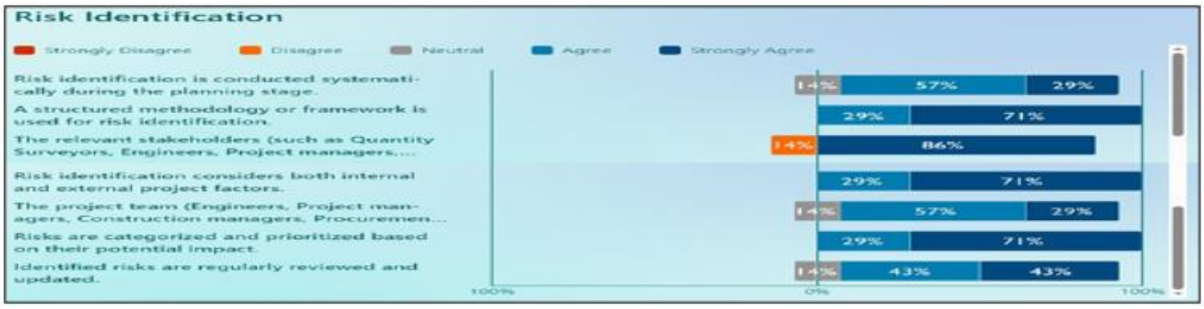


Figure 2 - Risk Identification Results *Source: Compiled by authors*

Stakeholder involvement

86% of respondents, predominantly Programme Managers, Quantity Surveyors, Risk Advisors, Project Managers, and Engineering Managers from EPCM firms and consulting companies, noted active stakeholder involvement in risk identification. All respondents agreed that stakeholders contributed valuable insights, with 71% prioritizing risks based on stakeholder perspectives. Regarding decision-making for risk mitigation, 71% of respondents reported strong stakeholder participation.

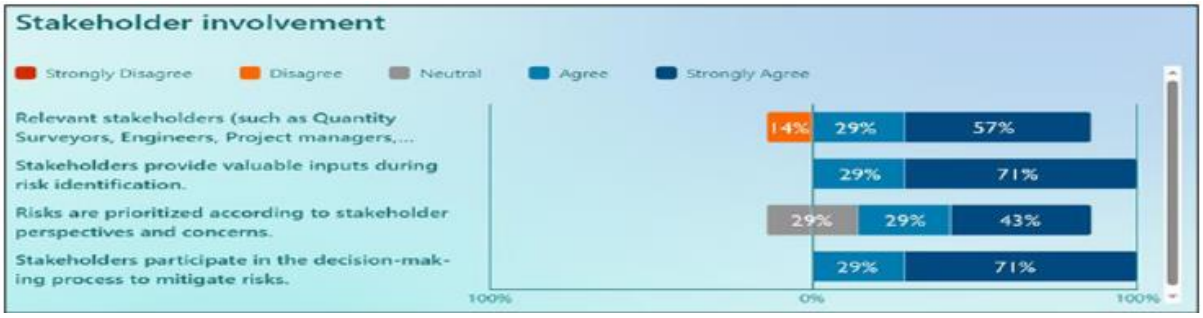


Figure 3 - Stakeholder Involvement Results *Source: Compiled by authors*

Cost overruns linked to risk identification

All respondents unanimously recognized the strong connection between risk identification and cost overruns, with 71% strongly agreeing and 29% agreeing. Additionally, 100% emphasized the substantial impact of inadequate risk identification during planning on cost overruns. Moreover, 71% agreed that cost overruns are often linked to poorly identified risks. Projects with robust risk identification practices experienced significantly fewer cost overruns, as affirmed by 71% strongly agreeing and 29% agreeing.

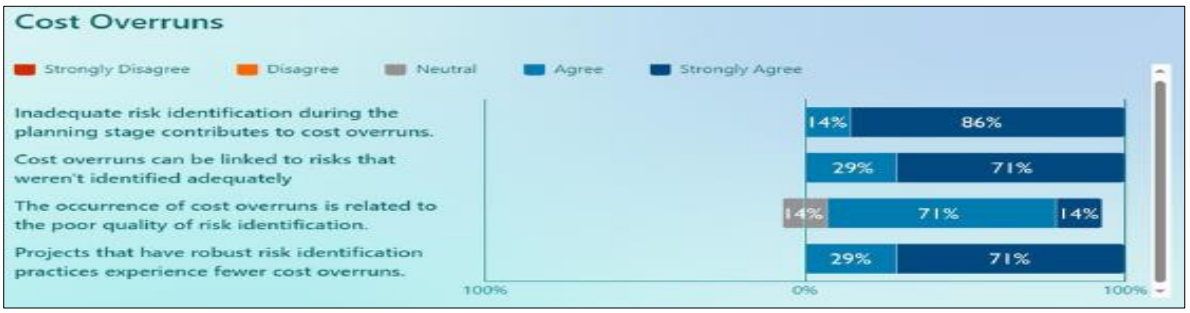


Figure 4 - Cost Overruns Linked to Risk Identification Results *Source: Compiled by authors*

Recommendations for improvement

Respondents unanimously recommended several risk management improvements for construction projects. 71% strongly agreed and 29% agreed on implementing standardized risk identification guidelines. Similarly, 71% strongly supported, and 14% agreed on prioritizing

risk identification training, with 14% disagreeing. All respondents endorsed the need for dedicated resources (57% strongly, 43% agreed) and regular monitoring and review of risks (71% strongly, 29% agreed). Additionally, 71% strongly agreed, and 29% agreed on fostering a culture of open communication and information sharing. These recommendations emphasize the need for continuous improvement and a proactive approach to minimize cost overruns.

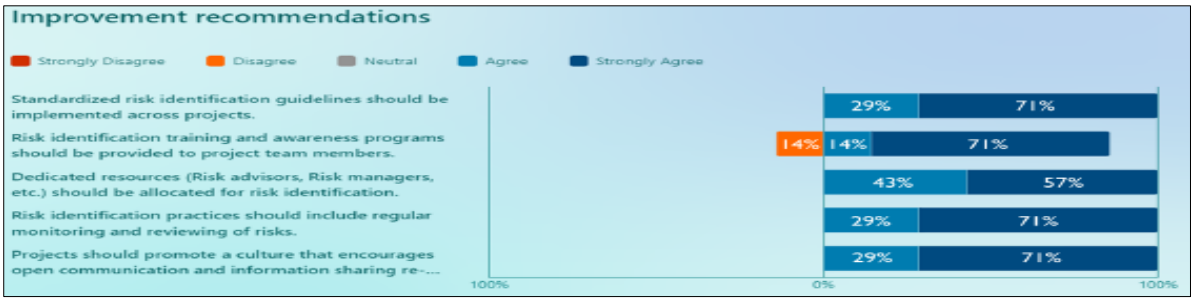


Figure 5 - Recommendation and Improvements Results *Source: Compiled by author*

Discussion

The questionnaire results underscore the critical relationship between quality risk identification during planning and cost overruns in South African megaprojects. Robust risk identification processes, involving structured methodologies and relevant stakeholders, are essential for mitigating cost overruns which align with the literature (Zhai et al., 2020; Sanchez-Cazorla et al., 2016). Respondents unanimously highlighted the importance of this process in preventing overruns. Recommendations include standardization, education, resource allocation, and fostering a collaborative project culture. The findings emphasize the vital role of risk identification in South African megaprojects and the consequences of neglecting this process.

Qualitative data analysis

Thematic analysis approach and word cloud visualisations

Researchers conducted thematic analysis on qualitative data, coding transcribed text into descriptive units using Excel for consistency. Codes were refined into broader themes to identify patterns, aiding in data interpretation and narrative development through consensus resolution of discrepancies. Word cloud visualizations were used to quickly identify frequently mentioned terms like 'risk,' 'cost overruns,' 'risk registers,' 'stakeholders,' and 'identification.' This graphical representation highlighted key themes and guided qualitative analysis by emphasizing focus areas in respondents' narratives.

Effective risk identification faces challenges like limited stakeholder participation, time constraints, and incomplete information, requiring efficient communication, planning, and experienced professionals. Involving diverse stakeholders improves risk management by ensuring active participation in identifying and minimizing risks. Inadequate risk identification leads to cost overruns, with one respondent noting that 80% of unidentified risks could cause overruns. Cost overruns also stem from unrealistic client expectations and inexperienced teams, highlighting the need for qualified professionals. Respondents suggested standardizing risk identification processes, training teams, and emphasizing continuous improvement. Effective communication and collaboration among project teams, stakeholders, and clients are crucial. See Figure 6.



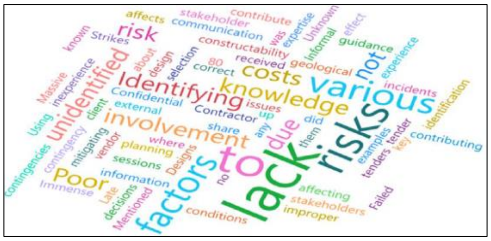
Cost overruns



Stakeholder involvement



Improve risk identification



Cost overruns due to inadequate risk identification

Figure 6: Word Cloud Visualizations *Source: Compiled by authors*

Discussion

The qualitative analysis of South African mega-projects highlighted the importance of stakeholder involvement in effective risk identification, echoing literature emphasizing key project member engagement (Zhai et al., 2020). Respondents emphasized the detrimental impact of inadequate risk identification on cost overruns, providing examples that support existing research findings (Ramabodu & Verster, 2013). Identified challenges included limited stakeholder participation, communication issues, and external factors like COVID-19. Recommendations for improvement, such as standardization and enhanced stakeholder engagement, were consistent with effective planning methods advocated by Ashkanani and Franzoi (2022).

The qualitative insights align with quantitative findings, emphasizing the critical role of effective risk identification in mitigating cost overruns. Recommendations include continuous improvement and standardization in mega-projects, consistent with Nabawy et al. (2020). An intriguing finding was varying definitions of mega-projects based on cost, indicating flexibility in the term across industries or regions.

The findings support the literature by emphasizing structured processes, clear risk identification, and broad stakeholder involvement. Effective risk management in mega-projects requires a comprehensive approach using various practices, tools, and techniques during the planning stages. Early and continuous risk identification was highlighted as crucial as underscored by Ashkanani & Franzoi (2022) and Sanchez-Cazorla et al. (2016).

Training and experience are crucial for effective risk management, echoing findings in the literature (Ashkanani & Franzoi, 2022). Respondents highlight the pivotal roles of risk experts and stakeholder inclusion. However, challenges such as incomplete information and time constraints often hinder effective risk management. Inadequate risk identification significantly impacts cost overruns, as emphasized in both qualitative and quantitative data. Continuous improvement in risk identification methods, drawing from past projects, and regularly updating risk management practices are essential, emphasizing a nuanced, context-specific approach (Sanchez-Cazorla et al., 2016).

CONCLUSION

The quantitative survey among South African mega-project professionals reveals widespread agreement on systematic risk identification procedures during planning. Most participants recognize structured approaches and stakeholder involvement, indicating mature risk management practices. However, dissenting views remain, especially regarding stakeholder engagement.

Both quantitative surveys and qualitative interviews underscore the critical role of involving diverse stakeholders in effective risk identification and management. They highlight the necessity for continuous improvement in risk identification methods, advocating for regular updates and learning from past project experiences.

Qualitative interviews detailed the rationale and methods behind widespread risk management practices in mega-projects. Experts emphasize stakeholder diversity, discussing tools used and challenges like decision-making and external influences. These insights enhance our understanding of the complexities involved in risk identification during the planning stage.

Qualitative data suggest standardization, training, a supportive social environment, and improved communication. Both datasets address issues like inadequate risk identification and stakeholder involvement, with qualitative interviews providing detailed insights into challenges and improvement strategies. They also highlight external factors' impact on cost overruns, less covered in the quantitative survey. Overall, the combined data sources provide a comprehensive picture of the study question. The findings indicate that the lack of a quality risk identification process in the planning stage indeed affects cost overruns in mega-projects in South Africa.

Contribution of the Study

The primary objective of this study was to investigate the quality assessment of the Quantitative Risk Assessment (QRA) input stage for mega-projects in South Africa, thereby contributing to the body of knowledge in risk management and filling a gap. This investigation has provided examples of the risks associated with planning and aims to benefit construction stakeholders and others in similar fields. The data analysis sheds light on the nuanced landscape of risk identification, its impact on cost overruns, and strategies for its improvement.

REFERENCES

Adeleke, A.Q., Bahaudin, A.Y., Kamaruddeen, A.M., Bamgbade, J.A., Salimon, M.G., Khan, M.W.A., Sorooshian, S., (2018). The Influence of Organizational External Factors on Construction Risk Management among Nigerian Construction Companies. *Saf. Health Work 9*, 115–124. https://doi.org/10.1016/j.shaw.2017.05.004

Afzal, F., Yunfei, S., Nazir, M., Mahmood, S., (2019). A review of artificial intelligence-based risk assessment methods for capturing complexity-risk interdependencies: Cost overrun in construction projects. International Journal of Managing Projects in Business 14(2) https://doi.org/10.1108/IJMPB-02-2019-0047

Aiyetan, A. O. & Das, D. K., (2022). Factors And Strategies for Improving Construction Management on Sites in Mega-Projects In South Africa: An Explorative Survey. *Multidisciplinary Digital Publishing Institute (MDPI): Infrastructure*, 7(19), https://doi.org/10.3390/infrastructures7020019

Aljohani, A. Ahiaga-Dagbui, D. and Moore D. (2017). 'Construction Projects Cost Overrun: What Does the Literature Tell Us? International Journal of Innovation, Management and Technology, 8, pp. 137-143, doi: 10.18178/ijimt.2017.8.2.717

Ashkanani, S., and Franzoi, R., (2022). An overview of mega-project management systems. Management Matters 19, pp. 129–148. https://doi.org/10.1108/MANM-01-2022-0006

Babaei, A., Locatelli, G. and Sainati, T. (2021). What Is Wrong with The Front-End of Infrastructure Megaprojects and How to Fix It: A Systematic Literature Review. *Project Leadership and Society*, *2*, p.100032.

Brady, D. C., (2012). AACE International Recommended Practice No 63R-11: Risk Treatment. s.l.: AACE International.

Brady, D. C., (2013). AACE International Recommended Practice No 72R-12: Developing A Risk Management Plan. s.l.:AACE International.

Brookes, N.J. and Locatelli, G. (2015). Power plants as megaprojects: Using empirics to shape policy, planning, and construction management. *Utilities Policy*, *36*, pp.57-66.

Caldas, C. & Gupta, A., (2016). Critical Factors Impacting the Performance of Mega-Projects. *Engineering, Construction, Architectural Management*, 24(6), pp. 920-934. https://doi.org/10.1108/ECAM-05-2016-0117

Doloi, H, (2013). Cost Overruns and Failure in Project Management: Understanding the Roles of Key Stakeholders in Construction Projects, Journal of Construction Engineering and Management, 139(3), DOI: 10.1061/(ASCE)CO.1943-7862 .0000621.

Dumont, P.R., Gibson. G.E., Fish J.R. (1997). Scope Management Using Project Definition Rating Index. *Journal of Management in Engineering*, 13 (5): pp. 54-60. https://doi.org/10.1061/(ASCE)0742-597X(1997)13:5(54)

Durdyev, S. (2021). Review of construction journals on causes of project cost overruns. *Engineering, Construction and Architectural Management*, *28*(4), pp.1241-1260.

Evrin, V., (2021). Risk Assessment and Analysis Methods: Qualitative and Quantitative. s.l.: ISACA.

Faizollahi, M., Akukwe, C., (2021). Tackling the planning challenges in mega-projects: A case study from greenfield infrastructure mega-projects in Scandinavia.

Flyvbjerg, B, (2014). "What You Should Know about Mega-projects and Why: An Overview," Project Management Journal, vol. 45, no. 2, April-May, pp. 6-19. https://doi.org/10.1002/pmj.21409

Goh, C.S., Abdul-Rahman, H. and Abdul Samad, Z., (2013). Applying risk management workshop for a public construction project: Case study. *Journal of Construction Engineering and Management*, *139*(5), pp.572-580.

Hanna, A. S., & Skiffington, M. A. (2010). "Effect of preconstruction planning effort on sheet metal project performance". Journal of Construction Engineering and Management, 136(2), pp. 235-241. https://doi.org/10.1061/(ASCE)0733-9364(2010)136:2(235)

Haslinda, A.N., Xian, T.W., Norfarahayu, Hanafi, R.M., and Fikri, H.M. (2018). Investigation on the Factors Influencing Construction Time and Cost Overrun for High-Rise Building Projects in Penang, Journal of Physics: Conference Series 995, DOI 10.1088/1742-6596/995/1/012043.

Hopkin, P., (2017). Fundamentals Of Risk Management: Understanding, Evaluating and Implementing Effective Risk Management, Fourth Edition. Ed. Kogan Page Ltd, New York.

Hollmann, J. K., (2022). AACE International Recommended Practice No 62R-11: Risk Assessment: Identification and Qualitative Analysis. s.l.: AACE International.

Irimia-Diéguez, A.I., Sanchez-Cazorla, A. and Alfalla-Luque, R., (2014). Risk management in megaprojects. *Procedia-Social and Behavioral Sciences*, *119*, pp.407-416.

Li. Y, Xiang. P, You. K, Guo. J, Liu. Z, Ren. H (2021). Identifying The Key Risk Factors of Mega Infrastructure Projects from An Extended Sustainable Development Perspective. Multidisciplinary Digital Publishing Institute (MDPI): 18(7515). https://doi.org/10.3390/ijerph18147515

Li, Y., Lu, Y., Taylor, J. E. & Han, Y. (2018). Bibliographic And Comparative Analyses to Explore Emerging. International Journal of Project Management, Volume 34, pp. 342–361. https://doi.org/10.1016/j.ijproman.2017.05.008

Ramabodu, M.S and. Verster, J.J.P. (2013). Factors That Influence Cost Overruns In South African Public Sector Mega-Projects, International Journal of Project Organisation and Management, 5(1-2), https://doi.org/10.1504/IJPOM.2013.053153

Moshtaghain, F., Golabchi, M., Noorzai, E., (2020). A framework to dynamic identification of project risks. Smart Sustain. Built Environ. ahead-of-print. https://doi.org/10.1108/SASBE-09-2019-0123

Nabawy, M., Ofori, G., Morcos, M. & Egbu, C., (2021). Risk Identification Framework in Construction of Egyptian Mega Housing Projects. Ain Shams Engineering Journal, Volume 12, pp. 2047-2056. https://doi.org/10.1016/j.asej.2020.09.016

Naumets, S., Lu, M., and Ali, M., (2022). Project Schedule Development under Environment-Induced Time-Window Constraints: Case of Constructing River-Crossing Bridge in Remote Northern Region, Journal of Construction Engineering and Management Archive, 148(12) https://doi.org/10.1061/(ASCE)CO.1943-7862.0002401

Nyvik, C.L.B., Flage, R., Guikema, S., (2021). On the Use of Standards and Guidelines as a Tool to Fulfil Regulatory Requirements. Risk Anal. 41, pp. 1744–1750. https://doi.org/10.1111/risa.13672

Project Management Institute, (2021). A Guide to The Project Management Body of Knowledge (PMBOK Guide). 7 ed. Newton Square, PA: Project Management Institute.

Rzempala, J., Borkowski, D. & Rzempala, A. P., (2022). Risk Identification in Cogeneration (Combined Heat and Power) Projects: A Polish Case Study. Multidisciplinary Digital Publishing Institute (MDPI): Energies, pp. 15-42. https://doi.org/10.3390/en15010042

Sanchez-Cazorla, A., Alfalla-Luque, R. and Irimia-Dieguez, A. I., (2016). Risk Identification in Mega-projects As a Crucial Phase of Risk Management: A Literature Review. Project Management Journal, 47(6), pp. 75-93. https://doi.org/10.1177/875697281604700606

Seddeeq, A.B. Assaf, S. Abdallah, A. and Hassanain, M.A. (2019). Time and Cost Overrun in the Saudi Arabian Oil and Gas Construction Industry, Multidisciplinary Digital Publishing Institute - Building, 9(2), https://doi.org/10.3390/buildings9020041

Simushi, S., Wium, J., (2020). Time and Cost Overruns on Large Projects: Understanding the Root Cause. J. Constr. Dev. Ctries. 25, pp. 129–146. https://doi.org/10.21315/jcdc2020.25.1.7

Stephenson, L. H., (2015). Total Cost Management Framework. An Integrated Approach to Portfolio, Program and Project Management. 2nd ed. Morgantown: AACE International.

Wang, Y., Le, Y. and Dai, J. (2015). Incorporation Of Alternatives and Importance Levels in Scheduling Complex Construction Programs. *Journal of Management in Engineering*, *31*(6), p.04014098.

Zhai, Z., Shan, M. & Le, Y. (2020). Investigating The Impact of Governmental Governance on Mega-projects Performance: Evidence from China. Technological and Economic Development of Economy, 26(2), pp. 449–478, https://doi.org/10.3846/tede.2020.11334

Zheng, X. et al., (2021). Unveiling Complex Relational Behaviour in Mega-projects: A Qualitative-Quantitative Network Approach. International Journal of Project Management, Volume 39, pp. 738–749, https://doi.org/10.1016/j.ijproman.2021.07.001



UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

